Proceedings of the West Africa Built Environment Research (WABER) Conference 2011 (19-21 July 2011, Accra, Ghana)

Publisher statement: Published by West Africa Built Environment Research (WABER) Conference C/o Dr Samuel Laryea School of Construction Management and Engineering University of Reading PO Box 219, Reading, UK RG6 6AW Email: s.laryea@reading.ac.uk © The copyright for papers in this publication belongs to the authors of the papers. Correspondence All correspondence relating to the WABER Conference should be addressed to: Dr Sena Agyepong Central University Accra, Ghana Email: senaagbodjah@yahoo.com Please visit www.waberconference.com for more information Declaration All papers in this publication have been through a review process involving initial screening of

WEST AFRICA BUILT ENVIRONMENT RESEARCH (WABER) CONFERENCE

19-21 July 2011
Accra, Ghana

Proceedings of the WABER 2011 conference

Editors
Dr Samuel Laryea
Dr Roine Leiringer
Professor Will Hughes

A - Kon Consults Limited
Chartered Quantity Surveyors

CONSTRUCTIONAL ENGINEERS
AND CONTRACTORS
K + H LIMITED

Proceedings of the West Africa Built Environment Research (WABER) Conference 2011
Accra, Ghana, 19-21 July 2011

Editors

Dr Samuel Laryea, University of Reading, UK
Dr Roine Leiringer, Chalmers University of Technology, Sweden
Professor Will Hughes, University of Reading, UK

First published 2011

ISBN 978-0-9566060-1-3

Published by
West Africa Built Environment Research (WABER) Conference
C/o Dr Samuel Laryea
School of Construction Management and Engineering
University of Reading
PO Box 219, Reading, UK
RG6 6AW
Email: s.laryea@reading.ac.uk

Correspondence

All correspondence relating to the WABER Conference should be addressed to:

Dr Sena Agyepong
Central University
Accra, Ghana
Email: senaagbodjah@yahoo.com
Please visit www.waberconference.com for more information

Declaration

All papers in this publication have been through a review process involving initial screening of abstracts, review by at least two referees, reporting of comments to authors, modifications of papers by authors and re-evaluation of re-submitted papers to ensure quality of content.

FOREWORD

Welcome to this year's WABER conference in Accra, Ghana. Thank you for coming and we hope you enjoy the conference. The WABER conference has developed rapidly in the past three years, but our aims remain the same. We strive to: help young built environment researchers in West Africa (WA) to develop their research work and skills through constructive face-to-face interaction with their peers and experienced international academics; supply a platform for interaction among more senior academics and an outlet for disseminating their research work; and to serve as a vehicle for developing the built environment field in Africa.

Three conferences have so far been organized, 2009-2011, bringing together nearly three hundred academics, researchers and practitioners from 50+ different institutions in WA. Through WABER, many young researchers have been helped to develop their research work and skills through constructive face-to-face interaction with experienced academics. We find this encouraging and we will continue to work together with colleagues in WA to develop initiatives that provide young researchers in WA with opportunities to develop their research potential and aspirations.

This year's conference proceedings consist of 95 papers. This represents around 50 percent of abstracts and full papers that were initially submitted. We congratulate the authors of papers that made it into the proceedings for a job well done. The published papers cover a wide array of topics including: Building services, Construction design and technology, Construction economics and finance, Construction education, Construction materials and production, Contracts, Cost and financial management, Energy generation and consumption, Engineering sciences, Facilities management, Health and safety, Housing, Human resources and skills, Information technology, Materials science, Procurement, Project administration and management, Quantity surveying, Real estate and planning, Risk management, Supply chain management, Sustainable technologies, Urban planning and development, Waste management. As such they reflect various areas of socio-economic development aspirations of countries in West Africa. One thing that is strikingly clear is that the construction sector has an important part to play in helping to realize these aspirations.

We hope that the publication and discussion of these papers at this conference will contribute towards the development of knowledge and technologies for development in West Africa and beyond. Given that the delegates at this year's conference come from 10 different countries and 45 different academic institutions, there is plenty of scope for cross boundary interaction and learning. The conference also provides for a rich intellectual, international and multicultural blend and platform for networking and developing new knowledge, connections and longer-term collaborations. We hope that the delegates make good use of this opportunity.

We wish to express strong appreciation to two companies in Ghana who have supported us financially. The first is A-Kon Consults Limited who are Chartered Quantity Surveyors with head office based in Accra. The second is K+H Limited who are Constructional Engineers and Contractors with head office based in Takoradi. We are grateful for your support and input and we look forward to a mutually beneficial long-term relationship.

We are blessed to have four distinguished Keynote Speakers: Professor George Ofori (National University of Singapore); Dr Roine Leiringer (Chalmers University, Sweden); Dr Chris Harty (University of Reading, UK); and Professor Will Hughes (University of Reading, UK). Thank you very much for coming. As always, many thanks are due to Dr Sena Agyepong for her excellent and capable management of our local organizing arrangements. Above all, thank you to all of you for coming to this conference. Our conference next year (2012) will take place in Nigeria and we look forward to seeing all of you again. Enjoy Accra and have a safe journey back home.

Dr Samuel Laryea
School of Construction Management and Engineering
University of Reading, July 2011

SCIENTIFIC COMMITTEE

REVIEW PANEL

In addition to the members of our scientific committee, the following people have helped to review abstracts and papers for the conference and we would like to acknowledge their contribution and thank them.

Dr. Moshood O. Fadeyi, British University in Dubai, UAE

Josip Sertic, University of Zagreb, Croatia

Yingbin Feng, University of Western Sydney, Australia

Dr Li Shan, Department of Building, National University of Singapore, Singapore

Dr Hasan Haroglu, University of Reading, UK

Dr Richard Nyuur, University of Swansea, Wales

Mr. Igor Martek, University of Melbourne, Australia

Dauda Dan-Asabe, University of Reading, UK

Patrick Manu, University of Wolverhampton, UK

Damilola Ekundayo, Northumbria University, UK

Ms Ma Shichao, The University of Hong Kong

Tangi Rebekka Amakali, University of Reading, UK

Dr Bekithemba Mpofu, College of Estate Management, UK

Sarfo Mensah, Kumasi Polytechnic, Ghana

Funlola Famuyiwa, University of Lagos, Nigeria

Dr De-Graft Owusu-Manu, KNUST, Kumasi, Ghana

Dr Stephen Kong, Civil Engineering and Development Department, Hong Kong

Dr Michael Boansi, KNUST, Kumasi, Ghana

Ms Chuanjing Ju Carrie, The University of Hong Kong

Dr Rita Li, Hong Kong Shue Yan University

Dr. Alan Zhai, China Harbour Engineering Company Ltd

Dr. Jacky, The University of Hong Kong

Mr Zhang Yu, The University of Hong Kong

Mr. John Kissi, Mouchel Ltd, UK

Ms Dan Zhang, The University of Hong Kong

Dr James Rotimi, University of Auckland, New Zealand

Dr Shu-Ling Lu, University of Reading, UK

Dr Carmel M. Lindkvist, University of Reading, UK

Dr Victor Chen, University of Melbourne, Australia

Dr Stefan Christoffer Gottlieb, Danish Building Research Institute, Aalborg University

Dr Gabriel Nani, KNUST, Kumasi, Ghana

Amna Shibeika, University of Reading, UK

Dr Kumi Tashiro, The University of Hong Kong

Kulomri Adogbo, Ahmadu Bello University, Nigeria

Sohrab Donyavi, University of Reading, UK

Afolabi A. Dania, University of Reading, UK

Ms Shen Yu Zhong, The University of Hong Kong

Peter Gangas Chindo, Ahmadu Bello University, Nigeria

Dr T.K Chan, University of Melbourne, Australia

Prof Christine Räisänen, Chalmers University, Sweden

Alan Zhai, Loughborough University

John Shen Yuzhong, University of Hong Kong

Ms Betty Chiu, The University of Hong Kong

Dr Mark Adom Asamoah, KNUST, Kumasi, Ghana

Ms Rita Zhang, Peilhua, The University of Hong Kong

Dr. Zhikun Ding, The University of Hong Kong

Mr Tony Wei Lu, The University of Hong Kong

Mr Enoch Sackey, Loughborough University, UK

Dr. Yunyan Jia, The University of Hong Kong

Mr John Shen Yuzhong, The University of Hong Kong

Dr Hao Wu, University of Melbourne, Australia

Dr. Raglan Lam, Raglan Ltd, Hong Kong

THEME LEADERS

We are grateful to the following academics for leading the refereeing process for papers relating to the research areas designated against their name(s):

Dr Franklin Obeng-Odoom, University of Sydney, Australia
Housing, land use and urban economic development, urbanisation

Dr Aaron Anvuur, University College of London, UK
Organisation strategy and supply chain management

Dr Martin Tuuli, Loughborough University, UK
Quantity surveying, cost and financial management

Dr Sena Agyepong, Central Univeristy, Ghana
Human resources and skills

Dr Kemi Adeyeye, University of Brighton, UK
Construction design and technology

Dr Tyler Frazier, Technische Universität Berlin, Germany
Urban infrastructure planning, land development regulations, real estate price modeling

Dr Wisdom Kwawu, University of Reading, UK
Facilities management

Dr Roine Leiringer, Chalmers University, Sweden
Dr Samuel Laryea, University of Reading, UK
Procurement, contracting and risk management

Dr Ajibade Ayodeji Aibinu, University of Melbourne, Australia
Contract administration

Dr Emmanuel Adu Essah, University of Reading, UK
Solar energy systems, sustainable technologies, building services

PROGRAMME

TUESDAY 19 JULY 2011 - 08:00-17:30

08:00-09:00 REGISTRATION

OPENING SESSION

09:00-09:10	Welcome address by *Mr. Moses Anibaba* (Director of British Council in Ghana): *Role of the British Council in Africa*
09:10-09:15	Opening remarks by *Professor Will Hughes* (Editor-in-chief of Construction Management and Economics; and Professor of Construction Management and Economics, University of Reading, UK)
09:15-09:25	Guest of Honour address by *Hon. Samia Nkrumah* (MP, Parliament of Ghana)
	Title of address: "*Role of the built environment community in the development of societies in Africa*"
09:25-09:35	Chairman's remarks by *Mr. Nat Amarteifio* (Architect and Former Mayor of Accra)
09:35:09:45	Official WABER 2011 Group Photograph

KEYNOTE ADDRESS

10:00-10:05	Introduction of keynote address/speaker by Mr Samuel Asare-Konadu, MD of A-Kon Consults Ltd
10:05-10:30	A-Kon Consults Keynote address by Professor Will Hughes (Professor of Construction Management and Economics, University of Reading, UK; Editor-in-chief of Construction Management and Economics journal)
	Title: Academic profile and conflicting agendas: individuals, departments, universities, journals, industry
10:30-10:40	Q&A
10:40-11:00	**Refreshments and networking break**

WORKSHOP SESSION (11:00-13:00)

Chairperson Dr Ola Uduku (Edinburgh College of Art School of Architecture, Scotland)

11:00-11:10	Managing the adverse health and safety influence of subcontracting – Patrick Manu, Nii Ankrah, David Proverbs, Subashini Suresh and Emmanuel Adukpo
11:10-11:20	A review of the current health and safety legislation in Botswana relative to construction industry stakeholders – Erastus Mwanaumo and Wellington Thwala
11:20-11:40	Discussion
11:40-11:50	Identification of health and safety performance improvement measuring indicators – Justus Agumba, Wellington Thwala and Theo Haupt
11:50-12:00	Investigating the perceptions of architects in the Ghanaian building industry with regard to photovoltaic energy technology – Naa Adjeley Ashiboe-Mensah, Fred Akuffo and Frank Fugar
12:00-12:20	Discussion
12:20-12:30	Exploring waste minimization measures in the Ghanaian construction industry – J Ayarkwa, K Agyekum and E Adinyira
12:30-12:40	Designing out waste on mass housing construction sites in Minna, Niger state – Oluwatoyin Ayodeji Olaniyan
12:40-13:00	Discussion

13:00-14:00	**Lunch and networking break**

KEYNOTE ADDRESS

14:00-14:30	Keynote address by Professor George Ofori (National University of Singapore, Singapore) *Title: A review of construction industry development programmes*
14:30-14:40	Q&A
14:40-15:00	**Networking break**

WORKSHOP SESSION (15:00-17:30)

Chairperson Dr Esi Ansah (Ashesi University, Ghana)

15:00-15:10	Urbanisation and the marketplace in West African countries – Enitan Oloto and Kayode Adebayo
15:10-15:20	Reinventing prototype buildings: The significance of prefabrication in mass housing construction – Lateef Lawal
15:20-15:40	Discussion
15:40-15:50	Gender issues in land: Implications for housing development in Nigeria – Ajayi Adebola
15:50-16:00	Urban land use planning in Ghana - Kwasi Awuah, Felix Hammond, Colin Booth and Jessica Lamond
16:00-16:20	Discussion
16:20-16:30	Hydrological performance of rainwater harvesting system in the residential sector – Omolara Lade, David Oloke, Collin Booth, Michael Fullen and David Proverbs
16:30-16:40	The likely effect of sustainable landscape on the quality of life through tourism – Dorcas Ayeni, O.J. Ebohon and A.H. Taki
16:40-17:00	Discussion
17:00-17:10	Innovative approaches to sustainable built environments in Nigeria – Chinwe Sam-Amobi
17:10-17:20	Framework analysis of technology and design of sustainable affordable housing in Nigeria - Olatunji Olagunju, David Oloke, Felix Hammond and Pat Costello
17:20-17:30	Discussion
17:30	Close

SOCIALISING

19:30	**Socialising at the new Movenpick Ambassador Hotel in Accra City Centre** **http://www.moevenpick-hotels.com/en/pub/your_hotels/worldmap/accra/overview.cfm**

WEDNESDAY 20 JULY 2011 - 09:00-17:30

RESEARCH SKILLS WORKSHOP (MAIN AUDITORIUM)

09:00-10:30	Data collection and analysis: what is data, how do you collect it, and how do you analyse it? – Dr Chris Harty (School of Construction Management and Engineering, University of Reading, UK)
10:30-11:00	**Refreshments and networking break**

PARALLEL SESSIONS (11:00-13:10)

STREAM 1 (MAIN AUDITORIUM)

Chairperson Dr Martin M. Tuuli (Loughborough University, UK)

11:00-11:10	Energy generation and consumption in Ghana – Emmanuel Essah
11:10-11:20	Industrial training in Ghana: perceptions of the undergraduate construction student – J. Ayarkwa, E. Adinyira and K. Agyekum
11:20-11:30	Discussion
11:30-11:40	Factors affecting women enrolment in construction education in Nigeria – Joshua Dada
11:40-11:50	Built environment education and research in West Africa – Samuel Laryea
11:50-12:00	Discussion

Chairperson Professor Joshua Ayarkwa (KNUST, Kumasi, Ghana)

12:10-12:20	Causes of variations on building projects in Nigeria – J.A. Babalola and A.F. Idehen
12:20-12:30	On the accuracy of cost estimates – Haruna Musa, Yahaya Ibrahim and Ahmed Ibrahim
12:30-12:40	Discussion
12:40-12:50	A comparative analysis of clients' and consultants' perspective of construction project performance – William Gyadu-Asiedu
12:50-13:00	Performance of building projects funded by public organizations – Sarfo Mensah, Ayirebi Dansoh and Peter Amoah
13:00-13:10	Discussion
13:10-14:30	**Lunch and networking break**

STREAM 2 (SEMINAR ROOM)

Chairperson Dr Noah Karley (Heriot Watt University, Scotland)

11:00-11:10	A comparative study of housing transformation processes in three government estates in South Western, Nigeria – Victor Adegbehingbe
11:10-11:20	An overview of human settlement in Nigeria: A ray of hope for the slum dwellers? – Clinton Aigbavboa and Wellington Thwala
11:20-11:30	Discussion
11:30-11:40	Affordability assessment of the housing units built from federal mortgage bank's loans in Nigeria – Musa Nuhu Madawaki

11:40-11:50	Public-private participation in housing in Nigeria and the case for community participation – Abraham Taiwo and Olumuyiwa Adegun
11:50-12:00	Discussion

Chairperson Professor Kabir Bala (Ahmadu Bello University, Nigeria)

12:10-12:20	Historical overview of housing provision in pre and post independence Ghana – T. Kwofie, E. Adinyira and E. Botchway
12:20-12:30	House owners' participation in mass housing provision in Niger State Nigeria – Adedayo Folaranmi
12:30-12:40	Discussion
12:40-12:50	Framework for performance-based post-occupancy evaluation of educational institution buildings in Nigeria – Aliyu Shika and Abubakar Dardau
12:50-13:00	Post occupancy evaluation of public office buildings in Minna urban – Ayoola Babatunde, Ayo Adeniran and Kemiki Olurotimi
13:00-13:10	Discussion
13:10-14:30	**Lunch and networking break**

KEYNOTE ADDRESS (MAIN AUDITORIUM)

14:30-14:55	K+H Ltd Keynote address by Dr Roine Leiringer (Chalmers University, Sweden) *Title: Built environment research in West Africa: current trends and future directions*
14:55-15:05	Q&A

PARALLEL SESSIONS (15:10-17:30)

STREAM 1 (MAIN AUDITORIUM)

Chairperson Dr Emmanuel Olufemi Omisore (Obafemi Awolowo University, Nigeria)

15:10-15:20	Jos plateau volcanic deposits as sustainable cementitious materials for partial replacement of Portland cement in concrete mixtures
15:20-15:30	Effect of replacement of sand with granite fines on the compressive and tensile strengths of palm kernel shell concrete – John Babafemi and Babatunde Olawuyi
15:30-15:40	Discussion
15:40-15:50	Effects of Nigerian rice husk ash produced using a charcoal fired incinerator on properties of cement mortar and concrete – A.E. Abalaka, O.G. Okoli, M.M. Garba and I.K. Zubairu
15:50-16:00	Establishing the compressive strength of sandcrete blocks produced in the Central Region, Ghana – Emmanuel Bamfo-Agyei
16:00-16:10	Discussion
16:10-16:30	**Networking break**

Chairperson Dr Victor Adegbehingbe (Federal University of Technology, Akure, Nigeria)

16:30-16:40	Factors influencing the extensive use of glass on facades of office buildings in Accra, – Adwoa Difie Ampadu-Asiamah and Emmanuel Akoi-Gyebi Adjei
16:40-16:50	Cost implications of biodegradation of Khaya grandifoliola (dry land mahogany) by aspergillus spp in residential buildings – I.H. Mshelgaru and A.D. Abdulazeez
17:00-17:10	Discussion
17:00-17:10	Establishing a maintenance cost profile of residential buildings – D. O. Mac-Barango and I. I. Kakulu
17:10-17:20	Drivers for estimating construction costs of institutional building projects in Nigeria – Baba Waziri and Kabir Bala

17:20-17:30	Discussion
17:30	Close

STREAM 2 (SEMINAR ROOM)

Chairperson Mrs Mae-ling Lokko / Joe Osae-Addo (Constructs LLC, Ghana)

15:10-15:20	Merging architectural and sculptural forms in the building industry - Victor Kweku Bondzie Micah and Owusu-Ansah Ankra
15:20-15:30	Client-architect behaviours towards cost advice in Nigeria – Baba Adama Kolo, Badiru Yunusa and Anita Dzikwi
15:30-15:40	Discussion
15:40-15:50	Designs and construction of buildings in Ghana: The disability factor – Kwaku Owusu and Nana Buabeng Owusu-Ansah
15:50-16:00	Bioclimatic and design strategies analysis towards the improvement of comfort in semi-detached houses in Ghana - David Nyame-Tawiah, Christian Koranteng and Adeline Mawupemor Woyome
16:00-16:10	Discussion
16:10-16:30	**Networking break**

Chairperson Dr Sena Agyepong (Ashesi University, Ghana)

16:30-16:40	An evaluation of the trend of budgetary allocations for infrastructural development in Osun state, south-western, Nigeria – Opawole Akintayo, Jagboro Onajite and Babatunde Olusola
16:40-16:50	Constraints in real estate development finance in Ghana – Nkyi Benjamin Appiagyei and Ayirebi Dansoh
17:00-17:10	Discussion
17:00-17:10	Remittances to Ghana: Benefits to the housing sector and impact of financial crisis – Noah Kofi Karley
17:10-17:20	Spatial scales and measurement of housing values in Nigeria – Ola Aluko
17:20-17:30	Discussion
17:30	Close

SOCIALISING

19:30 **Socialising at Alisa Hotel in North Ridge Accra**
http://www.alisahotels.com/

THURSDAY 21 JULY 2011 - 09:00-17:30

WORKSHOP SESSION

Chairperson Professor G.W.K. Intsiful (KNUST, Kumasi, Ghana)

09:00-09:10 Sources of deficient information regime in urban real estate markets in Sub-Saharan African countries – Stanislaus Adiaba, Felix Hammond, David Proverbs, Jessica Lamond and Colin Booth
09:10-09:20 Public private partnership (PPP) in housing delivery in Niger State – Suleiman Bolaji
09:20-09:30 An integrated relationship and supply chain management framework for improving engineering and design service delivery to building contractors in Ghana – Nanyi Orgen, Divine Ahadzie, Joshua Ayarkwa, Edward Badu
09:30-09:50 Discussion

PARALLEL SESSIONS (10:00-13:10)

STREAM 1 (MAIN AUDITORIUM)

Chairperson Dr Wellington Didibhuku Thwala (University of Johannesburg, South Africa)

10:00-10:10 Casual workers preference of occupational health and safety items on building construction sites in Ghana – Frederick Owusu Danso, Edward Badu and Divine Ahadzie
10:10-10:20 Influence of construction site OHS facilities on OHS performance in Nigeria – Godwin Idoro
10:20-10:30 Discussion
10:30-10:40 Health and safety in Ghanaian construction industry – A. Nimo Boakye, B.B. Akomah and David Coles
10:40-10:50 How should health and safety be measured as a tender evaluation criterion in the Ghanaian construction industry? – Wise Akortsu
10:50-11:00 Discussion
11:00-11-30 **Refreshments and networking break**

Chairperson Dr Emmanuel Essah (University of Reading, UK)

11:30-11:40 Sustainable construction in Nigeria – James Jatau and Anthony Westcott
11:40-11:50 “Sustainable” or “green” construction in Lagos, Nigeria – Immaculata Nwokoro and Henry Onukwube
11:50-12:00 Discussion
12:10-12:20 Sustainable tourism architecture – Stephen Oluigbo
12:20-12:30 Malaika Children’s Village, Mkuranga, Tanzania: A case study of sustainable construction in Africa - Ifeyinwa Dimoriaku and Rita Obiozo
12:30-12:40 Discussion
12:40-12:50 The thermal performance of an educational office building in Ghana - Jimmy Nkrumah, Christian Koranteng and Kojo Safo-Kantanka
12:50-13:00 A study of the sources of noise pollution and their impacts on the built environment – S.A. Ganiyu and Y.M.D. Adedeji
13:00-13:10 Discussion
13:10-14:30 **Lunch and networking break**

STREAM 2 (SEMINAR ROOM)

Chairperson Dr Nii Ankrah (University of Wolverhampton, UK)

10:00-10:10	Dynamics of empowerment in projects – Enoch Sackey, Martin Tuuli and Andy Dainty
10:10-10:20	Influence of channels of recruitment on performance of construction workers in Nigeria – Godwin Idoro and Ebenezer Bamidele
10:20-10:30	Discussion
10:30-10:40	Capacity-building in contract administration: key to effective utilization of District Assembly Common Fund – M Boadu, J Eshun and E Opoku-Ware
10:40-10:50	Leader influences on training effectiveness of construction professionals - Henry Onukwube
10:50-11:00	Discussion
11:00-11-30	**Refreshments and networking break**

Chairperson Dr Gabriel Nani (KNUST, Kumasi, Ghana)

11:30-11:40	Geosophic perspective in Yoruba urbanism – Olaniyi Okedele and Tunji Adejumo
11:40-11:50	Factors influencing land accessibility for housing development in Abuja, Nigeria – Andrew Stanley and O. Orobowale
11:50-12:00	Discussion
12:10-12:20	Assessment of patronage of Natural History Museum, Obafemi Awolowo University, Ile-Ife, Nigeria - Emmanuel Olufemi Omisore
12:20-12:30	Revitalization of Nigerian urban centres through effective use of open public spaces: a case study of Onitsha metropolis – N Okolo, C Okpala, K Ezeji and A Okolie
12:30-12:40	Discussion
12:40-12:50	Mining activities in Nigeria urban environment: Impetus for community development or environmental deterioration? – Samson Adeyinka, Albert Abegunde, Nathaniel Adeoye, S. Adeyemi
12:50-13:00	An investigation into the Environmental Protection Agency in the Ghanaian construction industry – E. Opintan-Baah, P.P. Yalley, P. Kwaw and G. Osei-Poku
13:00-13:10	Discussion
13:10-14:30	**Lunch and networking break**

PARALLEL SESSIONS (14:30-16:40)

STREAM 1 (MAIN AUDITORIUM)

Chairperson Professor Will Hughes (University of Reading, UK)

14:30-14:40	An investigation on why adjudication is not a popular dispute resolution method in the Ghanaian construction industry – Eric Baffour-Awuah, Charles Vroom and Peter Otchere
14:40-14:50	Management of building construction disputes in Nigeria – Henry Onukwube
14:50-15:00	Discussion
15:00-15:10	Challenges facing the smooth implementation of Ghana’s Public Procurement Law, 2003, Act 663 – Collins Ameyaw, Sarfo Mensah and Ernest Osei-Tutu
15:10-15:20	Assessing the impact of the National Building Regulation, 1996, L.I.1630 in Ghana – John Dadzie and David Coles
15:20-15:30	Discussion

Chairperson Professor Okedele Olaniyi (University of Lagos, Nigeria)

15:40-15:50	An investigative study of the impact of distance and demographic variables on the price of cement – D.O. Mac-Barango
15:50-16:00	Diesel (Ago) pump price increase and the prices of selected building materials in Nigeria (1990–2009) – John Idiake
16:00-16:10	Discussion
16:10-16:20	Partnering: an alternative contractual arrangement for construction project delivery in Ghana – Samuel Ansah
16:20-16:30	Evaluating the benefits of BOT infrastructure projects in Nigeria – Alhassan Dahiru and S. Bustani
16:30-16:40	Discussion

STREAM 2 (SEMINAR ROOM)

Chairperson Dr Chris Harty (University of Reading, UK)

14:30-14:40	Critical success factors for the implementation of Total Quality Management (TQM) in real estate development in Ghana – Kobina Imbeah and Ayirebi Dansoh
14:40-14:50	Investigation into the use of Total Quality Management in Nigerian construction industry – Peter Gangas Chindo and Kulomri Adogbo
14:50-15:00	Discussion
15:00-15:10	Construction participants' perspective on multi-criteria selection practice in Lagos State, Nigeria – Folasade Alabi
15:10-15:20	Influence of IT use at pre-contract stage of construction projects in Akwa Ibom State Nigeria – Jimmy Wilson and Godwin Idoro
15:20-15:30	Discussion

Chairperson Rev. Dr Frank Fugar (KNUST, Kumasi, Ghana)

15:40-15:50	Security measures adopted by estate surveyors shopping malls in Kaduna, Nigeria - David Ayock Ishaya and Daniel Dabo
15:50-16:00	Enhancing the image of transport terminals in Ghana – Peter Yalley, Gloria Osei Poku and Harold Adjarko
16:00-16:10	Discussion
16:10-16:20	Clay exploration, aesthetics and environmental sustainability: a case study of Akure and Ado-Ekiti, Nigeria – Ganiyu Sulayman Olubunmi and Ganiyu Sikiru Abiodun
16:20-16:30	Impact of improper solid waste disposal on urban housing in Akure, Nigeria – Alexander Fakere and Olaniyi Aluko
16:30-16:40	Discussion

CLOSING SESSION

16:45-17:00	Conference summary – Dr Roine Leiringer
17:00-17:30	Presentation of certificates and prizes – Professor Will Hughes
17:30	**Close and refreshments**

SOCIALISING

19:30	**Socialising at Novotel Hotel in Accra City Centre** **http://www.novotel.com/gb/hotel-1021-novotel-accra-city-centre/index.shtml**

CONTENTS

SECTION 1: KEYNOTES

SECTION 2: CONFERENCE PAPERS

SECTION 1: KEYNOTES

ACADEMIC PROFILE AND CONFLICTING AGENDAS: INDIVIDUALS, DEPARTMENTS, UNIVERSITIES, JOURNALS, INDUSTRY

Professor Will Hughes[1]

Editor-in-Chief, Construction Management and Economics, School of Construction Management and Engineering, University of Reading, PO Box 219, Reading, RG6 6AW, UK

This presentation covers the conflicting agendas and pressures that beset the academic. We are all members of diverse constituencies, as individuals, members of departments and faculties, members of a university, authors and referees in journals and, to varying degrees, contributors to industry. Universities have a distinctive task. As Edward Shils has said, "it is the methodical discovery and teaching of truths about serious and important things".

A "scientific" truth is not the same as a religious truth. One is relative, the other absolute. Science is no more than a provisional consensus. It involves the observation of certain specific phenomena within a theoretical framework in order to develop better explanations that improve our collective understanding. It is not the mere reporting of phenomena - i.e. science is not journalism. The focus on academic outputs relates to an intensifying search for recognition in the wider disciplinary community, as well as to competition for promotion. The conflicting agendas require academics to produce "multi-purpose papers" which fulfil several functions: they record scientific progress in the field, they create the sense of a "bundle of knowledge" or community of specialist scholars, they develop wider recognition in the academic community, they provide evidence for promotion cases. But academic outputs are not journalism and not dissemination, therefore not necessarily directly useful for industry.

To ensure that academic outputs are robust, they are peer evaluated. This involves questioning whether a paper makes a satisfactory contribution. Editors seek to encourage the exercise of judgement in their referees but referees do not decide the fate of the paper, editors do. Institutional pressures mean that a rational response is needed to the combined impact of increasing costs and decreasing income. This means an ever sharper dependence on league tables, rankings and evaluations of "impact". There is a universal problem of measurement, which as that you tend to only get what you measure. Any individual academic has to decide where to publish. It is necessary to develop a publication strategy that is most likely to measure up in terms of impact factors, league tables but this tends to transform the motivation to publish from reporting the results of research to demonstrating research-active status. But for an individual, the important thing is placing papers with peers.

In the area of built environment research, there are some important and difficult questions: Are practitioners and academics too close or too distant? What is the business case for funding research? Indeed, what is the business case for funding journals? There is a tendency for these pressures to re-write the academic agenda. Therefore, how should we respond? There is a choice between institutional and ethical responses. Is the agenda career-building or institution-building? There are

[1] w.p.hughes@reading.ac.uk

Hughes, W.P. (2011) Academic profile and conflicting agendas: individuals, departments, universities, journals, industry *In:* Laryea, S., Leiringer, R. and Hughes, W. (Eds) *Procs West Africa Built Environment Research (WABER) Conference*, 27-28 July 2010, Accra, Ghana, 1-2.

clearly consequences that depend on the mode of measurement. And there are common misconceptions of relationship between quality and quantity. For example, is there a choice between developing new insights and making money?

In conclusion, what helps us to progress in our careers is peer recognition. What makes us useful to departments and universities is recognition and impact. What makes a scientific paper useful is conformance with the customs and practice of the particular academic field. What makes academics useful to industry is being able to provide practical and positive advice. There are many conflicting agendas, in response to which the successful academic has to develop diverse tactics.

DEVELOPING THE CONSTRUCTION INDUSTRY: A DECADE OF CHANGE IN FOUR COUNTRIES

George Ofori[1], Evelyn Teo Ai Lin[2], Imelda Krisiani Tjandra[3]
Department of Building, National University of Singapore, Singapore

The report on the UK construction industry entitled *Rethinking Construction* which was written by a task force led by Sir John Egan (1998) inspired the construction industries in many parts of the world to carry out comprehensive reviews of the industries. Although there are similarities in the programmes of the countries, they were shaped by different institutional contexts, and their implementation faced different problems and challenges. Despite the extensive literature on change initiatives in each of the countries, there is hardly any international comparison of the programmes. The background to, and implementation of, the construction industry reform studies in the UK, Singapore, Hong Kong, and Malaysia are presented. The achievements realised, and challenges faced, in each country are discussed. The potential contribution which researchers can make and the merits of international research collaboration are highlighted.

Keywords: change, construction industry development, contextual constraints, international research collaboration.

INTRODUCTION

In the past decade, a number of studies have focused on reviewing the construction processes, practices, and performances in their countries. The studies have focused on how to re-engineer, reinvent, revalue, and rethink construction to improve its performance. The Egan Report (1998) inspired the initiation of construction industry reviews in several other countries. These include the Construction 21 (C21) study in Singapore (Construction 21 Steering Committee, 1999) and the *Construct for Excellence* report in Hong Kong (CIRC, 2001). Subsequently, in Malaysia, the Construction Industry Development Board (CIDB) and the Building Industry Presidents Council (BIPC) proposed recommendations and action plans to overcome the challenges faced by the construction industry, in the form of the Construction Industry Master Plan (CIMP) (CIDB, 2007). The reports produced from the studies have become blueprints on which programmes for the development of the respective construction industries have been based.

A joint research project is currently being undertaken on the change programmes for the construction industries in the UK, Singapore, and Hong Kong, to compare the objectives of the construction industry change programmes, and the outcomes from, their implementation. and the institutional characteristics of the construction industries in the three jurisdictions are also being studied. There were key similarities and differences among the three programmes. All three studies were intended to attain a

[1] bdgofori@nus.edu.sg
[2] bdgteoal@nus.edu.sg
[3] bdgikt@nus.edu.sg

Ofori, G., Ai Lin, E.T. and Tjandra, I.K. (2011) Developing the Construction Industry: A decade of change in four countries *In:* Laryea, S., Leiringer, R. and Hughes, W. (Eds) *Procs West Africa Built Environment Research (WABER) Conference,* 19-21 July 2011, Accra, Ghana, 3-16.

radical transformation of construction industry performance through a planned series of change initiatives. Performance targets relating to each of the recommendations were also set. However, the three reports were shaped by very different sets of local concerns. They also advocated different institutional arrangements for implementing the desired changes. Hence, it is possible to draw lessons from the three implementation programmes for future construction industry improvements in each jurisdiction and in other countries as well.

The background of construction industry improvement programmes in the UK, Singapore, Hong Kong and Malaysia is presented. Overviews of the progress which has been attained under the respective programmes in each country are then provided. The similarities and differences of the development among the four countries are discussed. The perceived future of the construction industry in Singapore is presented as a case study.

Objectives of paper

A joint study is being undertaken on construction industry development by teams from the University of Hong Kong, University of Reading and National University of Singapore. The collaboration involves the utilisation of a jointly developed research method. Box One shows the aim and objectives of the joint research.

Box One Collaborative research on industry development initiatives: Research aims and objectives

Research aims and objectives

The aim of the collaborative research is to study the implementation of the respective construction industry improvement programmes in Hong Kong, Singapore and the UK. The objectives are:
To compare the institutional characteristics of the construction industries in Hong Kong, Singapore and the UK.
In light of the above, to ascertain and evaluate the extent to which the respective implementation programmes have achieved the objectives set.
To evaluate the respective roles of government and private sector agencies in the implementation of the advocated reforms.
To draw lessons from the three implementation programmes for future industry improvements in each context.
To develop a research agenda for contributing to the effort to realise improvements in the construction industries of the three locations in addition to other national/regional contexts.
To present specific, tailored recommendations for the use of performance targets, with particular emphasis on appropriateness and monitoring.

Box Two presents the agreed research method which was adopted by the partners. In Singapore, the study involved the following stages: (a) interviews of prominent practitioners and administrators who were involved in the C21 process; (b) an extensive industry-wide questionnaire survey of developers, consultants (architects, engineers and quantity surveyors), contractors, subcontractors; (c) joint research workshop and conference (in Singapore) on the future of construction in Singapore; and (d) forum of construction industry leaders. The forum replaced the case studies whih had been part of the original programme, after it became apparent that such case studies were unlikely to yield the desired results in the particular context of the construction industry in Singapore.

CONSTRUCTION INDUSTRY IMPROVEMENT PROGRAMMES IN FOUR COUNTRIES

This section provides an overview of the background of construction industry improvement programmes in each of the four countries, in chronological order of the year of publication.

IMPROVEMENT PROGRAMME IN THE UNITED KINGDOM

In the UK, the construction industry has been perceived as under-achieving, in terms of meeting its own needs and those of its clients. Hence, a Construction Task Force was set up to advise the Deputy Prime Minister (from the clients' perspective) on the opportunities to improve the efficiency and quality of delivery of UK construction, to reinforce the impetus for change, and to make the industry more responsive to customer needs.

Box Two Collaborative research on industry development initiatives: Research method

The research adopts a multi-method of 'contextualist research' which emphasises the importance of locating present behaviour in the context of its historical antecedents (Pettigrew, 2003). Of particular importance is to focus on the dynamics of change in the three jurisdictions under consideration. Few current researchers within the context of construction management give significant attention to time, with the result that much of their work is an 'exercise in comparative statics'. In contrast, the research approach would recommend that researchers follow the approach of historians to 'reconstruct past contexts, processes, and decisions' in order to discover patterns, find underlying mechanisms and triggers, and combine inductive search with deductive reason (Orton, 1997). An important underlying principle is that the context within which change is instigated must be conceptualised as an active part of analysis (Fernie et al., 2007). But context is not only *shaping*, it is also *shaped* by action (Pettigrew, 1997). The advocated research approach will unpack how the three contexts have been shaped over time and the influence that this has had on the implementation of the respective change agendas. The research differs that it adopts a 'becoming ontology' rather than a 'being ontology' (Chia, 1995). As such it focuses on continuous processes of flux and transformation, rather than static characteristics that can be possessed and measured.

The research involves the following stages:
Comparative analysis of pre-existing dynamics of sectoral change in the three locations. This will involve an historical analysis of available statistics and published sources.
Archival studies and review of literature on performance-improvement initiatives in each location to provide the basis for the formulation of the questionnaire
Empirical studies in the three locations, comprising.
Workshops with prominent practitioners and policy makers (i) to verify the outputs from stages (1) and (2) and to identify emergent issues.
A questionnaire survey using a common set of questionnaire, adapted in each case to suit the local context
A series of semi-structured interviews with prominent practitioners and policy makers in each location.
Five detailed case studies of indicative firms in each location, with particular emphasis on the interaction between the firms' adopted strategies and the broader dynamics of change.
Workshops (3 no.) among the research teams and other invited international academics.
Publication of a joint report on the research project.

The Egan Report (1998) identified the problems that needed to be tackled, including the need to modernise, to address the dissatisfaction of private_ and public-sector clients due to under-achievement, as well as fragmentation of the industry.

Learning from the experience of the manufacturing and service industries, the Egan Report (1998) identified five key drivers of change: (i) committed leadership; (ii) a focus on the customer; (iii) integrated processes and teams; (iv) a quality driven agenda; and (v) commitment to people. To drive dramatic performance improvement, the report proposed that the construction industry should set clear measurable objectives, and then adopt quantified targets, milestones and performance indicators.

Pointing out that there are significant inefficiencies in the construction process, the report aimed for a much more systematised and integrated project process to reduce waste and improve both quality and efficiency. The report noted that substantial changes in the culture and structure of the construction industry were required to enable improvements in the project processes. These include changes in working conditions, skills and training, approaches to design, use of technology, and relationships between companies.

The Task Force called for commitment from major clients, the construction industry, and the government to improve the efficiency and quality of construction. It encouraged the public sector, as the largest client group, to play a leading role in the development of a more sophisticated and demanding customer base for construction.

IMPROVEMENT PROGRAMME IN SINGAPORE

The Construction 21 Committee Manpower was established in May 1998 by the Ministry of Manpower (MOM) to address the manpower problems in the construction industry in Singapore. It was subsequently merged with the Committee on Practices in the Construction Industry set up by the Ministry of National Development (MND) to form the Construction 21 Steering Committee.

The Construction 21 Committee and its four working groups comprised more than 80 people from the private, public, and people sectors. They represented the professional bodies, trade associations, regulatory bodies, public agencies, unions, tertiary institutions, and the public, represented by Members of Parliament.

The committee undertook study missions to Hong Kong, Japan, UK and US to learn the best practices in the industry. It also sought the views of Sir John Egan and Professor Daniel Jones, who were involved in the development of Egan Report (1998).

It was initially intended that the committee would investigate issues related to labour supply and productivity in the industry, but it conducted a thorough investigation and cover many aspects of the industry, from Processes (practices, techniques, and integrated approach to construction), and Players (professionalism and skills) to Products (exporting construction expertise). It developed a vision for the Singapore construction industry: “To be a World Class Builder in the Knowledge Age”, with the change in the public’s perception of the construction industry from a Dirty, Demanding, and Dangerous (3D) industry to a Professional, Productive, and Progressive (3P) industry. The committee made 39 recommendations under 6 strategic thrusts, which were: (i) enhancing the professionalism of the industry; (ii) raising the skills level; (iii) improving industry practices and techniques; (iv) an integrated approach to construction; (v) developing an external wing; and (vi) a collective championing effort for the construction industry.

IMPROVEMENT PROGRAMME IN HONG KONG

The Construction Industry Review Committee (CIRC), with membership widely drawn from the construction and property sectors, trades unions, universities, clients, and government, was set up in April 2000 to investigate issues in the construction industry in Hong Kong and to make recommendations for improvement. The report of the CIRC, entitled “Construct for Excellence” (CIRC, 2001) grouped the issues under three headings: performance, process, and business. The vision for the construction industry was: “an integrated construction industry that is capable of continuous improvement towards excellence in a market-driven environment”.

The report made 109 recommendations, which were grouped under seven key aims: (i) fostering a quality culture; (ii) achieving value in construction procurement; (iii) nurturing a professional workforce; (iv) developing an efficient, innovative, and productive industry; (v) improving safety and environmental performance; (vi) devising a new institutional framework to drive the industry; and (vii) implementation of a change programme for industry.

One of the recommendations was to set up an "industry co-ordinating body" to lead a change programme. The Provisional Construction Industry Co-ordination Board (PCICB) was established in September 2001 with membership drawn in part from the members of the Review Committee.

IMPROVEMENT PROGRAMME IN MALAYSIA

In Malaysia, following a decline in the performance of the construction industry, it was realised that there was an urgent need for the foundations of the industry to be strengthened to prepare it to face its future challenges. In 2003, the Construction Industry Development Board (CIDB) and the Building Industry Presidents Council (BIPC) identified the need to propose recommendations and action plans to attain this aim. The Construction Industry Master Plan (CIMP) was developed by the CIDB in collaboration with the BIPC and various organisations representing the industry.

The master plan, which covers the period of 2006-2015, outlined a strategic roadmap to develop the construction industry into a world-class, innovative, and knowledgeable global solution provider.

In order to achieve the vision, seven strategic thrusts were identified, and these formed the basis of the main recommendations. The thrusts were (i) integrate the construction industry value chain to enhance productivity and efficiency; (ii) strengthen the image of the construction industry; (iii) strive for the highest standard of quality, occupational safety and health, and environmental practices; (iv) develop human resource capabilities and capacities in the construction industry; (v) innovate through research and development (R&D) and adopt new construction methods; (vi) leverage on information and communication technology in the construction industry; and (vii) benefit from globalisation including the export of construction products and services.

A smaller committee comprising representatives of the Ministry of Works, Ministry of Entrepreneur and Cooperative Development, and Ministry of Finance would handle the implementation of the seven thrusts.

CHANGES IN THE FOUR COUNTRIES

This section presents the changes that have been happening in the four countries ever since the publications of the improvement programmes in the respective countries.

CHANGE IN THE UNITED KINGDOM

In the UK, the Strategic Forum was formed in 2001 to oversee the industry reform movement. It had revised the set of targets to be achieved by the end of 2007 (Strategic Forum for Construction, 2002). Recently, the time frame has been extended to 2012, relating to the construction works for the 2012 Olympic Games.

After the publication of the Egan Report, at least eleven more reports have been published. The reports were target-driven, focusing on performance measurement for efficiency. The latest report, *Never Waste a Good Crisis*, published in October 2009, reviewed the progress which had been made since the publication of the Egan Report. The report (Constructing Excellence, 2009) portrayed a dim situation. It noted that whereaqs there had been some progress, this was nowhere near enough to what had been expected. It also observed that the commitment to the principles in the Egan Report was only skin-deep. Few of the targets set in the Egan Report had been met in full, whereas most of them had fallen considerably short.

The Egan Report (1998) had set seven targets for 10 to 20% year-on-year improvement in capital cost, construction time, predictability, defects, accidents, productivity, turnover and profits. Constructing Excellence (2009) reported that, in general, the Egan targets had not been met in the industry. Improvement in profitability was largely due to favourable economic conditions in the last decade. While there were significant improvements in safety and productivity prforshowed reasonable progress, there was still a need for major improvement in the area of predictability. A programme of demonstration projects had been successful; more than 500 projects worth £14 billion had contributed to the industry's knowledge base of innovation and best practice (Constructing Excellence, 2009).

The report (Constructing Excellence, 2009) identified four key blockers to progress. Firstly, the growing economy in the years following the publication of the recommendations provided no impetus for a radical transformation of the construction industry. Secondly, there was a lack of capable people within the industry, particularly at the senior management level with the leadership skills required to bring about a radical cultural change. Thirdly, a lack of integration in the delivery process impeded continuous improvement. Fourthly, the diverse and fragmented structure of the industry made it difficult to serve the interests of the industry as a whole.

Furthermore, Green *et al.* (2008) argue that industry improvement reviews tend to insist that firms should adopt 'best practice' recipes such as lean thinking, partnering, and integrated teams. While the reports following the Egan Report (1998) focus on integration, the challenge is that the industry is heavily fragmented. There is hardly any effort to think of how to adapt the organisational routines to changing circumstances.

CHANGE IN SINGAPORE

The BCA closely co-ordinated and monitored the following-up of the recommendations. Even the recommendations that had not been approved (i.e. export promotion and research) were followed up. As one interviewee noted, *"The report card on C21 would be a decent one because everything that can be done has been done. In many cases, they went beyond what was proposed."*

In terms of the transformation from a 3D to a 3P industry, the interviewees agreed that the industry has progressed, but the degree of progression was not as much as it should have been. On strategic thrust 1, the Construction Real Estate Network (CORENET) project, a major IT initiative to provide an integrated infrastructure for the construction industry stakeholders to communicate with each other and exchange information, was as the most significant achievement of C21. The professionalism of the industry has been improved, but there is still room for improvement. New awards have been created, incorporating key points from previous ones. Many new degree programmes have been started to meet the needs of the industry, but a number of the interviewees expressed their concerns about the quality of the curriculum and graduates. There has been improvement in the implementation of the Continuing Professional Development (CPD) programme; it has now become mandatory for some professions, notably, architecture and engineering. A common code of conduct for the construction industry, which was one of the C21 recommendations, was drafted but it has not been implemented because, according to one interviewee, it was considered to be so general that it was not necessary. In the C21 report, the multi-layered subcontracting system was mentioned as one of the causes of poor productivity in the industry. Many of the small firms are poorly managed, lack the incentive and ability to invest in training and in new technology, and are unable to reap economies of scale in their operations, resulting in much wastage (Construction 21 Steering Committee, 1999). One of the recommendations in C21 was to license all contractors including sub-contractors in order to enhance their standards and professionalism. As the licensing was only implemented in December 2008, the impact has yet to be realised.

On strategic thrust 2, the issue of foreign workers was the main concern for many interviewees. They highlighted the cultural differences, transient nature of the workers, the hidden costs, low level of skills, impact on safety performance, and the support provided by the government to the workers. The Man-Year Entitlements (MYE), which determines the number of foreign workers which a company can employ for each project as determined by the cost and duration of the works, had been tightened and then the cuts had been somewhat restored in response to feedback from the industry. Unexpected practices have developed, which gave an impression that the MYE was still at a comfortable level for the contractors and hence, ineffective. There has been improvement on the construction workers' skills, with the introduction by the BCA of the Skill Evaluation Certificate (SEC) and Skill Evaluation Certificate (Knowledge) – SEC (K).

On strategic thrust 3, the interviewees noted that, owing to the legislation on buildability, productivity has improved, but there was still room for improvement. BCA's policy on productivity performance has progressed from considering buildability as the main determinant towards constructability. The Construction Quality Assessment Scheme (CONQUAS) (an objective method for assessing the quality of a construction project which was introduced in 1989) has improved quality to a certain degree, and it has been extended to the Quality Mark for residential buildings which seeks to give owners and end purchasers of units an indication of the quality. The National Productivity and Quality Specifications (NPQS) has been launched, but it has not been pervasively used in the industry. The NPQS is currently being revamped in an exercise involving a number of professional institutions.

C21 also targeted improvement in construction safety. The Joint MND-MOM Review Committee (JRC) on Construction Safety was convened after two serious accidents in 2004, in order to review the regulatory framework and ancillary systems to raise safety standards in the construction industry (JRC, 2005). The committee identified gaps in the regulatory framework and ancillary systems. It has made recommendations to help strengthen the legislative provisions pertaining to temporary structures, raise professionalism and competency of professionals, contractors, and supervisors, and make transparent the public sector procurement system to take safety into account. The Construction (Design and Management) or CDM Regulations will require designers to work closely with contractors in thinking through safety management for the entire life-cycle of a project (Gan, 2008). "Implementing WSH2015 for Construction Industry" was launched in 2007 to guide the efforts of the construction sector. Since then, considerable improvements have been made, including the development of the Construction Safety Audit Scoring System (ConSASS), the review and enhancement of the Construction Safety Orientation Course (CSOC), the publication of the construction accident case study booklet, the release on Guidelines on Design for Safety (DFS) in Buildings and Structures as well as the inaugural Construction Chief Executive Officer (CEO) Summit, where CEOs from top construction companies signed to pledge management commitment for zero injuries. The guide has since been updated to include areas for enhancement and new areas of work to achieve sectoral targets by 2018. "Implementing WSH 2018 for Construction

Sector in Singapore" (WSH Council, 2010) was published in April 2010. It sets the targeted outcomes, key strategies and initiatives to further enhance WSH standards in the construction sector and aims to guide all stakeholders to create a safer and healthier construction sector with a progressive and pervasive WSH culture.

Research remains limited and segregated within the construction industry in Singapore. However, research within the industry has been encouraged by the recent MND Research Fund for the Built Environment, which is administered by the BCA. In terms of safety, there has been much progress in the regulations and in the systems introduced by companies. However, these have not had the desired appreciable impact on performance. A web-based application for the Construction Management System was completed in 2004, but it did not take off in the industry. Finally, on the initiatives under thrust 3, the advice that modifications to the standard contracts for the private sector should be minimised has not been realised. On the contrary, indeed, many of the professional institutions have introduced additional new standard contract forms.

On strategic thrust 4, Design and Build (D&B) was one of the procurement methods encouraged by C21 owing to its perceived potential to foster integration in the construction process. However, some of the the interviewees emphasized that, as a procurement method, D&B may not be appropriate for certain projects. D&B is now mainly used in civil engineering projects. For building projects, it is more of Design, Development and Build. The formation of multi-disciplinary firms, as encouraged by C21, did not take off in the industry.

On strategic thrust 5, BCA has launched a number of programmes to promote exports of construction services, such as the Export Digest, Export Link Services, workshops, seminars, mission trips, and executive programmes. Singapore-based architects have done quite well abroad. Contractors have been aware of the need to go overseas, especially when there are fewer jobs in Singapore. A number of consortia have been set up to pursue projects overseas, and they have won and undertaken some works.

In terms of strategic thrust 6 on a collective championing effort, BCA actively monitored and followed up on the list of C21 recommendations. CIJC was formed in 2000 to formalise the co-operation among the key organizations in the construction industry embracing clients, various design professionals, and contractors. It comprises the Presidents of nine professional institutions and trade associations in Singapore's construction industry. Within CIJC, each institution was assigned relevant C21 initiatives to monitor progress in their implementation. BCA held quarterly meetings with CIJC to track the progress of implementation; in addition, there were many *ad hoc* meetings. Feedback sessions with the industry were also conducted. However, as found in the interviews, it is widely realised that the main limitation of CIJC is that there is no real leadership; the presidency rotates every year among the member organisations.

In summary, the adoption of a range of progressive practices in Singapore has been encouraged by C21. CORENET has been most successful. CONQUAS, buildability, and CPD programmes have also been promoted by C21. However, there were some recommendations that have not been implemented, such as codes of conduct and Construction (Design and Management) Regulations, which are working in progress. Some of the C21 initiatives and programmes have not succeeded. These include the intention to reduce the number of foreign workers in the industry, specifically the MYE scheme, maintainability study, NPQS, Construction Management System, standardization of contracts, and formation of multi-disciplinary firms.

The construction industry in Singapore continues to face new challenges. Among others, companies have to deal with rising costs of land and construction materials, and shortage of construction workers and rising wages. Owing to nthe impact of the major initiatives such as awards for performance, buildability, and CONQUAS, point-scoring system has become the main focus above all. After a decade of implementation of improvement initiatives, some underlying issues remain. Some characteristics of the industry, such as low productivity, labour intensity of work, and low-technology construction methods, remain. While commending the government for its efforts in regulating the construction market and industry, there is a sense among the industry stakeholders interviewed that there might be too many regulations. Hence, it is important to strike a balance, as too many regulations may dampen creativity. Given the limited supply of Singaporean construction workers, foreign workers are in Singapore to stay. Hence, the issue of foreign construction workers will have to be continually addressed. Finally, there is a need to strengthen the role of professional institutions and trade associations, tertiary educational institutions, and the CIJC.

CHANGE IN HONG KONG

Prior to the formation of the statutory co-ordinating body as recommended by CIRC (CIRC, 2001), the implementation of the CIRC recommendations was undertaken by an interim body, the PCICB. The process of implementing the recommendations had been held up by the unexpected delays in the formulation and promulgation of the legislation. The bill to set up the Construction Industry Council (CIC) was introduced in the Legislative Council only in 2004, while the tasks of implementation were handed over to the CIC only in 2007.

Interim reports (PCICB, 2005; ETWB, 2007) have reviewed the progress made in the implementation of the CIRC initiatives. The general perception was that there had been good progress in the implementation programmes. Nevertheless, Kumaraswamy *et al.* (2010) noted that there were areas for improvement, as found out from interviews with industry stakeholders.

Although the setting up of CIC is in the right direction towards the establishment of an institutional framework as envisaged by “Construct for Excellence” (CIRC, 2001), many believed that CIC lacks regulatory power, hence the progress in formulating and disseminating industry development initiatives was slow (Kumaraswamy *et al.*, 2010). Safety levels in construction, especially on public-sector projects, have been significantly improved. Quality levels have also been improved mainly due to the introduction of registration schemes for workers and subcontractors. Alternative procurement methods such as D&B and target cost contracts have not been as widely used as envisaged in the CIRC recommendations. There had been improvements in the development of an environmentally responsible industry, especially with the formation of the Hong Kong Green Building Council. In terms of nurturing a professional workforce, the regeneration of the workforce was identified as the key problem, as the image of the industry had made it difficult to attract new people to join the industry (Kumaraswamy *et al.*, 2010).

In summary, although the overall progress in the implementation of the CIRC recommendations in Hing Kong is satisfactory, there is room for improvement in certain areas such as improving the image of the industry, attracting new entrants to join the workforce, as well as implementing programmes in the private sector.

CHANGE IN MALAYSIA

In Malaysia, despite the decline in the volume of construction projects due to the recent global financial crisis, the construction industry remains strong and important to the national economy. However, growing dependence on foreign workers create a number of social issues such as proper treatment, discrimination, and violation.

In the future, the focus will be on the implementation of IT, green initiatives, and prefabrication. The government will continue to provide leadership in the implementation of the CIMP recommendations. It will also have to provide incentives and implement stimulus packages. The Green Building Index was launched in 2009 to assess environmental impacts of buildings and create guidelines for new building construction. The Industrialised Building System (IBS) programme will continue to be streamlined to promote prefabrication, improve productivity, and reduce the reliance on foreign workers.

As it is now five years since the CIMP was launched, a comprehensive review of the impact and effectiveness of the implementation of the initiatives under the master plan should be conducted.

SIMILARITIES AND DIFFERENCES AMONG THE FOUR COUNTRIES

Similarities and differences in the construction industry development programmes in the four countries studied can be drawn. The institutional contexts within which the reforms occurred were distinctive in each country. However, in all four countries, there were specific targets to achieve within a certain period based on specific recommendations. There was a radical tone of performance improvement in all four reports.

There are similarities in the original strategic thrusts of the four countries, as shown in Table 1. All countries studied highlighted improvements in quality and the issue of integration. While the Egan Report is more general, on this point, the last three reports (Singapore, Hong Kong, and Malaysia) are very specific and very similar in terms of structure, strategic thrusts, and recommendations, and implementation plans. Environmental performance, which was included in “Construct for Excellence” of Hong Kong and the CIMP of Malaysia, was not considered in the Egan Report of the UK and C21 of Singapore. However, the UK and Singapore have since focused on the issues. In the UK, Environmental Performance Indicators (EPIs) were launched in 2001 and sustainability has since been singled out as one of the key improvement areas (Strategic Forum, 2002, 2008). In Singapore, improving the environmental performance of the construction industry has been a major focus of the BCA over the past few years. The environmental development programme includes: making certification to environmental management system a requirement for medium-sized to large construction and consultancy firms; formulating benchmarks for assessing the environmental performance of both new and existing buildings, and infrastructure items (the Green Mark Scheme was launched in 2005); and providing funds to support R&D on the subject. The BCA has formulated two master plans for environmental performance, and the Singapore Green Building Council was set up in 2009. The regulations require buildings to meet a minimum Green Mark score before being granted building plan approval. The green building initiatives have been quite successful; they have been strongly supported in the industry, by clients, practitioners and users.

In all four countries, it was realised that many problems were deeply rooted in the construction industry; hence there was a need for a radical transformation that required a strong commitment from all stakeholders of the industry. The poor image of the industry was one of the concerns; it was considered to be making it difficult to attract new entrants to join the industry. This issue is particularly pressing in Singapore and Hong Kong which have relatively small population sizes. Other issues include low productivity, labour intensity of the work processes, as well as the diverse and fragmented structure of the industry. An “industry co-ordinating body” was proposed to lead the change programme in each country. In the UK and Hong Kong, the co-ordinating bodies were formed specifically for the reform programme. Over the years, during the implementation of the change programmes, it was apparent that the major institutions involved in it should be strengthened. In Singapore, many of the initiatives have been implemented with the support of legislation. While this has been effective, and many of the interviewees commended the government for its efforts, there was a feeling that the industry was over regulated. On the other hand, in Hong Kong, it is felt that the CIC lacks regulatory powers.

INFORMATION TECHNOLOGY

In the future, Building Information Model (BIM) will be used as a platform to facilitate the integration of knowledge in design and construction, and handing over to facilities management. BCA, together with the Industry Foundation Classes (IFC) Implementers Work Group (IIWG) of International Alliance for Interoperability (IAI), have been promoting the use of BIM.

As BCA is promoting green buildings, BIM facilitates the design of such buildings. For instance, designers are able to perform energy data analysis and to determine how “green” their virtual building models are. From there, they can explore ways to improve the building’s energy consumption. BIM can also simulate the amount of daylight during different times of the day, month and year. This allows architects, engineers and builders to experiment with different sun-shading features that can be integrated into a building’s design.

To encourage the adoption of this technology, BCA introduced a pilot project for the electronic submission of building plans. More than 10 architecture sites were involved in this pilot, and their live projects were submitted to various regulatory agencies, including BCA. The feedback from both the industry and various agencies was positive. With the success of the pilot project, the various agencies are now ready to receive and process architectural submissions created using BIM from the industry starting January 2010 (BCA, 2009).

CONCLUDING REMARKS

The four countries reviewed

In all the four countries reviewed, there is a general agreement that the involvement of the various stakeholders of the construction industries is of paramount importance in order to make reform happen. The general view is that progress has been made, but much more remains to be done; the degree of progression has not been as much as had been expected. Some of the underlying issues remain.

One decade after the publication of the reports, there were some questions among respondents in the study on whether the programmes are still relevant to answer today’s challenges. However, construction industries of the four countries reviewed have been keeping in touch with ongoing developments; for example, in Singapore, there has been a focus on through continuous improvement in IT applications, and in the area of sustainability which was neither mentioned nor envisaged in the C21 report.

The results obtained from the study so far also show that it is important to better understand the different institutional contexts shaping the changes in the construction industry in each country. At the same time, lessons learned from other countries will be useful for formulating strategies and recommendations for actions in other nations, so long as the specific initiatives are shaped with due recognition of the local contextual dynamics.

Table 1 Visions and strategic thrusts for the construction industries in the UK, Singapore, Hong Kong, and Malaysia (in chronological order)

United Kingdom Egan Report (1998)	**Singapore** Construction 21 (1999)	**Hong Kong** (Construct for Excellence (2001)	**Malaysia** Construction Industry Master Plan Malaysia 2006-2015 (2007)
VISION: "A modern construction industry (the need for a new way of working, such as lean production, standardisation, partnering)."	VISION: "To be a world class builder in the knowledge age."	VISION: "An integrated construction industry that is capable of continuous improvement towards excellence in a market-driven environment."	VISION: "A world-class, innovative, and knowledgeable global solution provider."
KEY DRIVERS OF CHANGE: Committed leadership. A focus on the customer. A commitment to people.	STRATEGIC THRUSTS: Enhancing professionalism of industry. Raising the skills level.	STRATEGIC THRUSTS: Nurturing professional workforce.	STRATEGIC THRUSTS: Develop human resource capabilities and capacities in the construction industry. Strengthen the construction industry image. Leverage on information and communication technology in the construction industry.
A quality driven agenda.	Improving industry practices and techniques.	Fostering a quality culture. Improving safety and environmental performance.	Strive for the highest standard of quality, occupational safety and health and environmental practices.
Integrated processes and teams.	Adopting an integrated approach to construction.	Achieving value in construction procurement.	Integrate the construction industry value chain to enhance productivity and efficiency.
		Developing an efficient, innovative, productive industry.	Innovate through research and development and adopt new construction methods.
	Developing an external wing.		Benefit from globalisation including the export of construction products and services.
	Collective championing effort for construction industry.	Devising a new institutional framework to drive the industry. Implementation of a change programme for industry.	

Other construction industry development programmes

Construction industry development programmes are being implemented in countries at all levels of development. These include the Netherlands, Sweden and the United States, as well as South Africa and Rwanda. Much has been achieved in most cases, but more remains to be done. The study discussed in this paper underscores the importance of country specificity. It shows that understanding of the economic, social and administrative context is key to progress in these efforts. Thus, care should be taken in seeking to replicate what has worked in one country in one's own nation. Another issue is the need for appropriate institutional frameworks, and for the involvement of all key stakeholders in the programme formulation and implementation efforts. Finally, whereas this is beyond the scope of this study, there is potential benefit in requinal inter-national collaboration in tackling common issues.

International collaboration

The study also shows that researchers, both as individual and groups have much to contribute in the effort to formulate effective construction industry development programmes. For example, such research can explore the likely institutional and contextual constraints and problems, and propose possible solutions. Thus, researchers constitute an important resource, especially in the developing countries. There is even greater value in international collaboration on industry development. WABER provides an excellent forum to facilitate the identification of research subjects of common interest, the formulation of common research frameworks and methods, and in the comparison of findings and potentially useful programmes.

ACKNOWLEDGEMENTS

The authors gratefully acknowledge the funding received from the National University of Singapore Research Fund. We are also grateful to our research partners in Hong Kong and the UK, in particular, the Principal Investigators, Professor Stuart Green and Professor Mohan Kumaraswamy respectively.

REFERENCES

Building and Construction Authority (2009). Media Release: Educating Singaporeans to be savvy in green buildings. BCA; Singapore.

Constructing Excellence (2009) Never Waste a Good Crisis. London.

Construction 21 Steering Committee (1999) Reinventing Construction. Ministry of Manpower and Ministry of National Development; Singapore.

Construction Industry Development Board (2007) Construction Industry Master Plan Malaysia 2006-2015. CIDB; Malaysia.

Construction Industry Review Committee (2001) Construct for Excellence. HKSAR Government; Hong Kong.

Egan, J. (1998) Rethinking Construction. DETR; London.

Environment Transport & Works Bureau (2007) Overall review of implementation of construction industry review committee recommendations. [internet] Hong Kong: ETWB. Retrieved from http://www.legco.gov.hk/yr06-07/english/panels/plw/papers/plw0724cb1-2148-2-e.pdf [Accessed 13 September 2010].

Green, S. D., Larsen, G. D. and Kao, C. C. (2008) "Competitive strategy revisited: contested concepts and dynamic capabilities" Construction Management and Economics, Vol. 26, No 1, pp.63-78. doi: 10.1080/01446190701656174

Gan, K. Y. (2008) Speech by Mr Gan Kim Yong, Acting Minister for Manpower at the WSH Council 2008 Construction CEO Summit, 18 November. [internet] Singapore: MOM. Retrieved from http://www.mom.gov.sg/publish/momportal/en/press_room/mom_speeches/2008/speech_by_mr_gan_kim.print.html?Status=1 [Accessed 28 July 2009].

Joint MND-MOM Review Committee (2005) Report of the Joint MND-MOM Review Committee on Construction Safety. [internet] Singapore: MOM. Retrieved from http://www.mom.gov.sg/publish/etc/medialib/mom_library/corporate/files.Par.53281.File.dat/MNDMOM_Constr_Safety_Report16Mayfinal1.pdf [Accessed 28 July 2009].

Kumaraswamy, M., Ofori, G., Mahesh, G., Teo, E., Tjandra, I., and Wong, K. (2010) Construction Industry Improvement Initiatives: Are We Really Translating Rhetoric into Reality? In R. Rameezdeen, S. Senaratne and Y.G. Sandanayake (Eds.), Proceedings of International Research Conference on Sustainability in Built Environment, Colombo, Sri Lanka, 18 & 19 June, ISBN: 978-955-9027-33-1 (pp.116-125). BEMRU, University of Moratuwa; Colombo.

Ministry of Trade and Industry (2010) 2010 GDP Growth Forecast Maintained at 13.0 to 15.0 Per Cent. [internet] Singapore: MTI (Published 2010) Retrieved from http://app.mti.gov.sg/data/ article/22542/doc/ESS_2Q10__PressRelease.pdf. [Accessed 16 September 2010].

Provisional Construction Industry Coordination Board (2005) Progress report on implementation of recommendations of the construction industry review committee. [internet] Hong Kong: CIC (Published 2005) Retrieved from http://pcicb-archive.hkcic.org/eng/progress/download/p-PCICB-142.e.pdft. [Accessed 13 September 2010].

Strategic Forum for Construction (2002) Accelerating Change. Rethinking Construction; London.

Strategic Forum for Construction (2008) Construction Commitments. Rethinking Construction; London.

Workplace Safety and Health Council (2010) Implementing WSH 2018 for Construction Sector in Singapore: Towards a Progressive and Pervasive Safety and Health Culture. WSH Council; Singapore.

BUILT ENVIRONMENT RESEARCH IN WEST AFRICA: CURRENT TRENDS AND FUTURE DIRECTIONS

Dr Roine Leiringer[1]

Dept. of Civil and Environmental Engineering, Chalmers University of Technology, Gothenburg, SE-41296 Sweden

The countries in West Africa (WA) are pushing for socio-economic development. It is evident that the construction sector has an important part to play in helping to realise this goal. It is equally evident that this necessitates an increased emphasis on research in the built environment in order to develop the necessary capacity, capabilities, knowledge and technologies for the sector. Such research work is not trivial and is liable to be highly context driven. It is therefore of interest to look into what kind of problems WA researchers are working on and the means and methods that they draw upon. Or put slightly differently, does the research that is undertaken match the socio-economic aspirations of countries in the region and is it aligned with international research endeavours and our current common knowledge? It is also of interest to look at how the research is carried out. Are the research methods used appropriate and adequate for the research problem at hand?

The West Africa Built Environment Research (WABER) conference was initiated in 2008. The objective is to provide a vehicle for the development of built environment research in WA through giving young researchers and early-career scholars an outlet for their research work; and to supply a platform for networking and collaboration among more senior academics. Two conferences have so far been organised, in 2009 and 2010, bringing together 180 academics, researchers and practitioners from the WA region. These delegates represent more than 30 universities/polytechnics, as well as a multitude of other research institutions.

This presentation draws on content analysis of the papers in the proceedings of these two conferences: 2008 (25) and 2009 (55), as well as those published in this current 2011 conference. These 170+ research papers provide a window into current research priorities and trends and, thus, offer an opportunity to understand the kinds of research work undertaken by built environment researchers in West Africa. They also provide an opportunity to further look into the how research is commonly undertaken.

Several conclusions are drawn from this content analysis exercise, including: 1) the two most common problem areas are ‘Physical infrastructure and environment’ and ‘Economics and construction industry development’. More than half of the published papers deal with issues within these two domains. 2) In more than 2/3s of the papers the problem formulation is given at a national level. Very few papers take a local, regional or international perspective. 3) There is a stark overrepresentation of survey studies relying on questionnaires for data collection. There are four times as many papers using surveys as there are of any other research method. 4) In a significant number of cases the chosen research method is not suitable for the problem under investigation.

[1] Roine.leiringer@chalmers.se

Leiringer, R. (2011) Built environment research in West Africa: current trends and future directions *In:* Laryea, S., Leiringer, R. and Hughes, W. (Eds) *Procs West Africa Built Environment Research (WABER) Conference*, 19-21 July 2011, Accra, Ghana, 17-18.

The findings lay bare some of the many challenges that are faced by academics in WA. It is clear that WA research by necessity is extremely problem driven. An apparent downside of the heavy focus on current practice is that the research in many cases takes the form of consultancy work. As such, the outputs are at times both valid and important however the impact is local and predominantly short term. There is, therefore, a need to look into how research problems can be formulated and appropriate research methods be used, so that knowledge can be created and distributed, thus providing a foundation for a more long term impact. The presentation ends with a couple of suggestions for alternative directions for future research and development work.

DATA COLLECTION AND ANALYSIS: WHAT IS DATA, HOW DO YOU COLLECT IT, AND HOW DO YOU ANALYSE IT?

Dr Chris Harty[1]
School of Construction Management and Engineering, University of Reading, UK

Good data collection and analysis form the keystones of good research, whether for a PhD or 10 year research project! This practical session will begin with a brief overview of approaches to data collection and analysis, with an emphasis on practical issues of data collection strategies, access and ethics, managing data sets and producing analyses which are consistent with the methodologies and theoretical frameworks employed.

The main part of the session will be a Q&A, where we will look at participants particular issues around data collection and analysis strategies and processes. What sort of data should we collect for a particular research problem or focus? How do we go about negotiating access or managing ethical and IP issues? How might we structure data sets or how should we represent data within thesis or papers? Any issues you might have be encountering as you do your research, please bring them along!

[1] c.f.harty@reading.ac.uk

Harty, C. (2011) Data collection and analysis: what is data, how do you collect it, and how do you analyse it? *In:* Laryea, S., Leiringer, R. and Hughes, W. (Eds) *Procs West Africa Built Environment Research (WABER) Conference*, 27-28 July 2010, Accra, Ghana, 19.

SECTION 2: CONFERENCE PAPERS

A COMPARATIVE ANALYSIS OF CLIENTS' AND CONSULTANTS' PERSPECTIVE OF CONSTRUCTION PROJECT PERFORMANCE

William Gyadu-Asiedu[1]
Sunyani Polytechnic, P.O.Box 206, Sunyani, BA Region, Ghana

The true state of construction projects at any stage in its life cycle has often been a source of disagreement between clients and their consultants leading to several disputes. This is due to the fact that consultants have always defined the performance of a project using their own perspective models which do not always meet clients' expectations. In recent times, construction project clients have become more involved in their projects, ensuring best practice and even, sustainability. Clients, thus, have their own perspective of project performance which needs to be considered in any assessment model in order to meet their satisfaction. Using interviews and multiple surveys, the study identified the key measures that defined the project performance in the perspectives of clients and consultants in Ghana. These were found to be fundamentally different, both in content and in focus. It then combined the two perspectives into a "shared perspective" and tested it on the individual stakeholders. The research also showed that given the same criteria, clients and consultants placed relatively similar emphasis on the same criterion; predicting a common direction with marginal dissimilarity. This pointed to the conclusion that the real differences that exist between clients and consultants is basically due to the different perspectives used by the two stakeholders in assessing project performance. Hence the study recommends that for effective assessment of construction project, a framework of the "shared perspective" representing both perspectives should be used.

Key words: client, consultant, Ghana, performance.

INTRODUCTION

Undesirable project performance results have been noted as a major hindrance to the development and growth of construction industries of several countries. Identified in various forms as low productivity, delays, cost overrun, poor quality and so on, poor project performance has been noted as the bane of construction industries of several countries, particularly, developing countries (Mutijwaa and Rwelamila, 2007; Le-Hoai et al., 2008). These have put an unimaginable stress on project execution relationships resulting in suspicion, mistrust, accusations and counter accusations between the key partners on a project in an industry that is supposed to thrive on healthy relationships. Another dimension to the disagreement bothers not only on the poor levels of project execution but also on the reportage of the true state of projects to clients and in a way that will properly inform them. This lack of accurate and timely information from consultants to sponsors of projects has given room for disagreements between the two, and, sometimes, causing the latter to lose confidence in the former (Gyadu-Asiedu, 2009, pp.). These define the conflicts that usually exist between clients and

[1] willgyas@yahoo.com

Gyadu-Asiedu, W. (2011) A comparative analysis of clients' and consultants' perspective of construction project performance *In:* Laryea, S., Leiringer, R. and Hughes, W. (Eds) *Procs West Africa Built Environment Research (WABER) Conference,* 19-21 July 2011, Accra, Ghana, 23-36.

consultants. The research, thus, focused on identifying what represents clients' views on a project performance and how they wish it to be assessed. These results are then compared with those of the consultants to determine the gap that influences the disputes and disagreements between the two stakeholders. Subsequently, this is expected to inform the design of a tool for performance measurement and management to ensure that projects achieve the purpose for which they are being implemented.

CLIENTS' PERSPECTIVE, NOT MERELY SATISFACTION

A major problem in project assessment is that most of the performance measurement models discussed in literature relating to clients or customers refer only to client satisfaction, customer satisfaction or end-user satisfaction (Freeman & Beale, 1992; Lim and Mohammed, 1999; Atkinson, 1999; Sadeh et al., 2000; Chan and Cahan, 2004; Patankul and Milosevic, 2009). Some of these measures include: *cost, time, quality, client's (or customer's) satisfaction, contribution to business, financial and commercial success, environmental Impact, benefits to defence and national infrastructure, project execution efficiency, benefit to end user, technical innovation, future perspective, personal growth,* etc. Such measures render clients' role in the project execution rather passive. This state of affairs does not move in tandem with recent developments in construction where the client is seen as initiator of improvement, innovation and sustainable construction.

For example, the relative important role played by clients in the implementation process of projects has been well acknowledged (Bennet et al., 1988; Latham, 1994; Yisa et al., 1996). The performance of the project throughout the phases is, to a large extent, a function of the client's disposition towards it. This is because the client may in the course of the project (a) ensure consistent funding (a) delay funding (c) divert funding or (d) stop funding altogether, causing delay or abandonment of the project. In other cases, the client could have inconsistent and erratic wishes, authorizing variations here and there throughout the project's life to the great frustration of consultants, the project manager and the contractor. The appointment of a consultant and, subsequently, a contractor is thus by no means a foregone conclusion.

With regard to the improvements required in the industry, Latham (1994 p4) emphasised the need of the government as a client to "deliberately set out to use their spending power…… to assist the productivity and competitiveness of the industry, in addition to obtaining value for money generally in the long term". In addition, he proposes that a government department "should take the lead to ensure best practice and drive for improvements are implemented throughout the public sector...", and also, that leading clients "have a substantial role to play in setting demanding standards and insisting upon improvements". " Ultimately", he continued, "they have the most to gain from ensuring the implementation of best practice". Yisa et al. (1996) note that public clients are gaining more autonomy in project execution and are placing emphasis on *speed*, *value-based services* and *cost-time-quality* performance for a particular project. This implies that clients are also concerned about development satisfaction, not completion or use satisfaction alone. This indicates that their involvement in the building process is increasing.

If such roles are attributable to the modern client, it calls for a project assessment criteria that goes beyond a mere *client satisfaction* as is being considered –it requires the assessment of a *whole perspective* of the client of project performance as represented by a number of criteria and indicators. In other words, client satisfaction, if it will have to be considered, should be a declaration by clients after they have considered the achievements of all the criteria and indicators that represent their perspective of project performance at the appropriate stage of the project; not by practitioners or consultants.

Another reason for having a special focus on clients in assessing project performance has to do with the different types of clients existing in the construction industry. For example, Melville and Gordon, (1983 pp 8-16) identified six kinds of clients. These are: (i) the individual client *(ii)* the committee cli*ent*: *For example*, *sports clubs, tenants associations*, *charitable or religious organisations*; (iii) the company client: *the Lay and the Informed or Expert*; (iv) the local authority client, acting for and on behalf of the government; (v) the central government: *Most of the capital investments in a developing country are undertaken by the central government* (Ofori, 1999 &2001); and (vi) nationalised institutions of the government. In another research, Mbachu (2003) categorises clients into two broad bases. One is based on "characteristics of the client system": *nature of organisational entity, source of project finance, construction industry experience, level of knowledge of the construction industry, frequency of project development, complexity of client organisation, type of business activities, purpose group of buildings mostly procured* and *procurement interests*. He grouped these into three distinct classification based on the nature of clients: public, individual (Private), and corporation clients. The second one is "needs-based categorisation of clients": similarity of overall needs preferences and development needs preferences. Mbachu (2003) notes two categorisation of clients' needs: non-observable (latent) and observable (stated and non-stated but expected) needs (Mbachu, 2003 pp 38-40). From the foregoing, the modern client in the construction industry could be identified according to which of the parameters is applicable to them. This goes to prove that all clients are not to be treated the same way regarding what gives them satisfaction: a client is not just a client. Figure 1 provides a proposed synthesised model by which clients in the industry could be identified according to their needs and characteristics. By this model it is also possible to appreciate that the type of client could be categorised differently based on the present needs and characteristics. The obvious differences that distinguish one from the other inevitably will lead to each of them having a peculiar way of looking at project performance, have different expectations, and hence a different perspective. Identifying this perspectives and meeting the specific expectations is what can account for their true satisfaction. The foregoing illustrates that the assessment of clients' satisfaction as a criterion is simply inadequate in reflecting their true needs, expectation and functionality. Supporting this view, Ryd (2004) pointed out that a "good understanding of the 'client's situation'" –"which demands effective means of working within the construction and management processes" –is the "basis for being able to satisfy the needs of the client". Hence Hill et al. (2007) propose the creation of a "shared mind" or "shared vision". Applying this concept will create a single model in which both the perspectives of the now "active-client" and the consultants will be represented to ensure a better assessment of the performance of the project to facilitate comprehensive project management and real client satisfaction.

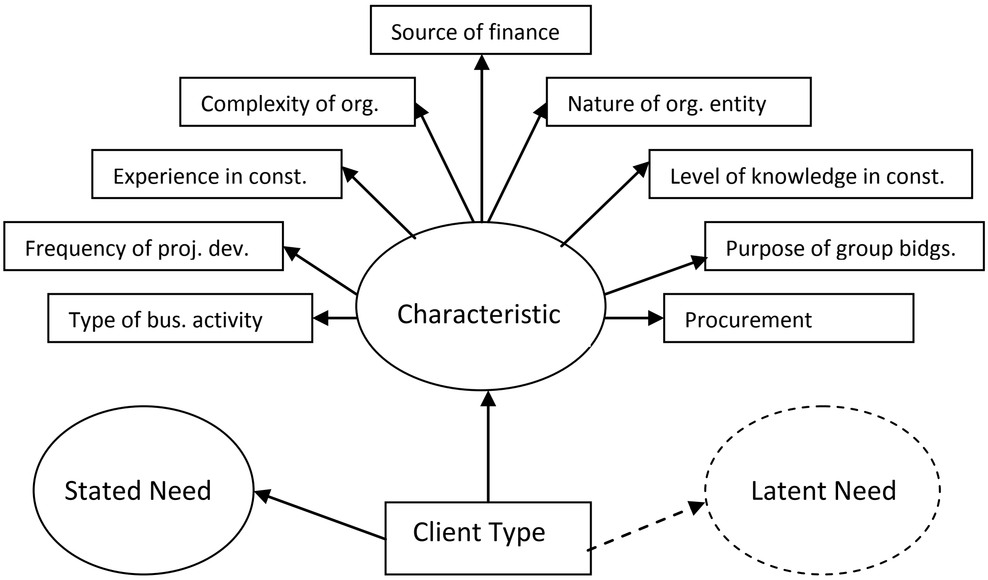


Fig. 1 A Model for Identification of clients according to Needs and Characteristics (Based on Melville and Gordon, 1983; Mbachu, 2003)

METHOD

The study used three-staged sequential mixed methods to develop criteria of project performance which represent the perspective of stakeholders (clients and consultants) of project performance.

Clients' Research

Clients' research began with an interview of eight major Government clients –the main focus of the study –in order to obtain key themes and subsequently, statement that indicated what constitute their expectations from their consultants as well as their projects. Key themes identified in the interview were used as basis to design the pilot survey. The pilot survey followed the framework of Mbachu's (2003) questionnaires in which four types of clients were targeted (Government client, Investors, Real Estate Developers and Owner Occupiers). The main purse of this survey was to determine the extent to which private clients (Owner Occupiers, Investors and Real Estate Developers on one hand) and Public Clients on the other hand agreed on the measures (key indicators and sub-indicators).This was followed by the first main survey which analysis resulted in identifying measures of assessment. These were qualitatively filtered and clustered (Gyadu-Asiedu, 2009) to arrive at measures and sub-measures that were used in the final surveys. The second and final main survey focused only on government clients and was meant to establish a relationship between (1) the dimensions and their indicators and (2) the indicators and their sub-indicators in a way that would be usable in assessment. The various measures within a relationship were weighted to show their level of influence among the set.

Sampling for clients' research

Purposive deliberate sampling was used to select 8 interviewees from 4 central government agencies (ministries): 2 Metropolitan assemblies; 1 district assembly and one department for the interview. In the first survey, 5 central government agencies (Ministries) were sampled out of 10, 70 assemblies were sampled out 138; 5 Nationalised institutions out of 10, 11 company clients were selected out 52 financial institution who are also construction clients; 20 out of 61 registered Real Estate developers and 15 private individual clients with additional 5 owner occupiers. A total sample size of 131 + 10% = 144 was selected.

In the final survey, only the government agencies were selected for the survey: 70 + 5 + 5 = 80. In addition, consultants participated in clients' survey. Based on resource constraints, and because more than 80% of the practising professionals are based in the capital (Accra) and to a smaller extent, the next biggest city (Kumasi), the survey population for the research was mainly restricted to these cities with additions from three other capital towns (Takoradi, Cape Coast, Koforidua and Sunyani), that is, six out of the 10 regions.

Practitioners Research

In the case of consultants or practitioners research, three consecutive surveys were undertaken to identify, filter and cluster the main measures and sub-measures that could be used to assess project performance. In the first survey, performance measures as obtained from literature formed the basis of the questionnaires. The purpose was to find out from consultant the relevance of the measures in Ghana. Respondents were also asked, in the process, to provide other measures which they knew were relevant in Ghana but were not captured in literature. Together these formed the basis of the second survey which was meant to confirm the identified measures in the first survey. After the second survey, an experts' workshop was organised to discuss and validate the identified measures. For the purposes of the workshop, one qualified as an 'expert' when one was a professional structural engineer, quantity surveyor, project manager or architect, which meant that they belong to the respective recognised institutions in Ghana and have been in good standing for not less than three years at the time of the workshop. The results from the workshop were filtered and clustered into measurable items. For both clients and practitioners penultimate surveys, filtering and clustering of measured were assessed against the following range of qualities (DTRL (2001, p. 29): *redundancy* (necessary and important ones*), operationality (*clearly defined enough for assessment), *size,* and *mutual independence of preference* –It is required in multi-criteria analysis (MCA) that criteria and what they measure must be independent of each other. This condition must be met if the sum of weighted averages is to be used to combine preference scores across criteria. It means that whenever two criteria are closely related that they are not preference independent of each other, they should be combined into a single criterion, which captures the common dimension of their value. The same is true of the indicators.

The final survey for the practitioners was done to establish an equation relating the sub-measures to their specific main measures just like that of clients.

For purposes of comparison between the perspectives of the two stakeholders which is the essence of this research, the criteria that defines clients needs/motivation was merged with the criteria defining project performance in practitioners' perspective to form a "shared perspective" and the two stakeholders were asked to rate them according to their level of influence. The results of the analysis threw more light on the issue of disagreements between the two stakeholders and whether or not these disagreements are warranted.

Sampling for practitioners' research

Table 1 show the approaches used in the entire data collection. Tables 2 and 3 show the details of clients' and practitioners' research and data collection methods .

Table 1 Approaches used in the data collection

Phases	Sampling Approach	Data Collection approach	Data analysis	Analysis and use of findings	Priority
1	Purposive deliberate	Interview, [Open-ended questions]	Qualitative	Noticing, coding, themes	Qualitative
2	*Random, Purposive deliberate* [for public client, Real estate developers], *snowballing* [for investors and owner occupiers]	Intra-method mixing, [closed- and opened-ended questions for both private and public clients]	Both qualitative and quantitative data analysis	i. Private and public results compared. ii. public clients findings documented	i. Public client results integrated with clients measures (needs/motivations) from practitioners' survey 1 ii. Cluster measures for survey 2
3	Random, Purposive deliberate	quantitative	quantitative	Results as findings	quantitative

Table 2 Client's Research Methods and data collections

Research phases	Client's Investigation		Practitioners' Investigation	
	Strategy	instrument	Strategy	instrument
One	Qualitative (interview)	Semi-structured questions	Intra-method mixing (QUAN, qual)	open- and closed-ended questionnaires
Two	Intra-method mixing (QUAN, qual)	open- and closed-ended questionnaires	Intra-method mixing (QUAN, qual)	open- and closed-ended questionnaires
Three	Quantitative	closed-ended questionnaires	Quantitative	closed-ended questionnaires

A total population of the focused groups was obtained from the professional bodies. 224 firms were isolated from 2036 registered professionals (as at 1996) comprising 223 Quantity Surveyors (45 firms), 254 Architects (130 firms), and 1829 Engineers (31 firms). From the list of engineers only the structural engineers were considered and 31 firms were identified. Because two state firms have branches in all the 10 regions, the total number of firms was increased to 244 out of which 157 were randomly sampled for all the research. In the second survey, 145 were reached with the questionnaire. For the practitioners' workshop, purposive deliberate sampling was used to select 40 experts. respectively.

Key: QUAN = Quantitative; qual = Qualitative; Capitalisation shows the predominant approach in the mix.

FINDINGS

Table 3 Practitioners' Research Methods and data collections

Phases	Sampling Approach	Data Collection approach	Data analysis	Analysis and use of findings	Priority
1	Stratified random, Purposive deliberate, opportunity and snowballing	Intra-method mixing [closed- and opened-ended questions]	Both qualitative and quantitative data analysis	Integrate both the results into a questionnaire for next phase	quantitative
2 a.	Stratified random, Purposive deliberate, opportunity and snowballing	Intra-method mixing [closed- and opened-ended questions]	Both qualitative and quantitative data analysis	i. Integrate all the three results and cluster them into a questionnaire, for next phase. ii. separate clients' perspective measures for clients' questionnaire for survey 1	Both quantitative and qualitative
2 b	Stratified random, Purposive deliberate, opportunity and snowballing	Focus, [experts' workshop]	qualitative		
3	Purposive deliberate, opportunity and snowballing	quantitative	quantitative	Results as findings	quantitative

Clients' Perspective

Two main dimensions were identified as representing clients' interest, satisfaction criteria and hence their perspective of project performance:

(1) N*eeds/Motivation (N/M)* and (ii) *Expectations from service providers (ESP).* These are each defined by criteria and indicators which may vary from client to client and over time. We conclude that it is simply inappropriate and a gross underestimation to refer to any one indicator among the rest as "clients' satisfaction" as has often been the case in literature. Clients have "perspectives" of projects, which must be identified and satisfied by their employees. This will be the true measure of clients' satisfaction. Practically, this could be used when assessing construction project performance in the Ghanaian construction industry. Focusing on the government clients, N/M is defined by *contribution to good governance (CGG), contribution to national infrastructure (CNI)* and *addressing future infrastructural needs (AFIN).* Without prejudice to other possibilities, this research limited the service providers to *Project Managers/Consultant (PM/C), Architects (ARCH), Quantity Surveyors (QS), Consulting Engineers (CE) and Contractors (Con).* Others may be roped in while existing ones may be removed according to the demands of the project. Together with their needs/motivation of undertaking project, clients' expectations from these service providers must also be fully met for them to be satisfied. The equations below show the relationship between dimensions and criteria describing clients' perspective. Because the weightings of each set of sub-measures that define the main measure add up to 100%, the analysis of the survey results established the following relationship between them. In addition, clients' position, based on interview, was that they expect 100% performance from every service provider hence equal weighting is given them, distributed according to their number (equation 2).

N/M = 32.1CGG$_1$ + 37.9CNI + 30AFIN…………………………………1

ESP = 2.0 ARCH +2.0 QS +2.0 SE + 2.0PM/C + 2.0 Con........................2

These are represented in the Figures 2 and 3 below.

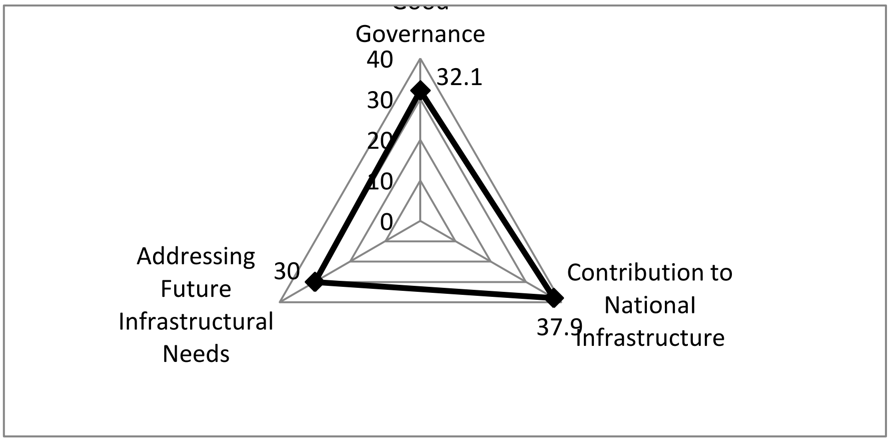


Fig. 2 Clients' Model of their Needs/Motivation Criteria.

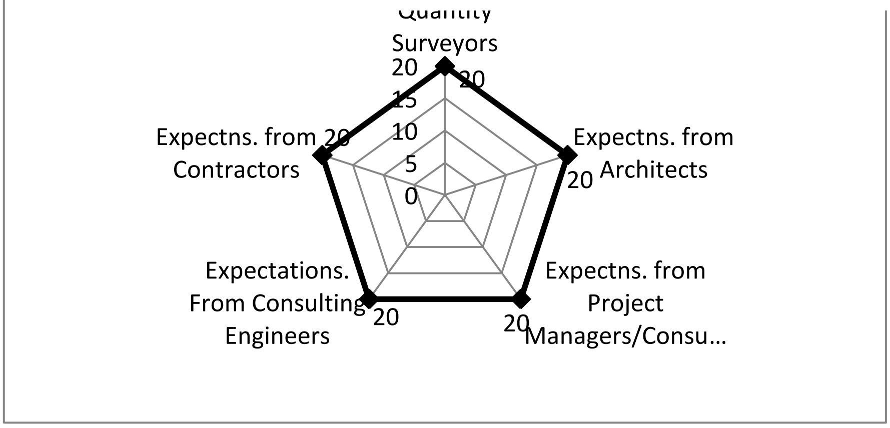


Fig. 3 Clients' Model of the five criteria that represent their expectations from service providers. [NB: Equal weightings for all show that clients expect nothing less than 100% from each service provider].

Practitioners' Perspective

Analysed results from the practitioners' responses represent the weightings for each of the measures and sub-measures. Together they represent the models of practitioners' perspective of project performance. Equation 3 describes practitioners' perspective model.

PP = 26.2C + 18.5T + 20.1Q + 14.9MEE + 10.2EI + 9.8SI …...........................3

This describes the relationships between Project Performance (PP) and the criteria by which they could be assessed. The relationship shows that in assessing *project performance* (PP) in the perspective of practitioners, *cost* (C) must be given the highest priority with 26.2%, followed by *quality* (Q): 20.1%, then *time* (T): 18.5%, *management and execution efficiency* (MEE): 14.9%, *environment impact* (EI): 10.2% and *social impact* (SI): 9.8%. This relationship provides information as to which criterion is playing what role at any level of project performance at any stage of the assessment. Each of the six criteria is also measurable by their respective indicators as shown in equations 3.1 to 3.6

C = 12.8 ESC +20.3MC + 9LC + 10.5IC + 22.2FC + 25.2TCO …......................................3.1
T = 20.6TVC+ 30.1TP + 13.9IT + 35.4TW……………………………..........................3.2
Q = 15.2R+ 21.5MTR + 17.5STR + 28.2E/AR + 17.7V...3.3
MEE = 16.2DMP + 15.6CR + 21.4EPT + 19.2SCON + 14IAW + 13.7SM..........................3.4
EI= 27.6IE + 21.1NEE + 19.9NRI + 31.3DC...3.5
SI = 33.5NPA+ 35.4NSCA + 30.8TRA..3.6
Where,

i. Cost (C) has the following indicators: [*environmental and social cost (ESC), managerial cost (MC), legal cost (LC), incidental cost (IC), fluctuation cost FC) and total cost overrun (TCO)*]

ii. Time (T) has following indicators :[*time of variation and certification (TVC), time of payment of certified works (TP), incidental time (IT), time of completion of major works (TW)*]

iii. Quality (Q) has the following indicators: [*reworks (number /extent) (R), material tests records (MTR), service test records (STR), Engineer's/Architect's approval/disapproval (E/AR), variation (number/extent) (V)*]

iv. Management and Execution Efficiency : (MEE) has the following indicators [*decision making process (DMP), communication and reports (CR), efficiency of project team (EPT), supervision of contractor (SCON), inspection and approval of works (IAW), site meeting regularity (SM)*]

v. Environmental Impact (EI) has the following : [*investments on environmental issues (IE), number of employees with environmental tasks (NEE), number of reported incidents (NEE), degree of compliance (DE)*] and

vi. Social Impact (SI) has the following indicators : [*number of populations affected (NPA), number and types of community and institutional structures affected (NSCA), type of community/social resources affected (TRA)*]

Equation (3) is depicted in the Polygon below (Figure 4).

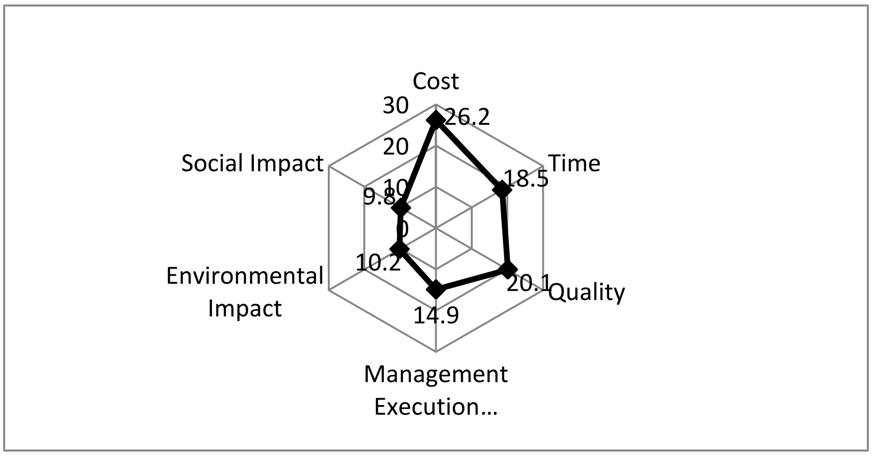


Fig. 4 A Model of Practitioners' Perspective.

The Shared Perspective

The last part of the analysis yielded the results of the shared perspective (i.e. a combination of the two perspectives): (1) clients' model on the shared perspective (2) practitioners model on the shared perspective, and (3) the combined model (clients' and practitioners') of the shared perspective as shown in equations 4, 5 and 6; and Figures 5, 6 and 7. Figure 8 depicts the superimposition of the two polygons representing the individual models on the shared perspective for further highlights on the comparison.

i. Clients' Model of the Shared Perspective

PP = 17.6Cost + 11.4T + 18.3Q + 7.6EI + 10.3SI + 11.7MEE + 11.6 ESP + 11.5N/M.......4

ii. Practitioners' Model of the Shared Perspective

PP = 18.1Cost + 14.3T + 16.4Q + 8.4EI + 8.5SI + 11.4MEE + 9.6 ESP + 12.9N/M..........5

iii. Combined Model of the Shared Perspective

PP = 17.9C + 13.2T + 17.2Q + 8.1EI + 9.2SI + 11.5MEE + 10.4ESP + 12.4N/M…..........6

The corresponding "polygons" are shown below:

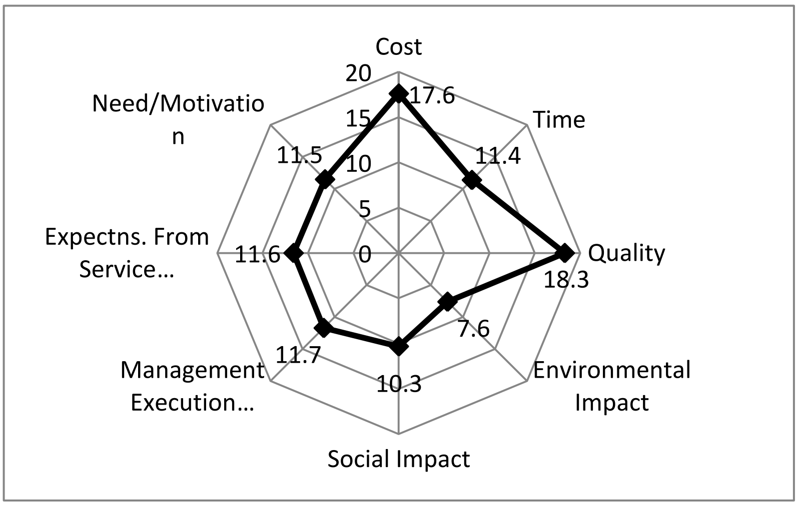


Fig. 5 A Model of the eight combined criteria in Clients' Separate view.

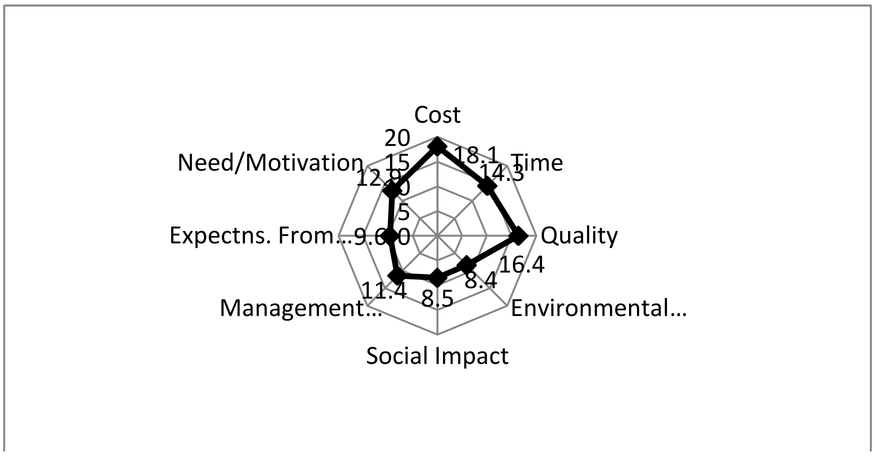


Fig. 6 A Model of the eight combined criteria in Practitioners' Separate View

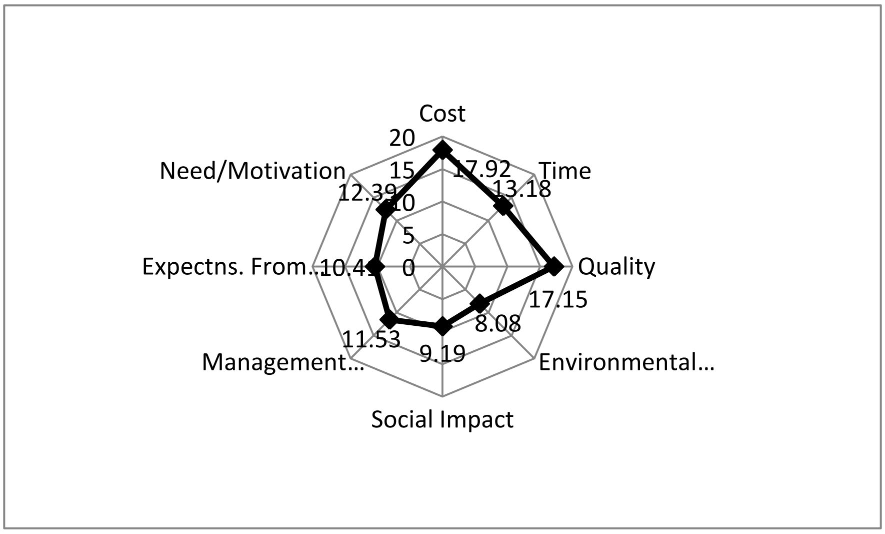


Fig. 7 A Model of the 'Shared Perspective' of construction project performance.

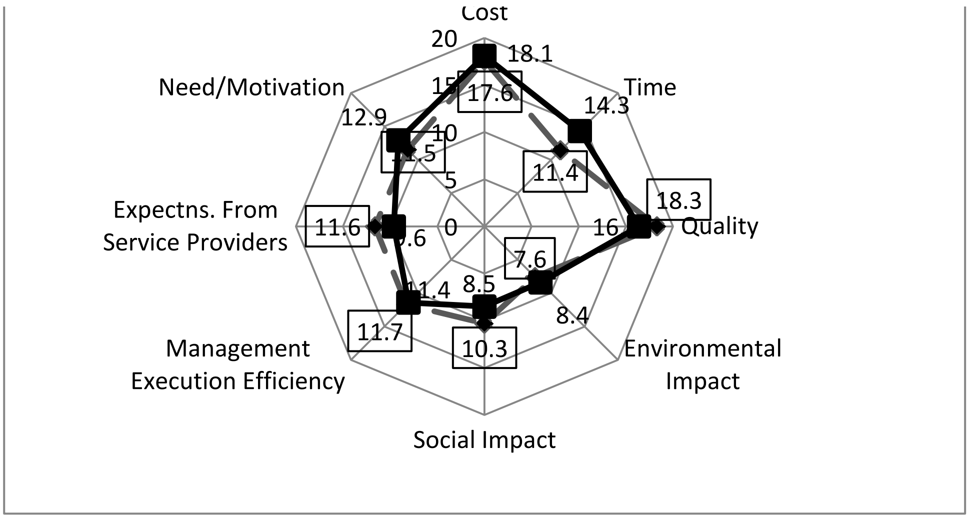


Fig.8 Comparison of Clients' and Practitioners' ratings of the eight main criteria
[NB: Dark-continuous colour line represents practitioners' rating; Light-broken colour line represents client's rating.]

DISCUSSIONS: HIGHLIGHTING THE "PERFORMANCE POLYGONS"

The analyses of the two surveys have resulted in the perspectives in which practitioners on one hand, and clients on the other, wish to assess the performance of construction projects in Ghana. They believe that in assessing project performance with the identified criteria and indicators, they attach different import to each of them according to the demands of the project, the expectations of the clients and other contingency factors. This is the essence of attaching weightings to these measures.

The weightings attached represent the averages of what importance the stakeholders attach to each criterion based on their experiences. The findings have shown that project performance (and particularly in construction) should be assessed with multi-criteria and multi-indicators with varying weightings to reflect the project's needs. Consequently, this research agrees with Atkinson (1999) that the assessment of a construction project performance should be considered in excess of the iron triangle of *cost, time* and *quality*. Working within the contingency theory as applied to the project situation, this research also notes that in the special case of construction projects the term 'multidimensional' as used to describe 'multi-criteria' is not limited to the 'numbers' of the "measures" used. Its meaning should extend to cover the number of changes these set of criteria and indicators can undergo due to the peculiarity of the needs of the project. In other words, the set of multi-measures used to assess construction project performance have the degree of freedom to undergo a number of changes contingent on the project's needs including, but not limited to:

i. Changes in weightings attached to the criteria and indicators according to their relative importance in the present project;

ii. Changes in the number of criteria and indicators that are necessary to define a criterion, in other words, a change in an aspect of the definition of a criterion (by extension or reduction in the sub-measures);

iii. Changes across the project life cycle.

Therefore, this research likens the multidimensional, multi-criteria nature of these assessment measures to *"an irregular polygon with 'kn' degrees of freedom"* where in this model, the degrees of freedom is determined by managerial decisions and include the freedom of the model to be "adapted" and "adopted" to any project situation (*position*); the freedom for the weightings to change to reflect the particular project situation, and the various phases across the project life cycle (*rotational orientation*); the freedom to increase or decrease the number of the indicators depending on the project circumstances, number and weights of parameters and needs (*overall-size*); and the possible resultant forms the assessment will take based on the various adaptations (*shape*)[NB: words in italics describe the degrees of freedom for a typical irregular polygon]. The model, thus, agrees with the contingency theory which is summarised as "one size does not fit all (Shenhar et al., 1997)". The research, thus, posits that models for assessing construction project performance should be contingency-based. Again, like all polygons, each corner can have several angles – each criterion can have several indicators.

CONCLUSION

Finally, a cursory observation of the shapes of figures 5, 6, 7 and 8 show that the differences in perspectives between clients and practitioners regarding the combined criteria (the eight) has to do only with the extent or emphasis and not the focus or direction, generally. The similarities between the shapes and the directions suggests, loosely though, that the disputes that usually exist between clients and practitioners regarding the status of a project may be an exaggeration of the reality based on mere perception and the use of limited measures. Bissah et al. (2003) gave five reasons/sources of conflict in project environment: *project goals not well defined, administrative procedures, schedules, communication problems and resource allocation.* Each of these creates a conflict situation as a result of *undefined expectations* and *inadequate information* on procedure or the lack of it. It shows that it is possible to minimise this suspicion and the resulting disagreements or disputes if things are clarified between and among key stakeholders of a project, and expressed in a 'shared perspective'. One of the means of eliminating this is by using a front-ended project management approach in which "*expectations* will be agreed as *expectation*, *criteria* will be agreed as *criteria*, and *weightings* to be agreed as *weightings*" from the outset and throughout the project. Not meeting these fundamental requirements and the absence of adequate updates based on issues agreed on will always generate "perceptions" based on suspicions in the minds of one stakeholder against the other where there is, in most cases, only a slight difference between the reality and what is supposed to be made clear.

Subsequently, these criteria are expected to be used into an assessment model which would measure the extent to which the project is succeeding or failing to achieve its set objectives based on the agreed criteria and indicators throughout the project life cycle –performance. This would include the determination of known factors that affect the smooth execution of the project in the forms of relationship issues, supervision by consultants, attitude of clients towards the project, those relating to the project, the external environment etc. Thus, the determination of the criteria and their indicators will be a necessary precursor for effective project performance measurement and management for desired results.

REFERENCES

Atkinson, R. (1999), "Project Management: Cost, Time and Quality, Two Best Guesses and A Phenomenon: It's Time to Accept Other Success Criteria", International Journal of Project Management, 17 (6)337-42

Bennett, J., Flanagan, R., Lansley, P., Gray, C. and Atkin, B. (1988), "Building Britain 2001", Centre for Strategic Studies in Construction". University of Reading, Reading.

Bissah, A.K.F., Wu, X., Zhang, T (2003), "Managing and Resolving Conflict in Project Environment", Conference proceedings, Second International Construction in the 21st Century (CITC-II), "Sustainability and Innovation in Management & Technology.

DTLR, (2001), Multi Criteria Analysis: A Manual. Department of Transport, Local Government and the Regions, London.

Freeman, M and Beale, P. (1992), "Measuring Project Success", Project Management Journal 23 (1), 8-17.

Gyadu-Asiedu, W (2009), Assessment of Construction Project Performance: Modeling Clients and Practitioners' Perspective. A Published PhD Dissertation by the Technology University of Eindhoven, Faculty of Architecture, Planning and Building.

Hill, K., Slivon, C. and Draper, J (2007), "Another Approach to Transforming Project Delivery: Creating a Shared Mind", Proceedings IGLC, Michigan, USA, pp 417-422

Latham, M. (1994), Constructing the team, Joint Review of Procurement and Contractual Arrangement in the United Kingdom. Design, Drawing and Print Services.

Le-Hoai, L, Lee,Y.D., Lee, J.Y. (2008), "Delay and Cost Overruns in Vietnam Large Construction Projects: A Comparison with other selected Countries", KSCE Journal of Civil Engineering, 12(6):367-377

Lim, K.C., Mohammed, A.Z., (1999). "Criteria of Project Success: An Exploration Re-Examination". International journal of project management, Vol. 17 No.4, pp.243-8, as quoted in Chan, A.P.C and Chan, A.P.L., (2004). "Key Performance Indicators for Measuring Construction Success". Benchmarking: An International Journal Vol.11 No. 2, 2004 Pp. 2003-221.

Latham, M. (1994), Constructing the team, Joint Review of Procurement and Contractual Arrangement in the United Kingdom. Design, Drawing and Print Services.

Melvile, I.A., and Gordon, I.A., (1983), Professional Practice for Building Works, the Estate Gazzette Limited.

Mutijwaa, P., and Rwelamila, D (2007), "Project Management Competence in Public Sector Infrastructure Organisation", Construction Management and Economics, Vol. 25, pp55-66

Ofori, G. (1999), "Satisfying the customer by changing production patterns to realise sustainable construction. Proceedings", Joint Triennial Symposium of CIB Commissions W65 and 55, Cape Town, 5-10 September, Vol. 1, pp. 41-56.

Ofori, G. (2001), "Indicators for Measuring Construction Industry Development in Developing Countries", Building Research & Information, Vol. 29, No. 1, pp 40-50

Ryd, N. (2004), "Facilitating Construction Briefing –from the Client's Perspective", Nordic Journal of Surveying and Real Estate Research, Vol.1, pp. 86-101.

Shenhar, A.J., Levy, O., Dvir, D. (1997), "Mapping the dimensions of project Success", Project Management Journal 8 (2) 5-13.

Yisa, S.B., Ndekugri, I and Brian, A. (1996), "A Review of Changes in the UK Construction Industry. Their Implication for the Marketing of Construction Services". European Journal of Marketing. 30 (30) 47-64. MCB University Press.

A COMPARATIVE STUDY OF HOUSING TRANSFORMATION PROCESSES IN THREE GOVERNMENT ESTATES IN SOUTH WESTERN, NIGERIA

Victor Olufemi Adegbehingbe[1]
Department of Architecture, Federal University of Technology, Akure, Nigeria

This Comparative study on Housing transformation examines the transformation processes in three government estates. It seeks to highlight the differences in the processes. The study investigates the oldest estates in three out of six states that made up of South-Western, Nigeria as case study. Data for the study were collected through observation, interview schedules and structured questionnaires administered on 474 transformers. Variables investigated include: Cost, Duration and Mode of transformation; Reaction to transformation activities in the neighbourhood; Effect on Environment and mode of construction . Results from the survey were analysed using descriptive statistics in form of frequency tables, percentages and charts, chi-square test and correlation analysis. Findings indicated that people embarked on Housing transformation to provide those infrastructures that were not provided by Government. The studies identify delay of approval of plan and lack of cash flow as problems encountered in the transformation process. The need to provide transformers with credit facilities, accommodate extension as phase construction, seek proper approval for proposals are some of the recommendations emphasized in the study.

Keywords: government estate, housing transformation, income level, infrastructure, Nigeria, phase construction.

INTRODUCTION

The deficit in housing in Nigeria has driven many inhabitants in the few states that provided formal housing estates to carryout physical transformation of their dwellings. According to Makachia(2005), physical housing transformation are understood as modifications, firstly, of the existing design product by the expansion of plinth area, addition of spaces laterally and vertically, or by adding spatial units like rooms, alcoves, corridors, etc. Secondly, Makachia(2005) viewed physical housing transformation as quantitatively re-organising the disposition of the provided spaces through relocating, resizing of opening spaces and/or the exterior environment. Physical transformations presume that the architect made no provision for the phenomenon at conception and design stage. As a result of unguided physical transformations, estates designed for residence assume different and multi-use buildings, incorporating cottage production and light industry, petty trade as well as social functions like recreation, bars and nursery schools. (Tipple 2000).

[1] victoradegbehin@yahoo.co.uk

Adegbehingbe, V.O. (2011) A comparative study of housing transformation processes in three government estates in South Western, Nigeria *In:* Laryea, S., Leiringer, R. and Hughes, W. (Eds) *Procs West Africa Built Environment Research (WABER) Conference,* 19-21 July 2011, Accra, Ghana, 37-44.

In Lagos, Ibadan and Akure and typical of other urban settlement in Nigeria and the third world, physical housing transformation have resulted in not only estates with un-envisaged aesthetics, but crowding and congestion (Adegbehingbe and Fadamiro,2007) . Emerging also are building units devoid of any desired comfort and privacy, reduced interior lighting, ventilation and other physical environmental degradation are observed by the researcher (.Adegbehingbe, Fadamiro and Ogunsote 2010.). This paper highlights the differences in housing transformation processes in the three Government estates, and recommends the need to provide transformers with credit facilities, accommodate extension as phase construction, and seek proper approval for proposals.

PROBLEM STATEMENT

Nigerian government at various levels could not meet the housing need of the people (Nigeria housing policy 2004). Even the few ones provided could not meet the expectation of the occupants (Tipple 2004). Some facilities needed where not provided and some not needed were provided (FGN 2001,Olotuah,2006). This has made the residential estates to be haphazardly developed to the detriment of the users (Agbola 1998). This brought about unplanned environment, which made the residential estates physically and functionally not alien with the existing physical regulations. Furthermore, most of the physical transformation activities taking place on the residential estates were not officially approve by planning authorities. Thus, leading to continuous destruction of unauthorized extensions by appropriate planning authorities. Lots of money earlier used in carrying out these physical transformation were lost (Nwuzi 1995). Many of the transformed buildings were converted to various usages, such as hotel accommodation and guest houses, thereby attracting social and security problems to the studied estates. Makachia (2005) asserted in a study that the environment generated are often wanting in emerging space and land use conflicts.

HYPOTHESIS

Within the context of this study, the null form of hypothesis was used. The null hypothesis of the study are:

H1: The duration of the physical transformation has no significant relationship with the cost of transformation in the study area.

H2: The mode of construction used while transforming buildings has no significant effect on the environment.

H3: Mode of transformation has no significant relationship with the reactions to physical transformation activities in the neighbourhood.

RESEARCH DESIGN

The study was carried out in the three oldest estates in three states out of the six states that made up of south-western Nigeria. The three states and housing estates are:-

Ijapo Estates Akure, Ondo State, Old Bodija Estates in Ibadan, Oyo state and Ikeja GRA, in Lagos, Lagos state, using close ended questionnaire. The survey sought to identify factors responsible for physical transformation activities that were carried out by occupants of the study estates. This was supported by preliminary site observation, and informal discussions with occupants of the residential buildings.

In the research, a total number of 474 questionnaires were retrieved and analysed in the study area. Among the variables examined are:-

Cost of transformation

- Duration of transformation
- Reaction to physical transformation activities in the neighbourhood.
- Effect of physical transformation on the environment
- Mode of transformation
- Mode of constructions

The population of this study was the household heads that transformed their buildings in the three study estates in Akure, Ibadan and Lagos.

Table 1 shows the percentage of distribution of questionnaires in the study areas.

S/NO	Housing Estate	Town/State	No of Respondent Retrieved and Analysed
1	Ikeja Housing Estate	Ikeja, Lagos State	133
2	Old Bodija Housing Estate	Ibadan, Oyo State	201
3.	Ijapo Housing Estate	Akure, Ondo State	140
	Total		474

Source: Adegbehingbe, 2009

RESULTS AND DISCUSSION OF FINDINGS

The analyses in Tables 2-7 deals with the comparative analysis of transformed buildings in the selected estates of Old Bodija, Ikeja and Ijapo Housing Estate. These involved the comparison of the following variables, among others: spaces / Bedrooms added after moving in, cost and duration of transformation, reaction and effect of transformation activities, Area gained through transformation, home based enterprises and other uses after transformation; mode of transformation, External and Internal area affected by transformation, problem before and during transformation, reason affecting transformation factor responsible for transformation and mode of construction of transformation. Out of these only six variables are discuss below .The descriptive statistics are presented in Tables 2- 7.

Cost of Transformation

Respondents of each study estate were asked how much is the cost (in Naira) of each transformation carried out by them. The costs were compared among the three study estates. In Old Bodija and Ijapo Estates, the cost were mostly less than 250,000 Naira while in Ikeja, the cost are between 501,000-750,000 Naira. However a reasonable number spent above 1million naira in all the study estates.

Table 2 : Cost of Transformation

S/N	Cost of transformation in Naira (CT Transformation)	Ikeja		Old Bodija		Ijapo	
		Freq	%	Freq	%	Freq	%
1.	Less than 250,000	14	10.5	108	53.7	54	38.60
2.	251,000-500,000	24	18.0	29	14.4	23	16.4
3.	501,000-750,000	44	33.1	19	9.5	15	10.70
4.	751,000-1,000,000	12	9.0	6	3.0	11	7.9
5.	Above One Million	39	29.30	39	19.4	37	26.4
	Total	133	100	201	100	140	100

Source: Adegbehingbe, 2009

This is due to the type of mode of transformation that are common in each study estate .The study shows that the most common type of mode in both Old Bodija(53.7%) and Ijapo (38.60%) is Renovation and Repainting and mostly costs less than 250,000 Naira. It was observed that a reasonable number of buildings in all the three study estates were demolished and rebuilt, each costing above 1million Naira each (Ikeja 29.30% ,Old Bodija 19.4% and Ijapo 26.4%). The study shows that most of respondents in Ikeja carry out rehabilitation of buildings costing between 501,000-750,000 naira (33.1%).

Duration of Transformation

How long it takes to carry out transformation (Duration) was investigated among respondents in each study estate. The comparison shows that in all the three estates: Ijapo 82.9%, Ikeja 86.5%, Old Bodija 60.2% of transformation takes less than 1 year and between 1 and 2 years. However, in old Bodija 19.4% of the transformation carried out takes above 5 years.

Table 3: Duration of Transformation.

S/N	Duration of Transformation (Du-transform)	Ikeja		Old Bodija		Ijapo	
		Freq	%	Freq	%	Freq	%
1.	Less than 1year	71	53.4	34	16.9	74	52.9
2.	1 – 2yrs	44	33.1	87	43.3	42	30.0
3.	2 – 3yrs	12	9.0	22	10.9	15	10.7
4.	3 – 4yrs	4	3.0	10	5.0	2	1.4
5.	4 – 5yrs	1	0.8	9	4.5	3	2.1
6	Above 5yrs	1	0.8	39	19.4	4	2.9
	Total	133	100	201	100	140	100

Source: Adegbehingbe, 2009

This finding supports why there was no abandoned transformed buildings and the fact that before a transformer starts embarking on any transformation, a substantial amount of money to be spent are accessible to him or her.

Reaction to Physical Transformation activities in the Neighbourhood

The researcher observed that a lot of transformation activities took place or are taken place during the survey, the respondents were asked their reactions to all these activities taken place in their neigbourhood and the response were compared with each other. Table 4: Reaction to Physical Transformation, Activities in the Neighbourhood (Re - Transformation)

S/N	Reaction to transformation activities (RE-Transform)	Ikeja		Old Bodija		Ijapo	
		Freq	%	Freq	%	Freq	%
1.	Indifferent	43	32.3	100	49.8	46	32.9
2.	Worrisome	25	18.8	2	1.0	10	7.1
3.	Providing Infrastructure	62	47.746.6	88	43.8	84	60.0
4.	Others	3	2.3	11	5.5	---	---
	Total	133	100	201	100	140	100

Source: Adegbehingbe, 2009

Majority of respondents in all the estate agreed that the physical transformation activities were providing infrastructure facilities which government can’t provide. Old Bodija 43.8%, Ikeja 46.6%, Ijapo 84%, while a lot of respondent were indifferent to these activities in their neighborhood (Old Bodija 49.8%, Ikeja 32.3% to and Ijapo 32.9%).

Effect of Physical Transformation Activities on the Environment

The researcher observed that a lot of transformation activities took place or were taking place during the survey. The respondents were asked to grade the effects of these activities on the environment on their neighbourhood. The responses obtained were compared with other estate. Majority of the respondents in Ikeja and Ijapo estates grade the effect to be middle, (Ikeja 40.6%, Ijapo 48.6%). The table below shows the results of the majority of those residing in Old Bodija are of the opinion that the physical transformation activities are of no effect on the environment (37.8%) while substantial grade the effect as middle (37.3%). This confirms Falade's (1998) assertion that, there is the need for adequate knowledge of the concept of effective environment management in a community for such studies.

Table 5: Effect on Environment

S/N	Effect on Environment	Ikeja		Old Bodija		Ijapo	
		Freq	%	Freq	%	Freq	%
1.	None	15	11.3	76	37.8	38	27.1
2.	Low	23	17.3	13	6.5	24	17.1
3.	Middle	54	40.6	75	37.3	68	48.6
4.	High	4.1	30.8	37	18.4	10	7.1
	Total	133	100	201	100	140	100

Source: Adegbehingbe, 2009

Mode of Transformation

The researcher further noted during the survey exercise, the mode of transformation that were carried out by the transformer, and made comparison among the study estates. The analysis shows that majority prefers renovation as mode of transformation as reflected in both Ikeja and Ijapo Housing Estate (Ikeja 51.1% and Ijapo 45.7%), while substantial number in Bodija prefers Rehabilitation (26.9%).

Table 6: Mode of transformation

S/N	Mode of transformation	Ikeja		Old Bodija		Ijapo	
		Freq	%	Freq	%	Freq	%
1.	Demolishing and Rebuilding	32	24	46	22.9	285	20.0
2.	Renovation	68	51.1	47	23.4	64	45.7
3.	Rehabilitation	22	16.5	54	26.9	39	27.9
4.	Repainting only	11	8.3	39	19.4	9	6.4
5	Others	--	--	15	7.5		
	Total	133	100	201	100	140	100

Source: Adegbehingbe, 2009.

.

Mode of Construction of Transformation

Table 7: Mode of construction for transformation

S/N	Mode of construction (Construction)	Ikeja		Old Bodija		Ijapo	
		Freq	%	Freq	%	Freq	%
1.	Self – Help	2	1.5	12	6.0	8	5.7
2.	Use of Local Bricklayer	63	47.4	123	61.2	114	81.4
3.	Use of major contractor	65	48.9	62	30.8	18	12.9
4.	Others	3	2.3	4	2.0	-	-
	Total	133	100	201	100		100

Source: Adegbehingbe, 2009

During the survey exercise, the researcher asked from respondents, what mode of construction were used while transforming their buildings. The table below indicates that respondents in all the estates made use of local bricklayers, Ikeja (47.4%), old Bodija (61.2%) and Ijapo (81.4%). It is of note that a large percentage of respondents at Ikeja (48.0%) and old Bodija (30.8%) made use of major contractor.

SUMMARY OF FINDINGS

The study reveals that majority of cost of transformation were either less than ₦250, 000 or above One Million Naira (Nigerian Currency), and majority of transformation took less than one year to complete. Majority of respondents in the study estates agreed that physical transformation activities were providing infrastructures which government could not provide. Old Bodija recorded 43.8%, Ikeja 46.6% and Ijapo 60%. While a lot of respondents were indifference to these activities in their neighbourhoods, Old Bodija recorded (49.0%), Ijapo (32.3%) and Ijapo (32.9%) respectively.

Majority of residents in Old Bodija were of the opinion that the physical transformation activities were of no effect on the environment with 37.8% rated the effect to be middle. The majority of respondents in Ikeja and Ijapo estates graded the effect to be middle. This confirm Falade’s (1988) assertion that there is the need for adequate knowledge of the concept of effective environmental management in a community for such study. The study shows that major prefer mode in both Ikeja and Ijapo Housing Estate is Renovation (Ikeja 51.1%) and Ijapo (45.7%). While prefer mode at old Bodija is Rehabilitation (26.9%). Substantial mode in Bodija is Demolition and Rebuilding (22.9%) and Renovation (23.4%). When asked what mode of construction was used while transforming their buildings. Ikeja GRA relied on Professional builders (63%) while majority of transformers in Ijapo housing estate made use of local bricklayers (81.4%).

In Ijapo housing estate, out of the surveyed 249 buildings, 140 were transformed, while 109 were not transformed.43 buildings are semi-detached, while 66 were of duplex buildings. In many transformation that took place, few external areas were affected. A typical example is the one being used as an office building, where the building was almost in original condition except some changes in external finishing. Another typical example was the one constructed as a corridor access to a duplex building.

Many of these buildings were transformed from their original design form, by demolishing original building on the plot and replacing them with another one. Not only main buildings were being transformed, wall fencing was also included. While many required the roof line to be raised.

In old bodija housing estate, out of the surveyed 323 dwellings, 201 were transformed, while 122 were not transformed(still in original design form). Out of these 122 not transformed, 32 number are storey buildings, 15 number are two bedrooms bungalow and 75 number are of semi-detached bungalows. In many of the transformation that took place at the old bodija estate, only internal areas were affected, the external areas were observed to be almost in original conditions. An ongoing transformation at the time of survey is the one in which a balcony was transformed to accommodate additional toilet facilities in a storey building. Many of these buildings were transformed from their original design form by demolishing original building on the plot and replaced with another one which are still under construction at the time of survey. Available open spaces between two dwellings were transformed to a restaurant. In many transformation only front view were affected.

In Ikeja GRA, there are a total of 714 plots dominated by residential use. Whereas, the estate was purely residential environment before independence, the non-provision for other uses made this estate inadequate. Consequently, the land use study as at the time of survey, show that this estate is made up of residential, commercial, public, recreational and service industry.

There were two types of buildings initially constructed on the estate (bungalow and storey building). As at the time of survey, fifty-four number of the bungalow type, and one hundred and twenty six type of the storey building are still in original design form(Not-transformed). Out of these, one hundred and twenty nine(129) dwellings were sampled (30-bungalow and 99 storey building). At the time of survey, noticeable numbers of dwellings in original design stages are being demolished and replaced with a massive construction of twenty units of 3 bedroom bungalow, still under construction at the time of survey. This is a case of gentrification.(Fagbohun,2003). In many occasion, only the front view was affected, while many extensions required the roof line to be raised. In Ikeja GRA, out of the 133 transformed building surveyed,8.3% were repainted, 16.5% were rehabilitated, 51.1% were renovated, while 24% of the transformed building were originally demolished and rebuilt with additional rooms and etc.

CONCLUSIONS

It is clear that the three null hypothesis examined in this study show significant relationship between the two variables in each case of the hypothesis, thus confirming the validity of the research findings. Occupants of residential buildings transformed their buildings due to inadequacy noted in the design of the original building on the study areas. Due to non-approval of application for transformation on time, transformers usually embarked on unguided transformation. This will be reduced, if approval can be communicated within a practicable time limit thus avoiding undue transformation.

RECOMMENDATIONS

In view of the above findings, the study therefore recommends the following:

In the short term, there is an urgent need to increase the number of staff of the planning approval authority in the housing corporation responsible for the management of the study estates, especially those in the contravention section. They should make sure that no modification or alterations are made in a building until these had been approved by the appropriate authority.

There is an obvious need to educate the occupants of the study estates on the negative influence of indiscriminate building transformation on the residential environment.

When approval for transformations is considered, it is recommended that necessary accounts of the effects of the proposed development on the household should be considered. It is recommended that economic and environmental implications should be considered along with planning and structural considerations.

Government should ensure that adequate net working of basic infrastructure such as drainage, water, electricity, etc are provided before an area is approved for development.

REFERENCES

Adegbehingbe, V.O and Fadamiro, J.A.(2007).Sustainability of built environment in Nigeria: Self-help transformation of Public housing option. A Conference Proceedings of International conference in Built Environment in the 21st Century (ICiBE 2007) Kuala Lumpur, Malaysia,13-15June.

Adegbehingbe,V.O. Fadamiro J.A.& Ogunsote O.O.(2010) .Reducing the need for Housing transformation in South- Western, Nigeria by Addressing the Causative Agent. Proceedings of the 1st International Conference, School of Environmental Technology, The Federal Universty of Technology, Akure, Nigeria, 25-27 October.

Agbola,S.B (1998). The Housing of Nigerians. A Review of Policy Development and implementation in the Housing Sector. Research Report, No 14. Development Centre, Ibadan, Nigeria, 79-86.

Fagbohun P.O.(2003).Housing and Livability in Nigeria Cities: A study into Housing situation in Oshodi, Lagos. A paper presented at a National Workshop on Private sector Driven Housing delivery 30th-31st July, Lagos, Nigeria.

Falade J.B (1998). Public Acquisition of land for land scraping and open space management. Journal of Nigeria Institute of Town Planners (XI) 1-13.

Federal Republic of Nigeria (2001). (Presidential Committee Report on Urban Developing and Housing).

Federal Government of Nigeria FGN(2004). National Housing Policy for Nigeria, Federal Ministry of Works and Housing,Abuja.

Makachia P.A.(2005).Influence of house form on dweller-initiated transformation in urban housing. IAHS World congress on housing.33rd,Pretoria,South Africa

Mai M.M. (2006) Transformation of Vernacular Housing Pattern, in peni-urban Abuja, Nigeria. Unpublished PhD Thesis, university Teknologi, Malaysia.

National Population Commission (1996) Census final results.

Nwuzi, I.A. (1995). Change of use and structural alterations in the Residential Areas of Port Harcourt. A case study of Diobu. An unpublished master thesis. The center for urban regional planning, faculty of social scerce, university of Ibadan.

Olotuah,A.O.(2000). Evaluation of sub-urban Housing Conditions in Akure, Nigeria. Africa Journal of Development studies 2(192)165.

Tipple A.G. (2000): Extending Themselves user initiated Transformation of Government built housing in developing countries. Liverpool University Press, Liverpool, 20-48.

Tipple, A.G. (2004): The place of Homebased Enterprises in the informal sector: Evidence from Cochabamba and Pretoria, urban studies, 42(4) 61-68.

A COMPARISON OF SELECTED NATIONAL ACOUSTICS BUILDING CODES: CASE STUDY OF CATHEDRAL ROAD, AKURE

Sikiru Abiodun Ganiyu[1] and Olu Ola Ogunsote[2]
[1]*Department of Architecture, Federal University of Technology, Akure, Nigeria*
[2]*Department of Architecture, Faculty of Environmental Sciences, University of Jos, Jos, Nigeria*

There are three problems that this present generation has to cater for: Poverty, Population and Pollution. Industrialisation and urbanisation has taken the problems of noise pollution to an unprecedented catastrophic level both in the developed and the developing nations of the modern world. While the advance countries have taken some legislative measures in form of Acoustics Building Codes to control the problem of noise and its attendant effects, the developing nations like Nigeria may not have faired well in this regards. This paper, therefore, is an attempt to compare the building codes in some selected countries of the world with emphasis on the acoustics regulations of the building codes. The countries whose Acoustic Building Codes are to be examined include: England (United Kingdom), United State of America, New Zealand, Australia and Nigeria. The Acoustic Building Codes of these nations will be compared with that of Nigeria in terms of regulatory provisions. A practical case study of Cathedral – Ondo road, Akure will be made to evaluate the level of compliance with the provisions of the National Building Code, if any.

Keywords: acoustics, building code, noise, pollution, urbanisation.

[1] fadhikr2002@yahoo.co.uk
[2] profogunsote@gmail.com

Ganiyu, S.A. and Ogunsote, O.O. (2011) A comparison of selected national acoustics building codes: case study of Cathedral Road, Akure *In:* Laryea, S., Leiringer, R. and Hughes, W. (Eds) *Procs West Africa Built Environment Research (WABER) Conference*, 19-21 July 2011, Accra, Ghana, 45-45.

A REVIEW OF THE CURRENT HEALTH AND SAFETY LEGISLATION IN BOTSWANA RELATIVE TO CONSTRUCTION INDUSTRY STAKEHOLDERS

Erastus Mwanaumo[1] and Wellington Didibhuku Thwala[2]
[1]*Building Sciences Department, Tshwane University of Technology, Pretoria, South Africa*
[2]*Department of Construction Management and Quantity Surveying, University of Johannesburg, Johannesburg, South Africa*

Most of the health and safety (H&S) regulations and legislation commonly found in Southern African developing countries are based on legislation enacted in the industrialized countries in the late 19th and early 20th centuries. This is evident in many factories acts promulgated for developing nations dating back to colonial times or soon after independence was granted. Botswana, formerly a British Protectorate, has two H&S legal frameworks meant for construction industry, viz. the Botswana Factories Act and the Workman's Compensation Act. In 1972 Lord Robens, the Chairman of a Royal Safety Commission Report, recommended self-regulation as this would engender continuous improvement and improve standards in legislation within a goal-setting legal framework supported by codes of practice and / or performance standards. These standards could be revised more easily than primary legislation which may require difficult enactment passage in parliament. This has not happened in the case of the Botswana Factories Act. International scholars affirm that the presence of legislation addressing H&S indicates a level of commitment and provides the framework within which H&S can occur. Many scholars agree that construction industry is unique and requires specific tailor made H&S laws and regulations as a starting point of preventive measures. The purpose of this paper is to review existing legislation to highlight the extent of coverage and relevance to the construction industry in Botswana. The review established that the current factories act is still largely meant to cover the industrial / manufacturing industries. It further established that there is no statutory obligation clearly stipulated to deal with H&S at the conceptual stage of any construction project within the construction industry. This suggests that there is urgent need for the state to arrange a forum with the construction industry practitioners to formulate regulations that will be specific and current for the construction industry.

Keywords: Botswana Factories Act, Health and safety, Workmen's Compensation Act.

INTRODUCTION

Most of the health and safety (H&S) regulations and legislation commonly found in Southern African developing countries are based on the legislation used in the industrialized countries in the late 19th and early 20th centuries. In particular, the Factories Act is the specific H&S legislation used by the developing countries that were colonized by Great Britain (Rantanen, 1992). This is evident in many Factories

[1] mwanaumoem@tut.ac.za
[2] didibhukut@uj.ac.za

Mwanaumo, E. and Thwala. W.D. (2011) A review of the current health and safety legislation in Botswana relative to construction industry stakeholders *In:* Laryea, S., Leiringer, R. and Hughes, W. (Eds) *Procs West Africa Built Environment Research (WABER) Conference,* 19-21 July 2011, Accra, Ghana, 47-57.

Acts for the developing nations dating back to colonial times or soon after independence was granted. The purpose of the legislation at the time was generally to provide protection to workers in industrial enterprises when governments were striving to promote industrialization and was based on relevant enactments in force in the colonizing State.

Since independence, Botswana, formerly a British Protectorate essentially has two kinds of H&S legal frameworks for the construction industry, viz. the Factories Act and the Workmen's Compensation Act. Both of these acts emanate from the old British legislation that covers largely industrial/manufacturing industries. The Botswana Factories Act is similar to the 'Robens style' of legislation derived from the UK and is a penal code (but not a criminal code) (Dingsdag, Sheahan & Biggs, 2006). It differs from the 'Robens style' in that it is not dependent on self-regulation by individual industry or factory. However, the Robens legislation, first introduced in the UK in 1974, was intended to engender continuous improvement and to improve standards in legislation within a goal-setting legal framework supported by codes of practice and / or performance standards which could be revised more easily than primary legislation which may require difficult enactment passage in parliament (Dingsdag et al., 2006). However, this has not happened in the case of the Factories Act, probably due to the inability of the Act to address all pertinent issues dealing with H&S, especially in the construction industry.

Developed nations have over the years identified that the level of H&S risks involved in the construction industry determine the degree of detail, time and effort required to comply with the legal duties. International scholars affirm that the presence of legislation addressing H&S indicates a level of commitment and provides the framework within which H&S can occur (Halpin and Woodhead, 1998). They further add that for the legal framework to be effective, it should specify all H&S activities including provision of regular briefings to increase the H&S awareness of personnel at all levels.

According to Ahasan (2001), the work practices of local workers in many developing African nations are difficult to understand in the context of the proper way of doing things. What leads to good performance varies from a flexible attitude towards H&S to unwillingness to learn or to apply national laws related to H&S. Lubega, Kiggundu, and Tindiwensi, (2000) further conducted research in five districts of Uganda. The group recommended ways for minimising and / or avoiding re-occurrence of accidents which included a review of the existing H&S regulations, enforcement, sensitisation and training.

The aim of this paper is to report on the review of the Botswana Factories Act 1973 (no.31 of 1973) of the Republic of Botswana and to highlight the extent of coverage and relevance of the Act to the construction industry, particularly with respect to the roles of construction project stakeholders in H&S interventions.

REVIEW OF LITERATURE

Over the years, progressive research contends that the concept of designing for H&S at the conceptual stage of each project is a viable H&S intervention in the construction industry (Gambatese, 2003). In 1985, the International Labor Organisation (ILO, 1985) acknowledged that designers should be involved when considering construction H&S. The European Foundation for the Improvement of Living and Working Conditions (1991) deduced that 60% of the accidents it surveyed could have been eliminated, reduced or avoided had more thought been given during the design stage. Further research conducted in Europe by Mackenzie, Gibbs and Bouchlaghem (1999) affirms the other researchers' findings that accidents happen due to shortcomings in design.

In the United States of America (USA), research conducted by Hecker, Gibbons and Barsotti (2001) established that antecedents in design, planning, scheduling and material specifications likely contributed to ergonomic risks of workers during the construction process. The ideal situation, therefore, is for construction H&S to be considered right at the conceptual stage of each project (Szymberski, 1997).

These findings agree that besides workers on site, project stakeholders such as architects, engineers, the client, and the inspectors are contibutors to the causes of incidents and accidents experienced on site. Why then is H&S not considered at the conceptual stage of each construction project in Botswana?

The Botswana construction industry still follows the traditional method of procuring projects. This method entails the involvement of designers and the client during the pre-contract stage when the project conceptualisation and feasibility study take place. After the initial stages have been concluded, the main contractor, domestic and specialised subcontractors are then procured for post-contract activities and join the earlier stakeholders in the execution of the project. Clearly then, at the conceptual stage, only the designers and the client (the financier of the project) are involved.

THE ROLE OF LEGISLATION IN A MULTI-STAKEHOLDER INTERVENTION

European legislation

Legislation plays an important role in any state. It is important to government in many ways: it is used diversely to implement policies, provide a framework for decision-making, regulate activity in the private sector, and prohibit conduct. To be effective, responsibilities of the industry and individuals would therefore have to be clearly stipulated in the legislation.

Construction industry practitioners are aware of the industry hazards and the related preventive measures. Since the EU recognized that construction was a highly hazardous industry, in 1992 it published a special Directive (EU Directive No. 92/57/EC of June 1992) that transformed the view of H&S in construction. This Directive is now known worldwide as the Construction Sites Directive (CSD) (Alves Dias, 2009). Since then, the construction industry has changed in all countries of the EU, and H&S in construction is now a matter of concern that most construction stakeholders are conscious of.

Since its publication, each EU country has brought the provisions of the CSD into national law. Some countries have made this Directive work by creating the mechanisms and means for effective implementation while others have made a "simple" transposition with few adaptations to their own situation, thereby sometimes creating confusion for those who must implement it or check its application every day. Other countries still have changed, or are changing, their first transposition, clarifying it and/or adding detail. In spite of the common base introduced by the CSD, the fact is that each country in the EU has its own approach (Alves Dias, 2009).

The CSD introduced a new approach to the improvement of OSH in construction. It highlighted the importance of prevention measures (managerial and material) to reduce work-related accidents and diseases in construction. It took the provisions of ILO Convention No.167 on "Safety and Health in Construction" (1988) into account and included specific roles and responsibilities concerning H&S, including the client and designer. The concept of H&S coordination for the design phase and for the construction phase was also introduced. This resulted in two new stakeholders in the construction process (the H&S coordinators for the design phase and for the construction phase) as well as the introduction of three new documents concerning hazard prevention (the prior notice, the safety and health plan, and the safety and health file) (Alves Dias, 2009).

United States of America legislation

In the United States, the Occupational Safety and Health Administration (OSHA) Act 1970 is responsible for enforcing labour regulations and delegating enforcement powers to 21 states, Puerto Rico, and the Virgin Islands (CPWR, 2002, 1). As part of its enforcement strategy, OSHA employs inspectors to conduct site visits and check whether construction sites are complying with H&S regulations.

OSHA also addresses the relationship between design and construction H&S in a number of ways (Cavanaugh, 2004). The standards are often a combination of performance-orientated and design-specific provisions.

Consequently the American Society of Civil Engineers' (ASCE) policy statement recognises that the engineers have responsibility for considering safety and constructability in the designs and specifications as well as that all stakeholders in construction must collaborate to ensure that H&S regulations and standards are complied with in construction (ASCE 2001).

Cavanaugh (2004), asserts that OSHA's policy on holding engineering firms responsible for incidents and accidents on site was affirmed by a federal court appeals case (Reich vs. SGH, 1993) where engineering firm - SGH - was charged by OSHA for two serious violations:

1. Inadequate formwork to support the intended load; and
2. Failure to have formwork drawings available on site.

The review commission concluded that the design firm (SGH) did not exercise the substantial supervision required during the construction. This case resulted in designers, engineering firms, being held responsible for general supervision of construction works and that they have a contractual right to control H&S.

The success of this case lies in the court's recognition that designers have an important role to play throughout the construction project processes – and that includes H&S consideration at the conceptual stage of each project.

Australian regulations and legislation

Australia has many organisations or agencies that deal with H&S construction regulations and legislation. Recommendation 19 of the Cole Inquiry encouraged the Commonwealth to refer to the National Occupational Health and Safety Commission (NOHSC), a body established as an overseeing agency to coordinate state, territory and federal programs in an attempt to work towards the prevention of occupational injuries and deaths (NOHSC, 2005).

The National Occupational Health and Safety Strategy 2002-2012 is a document that outlined five specific goals that would help reduce the overall number of injuries and deaths by reducing hazards and engaging managers and workers to consider and incorporate H&S, encourage proactive hazard reduction, and integrate the design phase into other areas (NOHSC, 2005).

In 2005, NOHSC released an outline of National Standards for Construction Work in order to prescribe preventive action to avert occupational deaths, injuries and disease (NOHSC, 2005). The document, among other issues, specifies the responsibilities of different stakeholders, which are presented under the headings of 'responsibilities of clients' and 'responsibilities of designers' (NOHSC, 2005). In a general sense, the document is a successful guide to prescriptive stakeholder responsibilities.

STATUS QUO OF H&S AND LEGISLATION IN BOTSWANA

The current scenario in Botswana regarding the H&S legislative framework is that Botswana only has the out dated Factories Act and Workmen's Compensation Act system in dealing with H&S issues and is finding it difficult to move to the new H&S Act system. The country still does not have the H&S national policy although it has been in draft form for over five years now.

Botswana further faces the problem of the administrative framework. The H&S issues are divided among three individual government ministries:

1. Ministry of Health under the department of Occupational Health Unit which deals mostly with health;
2. Ministry of Labour and Home Affairs under the Occupational Safety and Health Department, which deals with factory workers' safety and also workmen's compensation; and
3. Ministry of Minerals, Energy and Water Resource, which deals with the safety of mining, explosives and ***quarrying*** activities.

All three Ministries are independent units with fixed administration structures, own budgets, own goals and aims and yet all are supposed to be addressing one common goal - the employee's H&S.

Botswana construction projects, as in many countries, are ephemeral in nature, constantly changing in status, covering a huge range of construction processes of varying complexity and scale. The work processes and people change almost daily on sites. The industry is further highly fragmented, both in the workforce and professional disciplines. The fragmentation is echoed through the considerable number of representative bodies for clients, designers, contractors, suppliers and trade unions. There is no one body that represents all the organisations involved in the construction industry, and there are some groups who are not represented at all in the bodies that do exist.

One of the disturbing facts about the construction industry in Botswana is that it is undocumented. The industry has few information sources in the country, for example, Central Statistics office (CSO) has some information on the number of construction industry firms, and the employment in the sector.

The construction industry in Botswana further faces inadequate recording and notification systems. As a result official data on the incidence of occupational accidents and diseases on construction sites are imprecise and underestimated. For instance, labour statistics from the Central Statistics Office (CSO) indicate that 17% of the population, which equates to 285 382 people, were formally employed for the period 2000 – 2003. However, these statistical figures are not in themselves correct because the CSO excludes working proprietors' companies with fewer than five employees and those working for the Botswana Defence Force (BDF) (Ooteghem, 2006).

The inconsistency of labour statistics is further hightlighted in the International Labour Organisation (ILO) Report (2005). The report cites Botswana's economically active population as being 556 890 people, which is said to represent 35% of the entire population of Botswana. Occupational injury and disease statistics also differ from those given in Government records by Ooteghem (2006) (See Tables 1 and 2).

Table 1: Occupational injuries and diseases in Botswana for the year 2001

Category	**No.**
Accidents resulting in three days' absence from work	77 022
Work-related diseases	742
Fatalities caused by dangerous substances	155
Work-related mortalities	843

Source:ILO, 2005

Table 2: Occupational fatalities reported to Government Agencies (2000-2003)

Year	Workman's Compensation Unit (In the Ministry of Labour and Home Affairs)	Mines Inspectorate (in the Ministry of Minerals, Energy and Water Resources)	Department of Occupational Health and Safety (in the Ministry of Labour and Home Affairs)	Totals
2000	62	7	1	70
2001	72	3	6	81
2002	50	3	2	55
2003	67	6	2	75

Source:(Ooteghem, 2006

These findings clearly indicate the prevalence of H&S problems in the economy of Botswana. However, while these statistics are generic, international research confirms that construction in particular, is dangerous and / or highly hazardous, and is ranked among the three most hazardous industries together with agriculture and mining for both developed and developing countries (Birchall and Finalyson, 1996; López-Valcárcel, 2001; ILO, 2005).

The Factories Act 1973 (No31 of 1973) of the Republic of Botswana

All Botswana's industries, excluding mining, base their H&S on the Factories Acts. However, these laws do not apply effectively to the construction industry. This is seen in the name 'factories' implying that the Factories Act 1973 of Botswana is only applicable to 'factories' - a term that is defined to represent a production or manufacturing industry. For instance the Factories Act 1973 of Botswana states that primarily it is *'An Act to make provision for the regulation of the conditions of employment in 'factories' and other places as regards the safety, health and welfare of persons employed therein and for the safety and inspection of certain plant and machinery and for purposes incidental to or connected with matters aforesaid'.*

Section 55 of the Factories Act, provides the Minister of Labour with power to make regulations for better realisation of the objects and purposes of the Act not just in factories but also 'in other places', whilst Section 61 gives the Minister of Labour the authority to extend any part of the Act to certain types of workplaces which form these 'other places'. It is to be noted that the Minister's powers have been used to extend the application of the Act to:

- Building operations – that is the construction, structural alteration, repair or maintenance of a building (including re-pointing, re-decoration and external cleaning of the structure), the demolition of a building, and the preparation for, and laying the foundation of, an intended building
- Works of engineering construction – such as the construction of any railway line or siding, and the construction, structural alteration or repair (including re-pointing and re-painting) or the demolition of any tunnel, bridge, viaduct, waterworks, reservoir, pipeline, aqueduct, sewer, sewage works, or gas holder, and such other works as may be specified by the Minister

Although Section 61 of the Botswana Factories Act Number 31 of 1973 gives the Minister of Labour the authority to extend any part of the Act to building operations and works of engineering construction, the only aspects stated in the Act that are related to construction are for site activities. There is no mention of designers, clients, or any other construction industry pre-contract role players' responsibilities. From the perspective of the Factories Act, the employer referred to represents the Contractor who is the employer of labour on site as opposed to the client – the financier of the construction project.

The evident from the Factories Act shows that responsibilities of designers, producers, importers and suppliers included are those dealing with the processes in the factories. These designers are not the designers of the construction projects that are involved in the preconstruction stage of the construction project. Rather they are designers that operate in the completed built-up structure designing the processes that would be performed in that building. Clearly the H&S issues in the pre-contract stage of construction projects are not covered by the section covering the designers mentioned in the Act.

In essence, the existing Botswana Factories Act does not adequately address the regulations and legislation required for improving H&S performance and compliance in the construction industry. Further, the voluntary compliance which is reinforced by a measure of positive behaviour and attitude is equally weak. The construction workers seldom strike and are themselves less organized because of the temporary nature of their work. This behaviour has contributed to the lack of urgency by the state to review the Factories Act as there is no pressure from the industry participants and practitioners.

Loewenson (1999) suggests that a move from an old to a new legal framework depends to some extent on the complexity of their pre-existing laws. A more highly developed set of regulations based on the existing legal framework could make it difficult to move from the dated Factories Act system to the new H&S Act system.

The provision made in the Factories Act that its application may be extended to include the construction industry is therefore futile and only shows that construction is not a priority. The Act does not relate to specific activities in construction but provides guidelines for the general factory environment.

Besides these inadequacies of the Factories Act relative to H&S during pre-contract construction activities, the Act also has problems dealing with enforcement. Musonda

(2005) established an overwhelming complaint about the inadequacy of inspection services, when 80% of the respondents said that the Inspector of Factories had never visited their construction sites.

ANALYSIS OF THE FACTORIES ACT 1973 (NO 31 OF 1973) – REPUBLIC OF BOTSWANA

CLEARLY STATED IN THE FACTORIES ACT	IMPLIED	DEFINITELY MISSING FROM THE ACT
The following measures are clearly specified by Botswana Factories Act 1973:	*The following measures are not clearly specified by Botswana Factories Act 1973. They exist only by implication for the construction industry.*	*Although the Botswana Factories Act 1973 was designed to deal with all sectors of the economy as well as provide the framework of handling H&S in the country, the review showed that it lacks in the following:*
Air pollution	Measures to ensure consultation, co-operation and coordination on H&S between the various competent authorities and services as well as the competent authorities and employers' (In construction represented by the contractor, who is the employer of Labour) and workers' organizations.	Does not cover all branches of economic activity
The provision and use of personal protective equipment.	That there be cooperation between employers and workers and their representatives within the enterprise. No clear cooperation is stipulated in the Factories Act	Does not cover all categories of workers. The factories Act covers only *workers who work in factories as defined in the* Factories Act.
	Existence of mechanisms for the imposition of appropriate penalties in cases of infringement of laws and regulations	Design, construction, tools and equipment. Surveillance and monitoring of the working environment.

CLEARLY STATED IN THE FACTORIES ACT	IMPLIED	DEFINITELY MISSING FROM THE ACT
The provision of adequate welfare facilities (e.g. drinking water and sanitary facilities)	Empowerment of the competent authorities to suspend, restrict or prohibit work where there is a serious threat to the health and safety of workers, until appropriate corrective measures have been implemented	The notification of hazardous work and the related authorization and control requirements
The Competent authorities *[The department of labour and home affairs is responsible for the enforcement of the Factories Act]*	Education and training of workers. No such commitment is seen or recorded pertaining to Construction industry even though the Factories Act implies that the inexperienced workers are to be trained and supervised.	The classification and labelling of hazardous chemicals and the provision of related data sheets
The establishment and keeping of records of occupational accidents and diseases [Factories Act provides that records must be kept for two years after the last entry]	Taking of appropriate remedial action after any accident	Design, construction, layout and maintenance of workplaces and installations
A system of inspection *[the responsibility of the Chief Inspectorate of Factories]*	Prohibiting the deduction of costs of implementing the Act from the workers' wages	No provisions exist for the qualification and training requirements for staff in the competent authorities.

CONCLUSION

The purpose of the paper was to discuss the Factories Act of 1973 of Botswana to highlight the relevance of it to the modern H&S construction norms and practices. The literature review revealed that developed nations' construction H&S is driven by legislation and regulations. It also established that countries such as the United States of America, Australia and the European states – particularly the UK – have recognised the need to include roles and responsibilities of construction industry stakeholders into their legislation and regulations. This enables the industry practitioners to consider H&S at the conceptual stage of each project.

Why is H&S not considered at the conceptual stage of each project in Botswana? The analysis indicates that there is neither statutory obligation nor the desire on the part of designers and the client to consider H&S during project conceptualisation. The discussion further highlighted that perhaps the challenges faced by the construction industry in prioritising H&S lies in the failure of the legislation to clearly stipulate the practitioners' obligations.

EMPLOYER RESPONSIBILITIES (WHEN APPLIED IN CONSTRUCTION, THE EMPLOYER IS NOT THE CLIENT BUT THE CONTRACTOR)

CLEARLY STATED IN THE FACTORIES ACT	IMPLIED	DEFINITELY MISSING FROM THE ACT
Monitoring and inspection of the workplace, processes, machinery, tools equipment and other material elements of work	Rights and responsibilities of workers' representatives include:	Emergency preparedness and rescue not comprehensively addressed [**Factories Act** only addresses Fire]
Informing workers and their representatives on occupational hazards by posting the provisions of the Act in the factory].	Cooperation with the employer on health and safety matters	Non

WORKERS' RIGHTS AND RESPONSIBILITIES

CLEARLY STATED IN THE FACTORIES ACT	IMPLIED	THE ACT IS SILENT ON THE FOLLOWING
Access to relevant health and safety information by department of labour (competent authorities).	Non	Existence of specific provisions for other branches of activity or occupational hazards
Participation in inspection and monitoring activities and the review of H&S measures	Non	Occupational health services
Selection of a worker safety representative, Workers removing themselves from imminent danger and serious risk to health	Non	non

RIGHTS AND RESPONSIBILITIES OF WORKERS' REPRESENTATIVES

CLEARLY STATED IN THE FACTORIES ACT	IMPLIED	THE ACT IS SILENT ON THE FOLLOWING
Participation in inspections, monitoring and investigations related to H&S	Non	The Minister has the power to exempt factories from application of the Act in cases of public emergency for the period of that emergency
Consultation on H&S matters with the employer *(In construction represented by the contractor, who is the employer of Labour)*	Non	Existence of exclusions from the application of H&S provisions in whole or in part of branches of economic activity, or of specific categories of workers

RECOMMENDATIONS

It is the view of the authors that the relevant state authorities should arrange forums with the construction industry stakeholders to draft new H&S construction regulations for Botswana that will define the responsibilities and obligations of the stakeholders and be industry specific.

The authors would like to recommend that all Governments that are still using the outdated Factories Acts systems to enforce H&S regulations in construction projects should appoint review committees that should seek to replace the existing Factories Act system with a much more modern construction H&S legislative system.

REFERENCES

Ahasan, R. (2001) "Legacy of Implementing Industrial Health and Safety in Developing Countries". Journal of Physiological Anthropology, 20:6, pp311-319.

Alves Dias, L. (2003) “Inspecting Occupation Safety and Health in Construction Industry”. International Training Centre of the International Labour Organisation, 1st Edition, Turin, Italy, pp 10-20.

Birchall, S.J. and Finlayson, H. (1996) “The application of European derived safety management regulations to the UK construction industry”. In Dias, L.M.A. and Coble, R.J. (eds.), Implementation of Safety and Health on Construction Sites, Proceedings of the First International Conference of CIB Working Commission W99. Lisbon, Portugal, 4-7 September, pp. 41-51.

Cavanaugh, D. (2004) “The role of design in OSHA regulations”. In Hecker, S., Gambatese, J., Weinstein, M. (Eds.), Designing for Safety and Health in Construction: Proceedings from a Research and Practice Symposium, September 15–16, Portland, OR, USA, pp. 186–193.

Center to Protect Workers Rights (CPWR) (2002) OSHA's enforcement of construction safety and health regulations. The Construction Chartbook, CPWR, USA:.

Dingsdag, D.P., Sheahan, V.L., and Biggs, H.C. (2006) “Safety Culture in the Construction Industry: Changing behaviour through enforcement and education?”, In Proceedings Clients Driving Innovation: Moving Ideas into Practice. The Second International Conference of the CRC for Construction Innovation. Accessed from: https:// *eprints.qut.edu.au/3802/**1**/3802.pdf, 17th September 2010.*

European Foundation (1991) “From Drawing Board to Building Site”. European Foundation for the Improvement of Living and Working Conditions. London, HMSO Books.

European Union Directive 92/57/EEC (1992) “Implementation of minimum safety and health requirements at temporary or mobile construction sites”. JOCE Nr. L 245.

Gambatese, J. (2003) “Investigation of the Viability of Designing for Safety”. The Center to Protect Workers Rights, USA.

Halpin, D.W., Woodhead, R.W. (1998) Construction Management, Wiley, New York, NY.

Health and Safety Executive (1997) Successful Health and Safety Management. HSE Books, Sudbury.

Hecker, S., Gibbons, B., and Barsotti, A. (2001) “Making ergonomic changes in construction: worksite training and task interventions”. In Alexander, D. and Rabourn, R. (eds.), Applied Ergonomics, Taylor & Francis, London, pp. 162-189.

International Labour Organisation – ILO (1988) “Convention 167 on Safety and Health in Construction”. Geneva, Switzerland.

International Labour Organization (ILO) (1985) Safety and Health in Building and Civil Engineering Work, International Labor Office, Geneva, Switzerland.

International Labour Organization (ILO) Report (2005) “World Day for Safety and Health at Work 2005”, A Background Paper, In Focus Programme on Safe Work International Labour Office, Geneva.

Loewenson R. (1999) “Occupational Health and Safety in Southern Africa: Trends and Policy Issues”. ILO/SAMAT Policy Paper No. 8. SRO-Harare, Zimbabwe*:* International Labour Organization, *pp* 1-26.

López-Valcárcel, A. (2001) “Occupational safety and health in the construction work”. In African Newsletter on Occupational H&S Construction and Mining, 11:1, pp 2-8

Lubega, H. A., Kiggundu, B. M. and Tindiwensi, D. (2000) "An Investigation into the Causes of Accidents in the Construction Industry in Uganda", 2nd International *Conference On Construction In Developing Countries: Challenges Facing The Construction Industry In Developing Countries, 15-17 Nov 2002, Botswana, pp1-12*[online] Available http://buildnet.csir.co.za

Mackenzie, J., Gibbs, A.G.F., and Bouchlaghem, N.M. (1999) "Communication of H&S in the design phase". In Singh A, Hinze J.H and Coble R .J (eds.), Implementation of Safety and Health on Construction Sites. Rotterdam: A.A. Balkema

Musonda, I. (2005) "Health and safety (H&S) awareness and implementation in Botswana's construction industry". Proceedings 4th Triennial International Conference, Rethinking and Revitalizing Construction Safety, Health, Environment and Quality. Port Elizabeth, South Africa, CIB 142, May 2005, pp 17-20.

National Occupational Health and Safety Commission (NOHSC) (2005) Occupational Health and Safety. http://www.nohsc.gov.au/ (Accessed 16 October 2008).

Ooteghem, P.V. (2006) Work related injuries and illnesses in Botswana. International Journal of Occupational and Environmental Health, 12:1 pp 42-51.

Paton, N. (2003) Measure of success. Occupational Health, 57:12, pp16-19.

Rantanen, J. (1992) "Legislation as a tool in occupational health and safety". In African Newsletter on Occupational Health and Safety, Helsinki, 2:3, pp 64-67.

Szymberski, R. 1997. Construction Project Safety Planning. TAPPI Journal, 80:11 pp 69-74.

A STUDY OF THE SOURCES OF NOISE POLLUTION AND THEIR IMPACTS ON THE BUILT ENVIRONMENT: A CASE STUDY OF OBA-ILE HOUSING ESTATE, AKURE, NIGERIA

S. A. Ganiyu[1] and Y.M. D. Adedeji[2]
Department of Architecture, Federal University of Technology, Akure, Nigeria

Among the problems associated with technological advancement made by man in modern times which is not receiving enough attention from those responsible for the planning and designing of the built environment is noise pollution. Noise, an unwanted and irritating sound, is a form of environmental pollution and a source of stress. Loud noise is harmful and impacts negatively on the quality of the built environment. This paper, therefore, seeks to identify the major sources of noise and its impact in the built environment of a typical housing estate in Akure, the capital of Ondo State. The paper adopted a survey research method. It relied on the data collected from a survey carried out on some of the buildings along the major streets in Oba-Ile Housing Estate, Akure, Nigeria. It was observed that noises from vehicular traffic, pedestrian traffic and religious buildings, as the major sources of external noise, have very serious negative effects on the residents. Generating sets, telephone/mobile phones, radio and television sets constitute the major sources of internal noise with very serious negative effects on the residents of the study area. It recommends good design and building orientation, adequate set back, reduction in the opening sizes and reduction of noise from sources as some of the ways to minimise the problems of noise pollution in built environment.

Keywords: environmental pollution, noise, Oba-Ile housing estate, Nigeria.

INTRODUCTION

Noise which is an unwanted sound that disrupts human activities has been a major concern in many of the built environments. The focus of study is to identify the sources of noise pollution in typical residential estate of the built environment in order to proffer solution that will enhance the comfort of the residents. Relevant literatures were reviewed with a view to define the problem, identify the sources of noise pollution and the physiological and psychological effects of noise pollution on man. The results of a structured questionnaire administered on 35 residents of Oba-Ile Housing Estate, Akure are presented and discussed. Adequate set back, zoning, regular supply of electricity and creation of public awareness and enlightenment on the negative and damaging effects of noise are recommended as practical ways of reducing the impact of noise on the residents of residential areas of the built environment.

[1] fadhikr2002@yahoo.co.uk
[2] yomi_adedejiy2k@yahoo.com

Ganiyu, S.A. and Adedeji, Y.M.D. (2011) A study of the sources of noise pollution and their impacts on the built environment: A case study of Oba-Ile Housing Estate, Akure, Nigeria *In:* Laryea, S., Leiringer, R. and Hughes, W. (Eds) *Procs West Africa Built Environment Research (WABER) Conference*, 19-21 July 2011, Accra, Ghana, 59-67.

LITERATURE REVIEW

Noise pollution is displeasing human, animal or machine-created sound that disrupts the activity or balance of human or animal life (Wikipedia, 2010). Noise, according to Ephraime (2002), can be defined as undesirable sound and erratic; intermittent or statistically random oscillation. Ogunsote (1991) affirmed that it is an unwanted or damaging sound which interferes with what people are trying to do, or that which has an adverse effect on health and safety. Noise can also be understood as a complex sound, a mixture of many different frequencies or notes not harmonically related. Microsoft Encarta (2007) defines environmental noise pollution as the exposure of people or animals to levels of sound that are annoying, stressful, or damaging to the ears. It posited that loud and frightening sounds are part of nature; only in recent centuries has much of the world become urban, industrial, and chronically noisy. Noise can be transferred either through the air (known as air-borne sound/noise) or through solid structures/materials (structure-borne sound/noise or impact noise).

SOURCES OF NOISE POLLUTION IN THE BUILT ENVIRONNENT

To be able to effectively deal with the problem of noise, there is a need to first identify the sources of noise. According to Ogunsote (1991), the major sources of noise can be broadly divided into two: external and internal sources. However, Gregory (1998) identified three categories of source of noise to include:

Sources associated with activities and office equipment;
Sources associated with operation of building services; and
Sources of environmental sound from outside the building.
The first two categories of Gregory’s classification can be referred to as internal sources while the third category tallies with the external sources of Ogunsote’s classification (Ganiyu and Ogunsote, 2010).

EXTERNAL SOURCES OF NOISE

These constitute the major sources of environmental noise. They are noises that may be difficult to control from the source. They include, but are not limited to the following: noise from traffic and automobiles; noise from industries like quarries and mining industries; noise from pedestrians; noise from religious institutions like churches and mosques; noise from advertising agents and hawkers; noise from rallies like political campaigns, and so on (Ganiyu and Ogunsote, 2010).

INTERNAL SOURCES OF NOISE

These are noises associated with human activities within the building, operation of building services and office equipment. These may include door slam, footfall (especially in multi-storey buildings), conversation, radio and television sets, fans and air-conditioners, home appliances and motorised appliances such as power generating sets (Ogunsote, 2010).

These sources of noise can all be sources of vibration that may interfere with occupants of built environment’s activities and comfort. While some of these are tolerable and desirable, Ephraime (2002) posited that quite a number of them are undesirable, cause discomfort and may be harmful and hazardous. Table 1 shows relative noise levels and their subjective impressions.

Table 1: Relative Noise Levels and Subjective Impressions.

Noise Source	Distance from Noise Source (feet)	A-Weighted Sound Level in Decibels	Noise Environment	Subjective Impression
Civil Defence Siren	100	130		
Jet Takeoff	200	120		Pain Threshold
		110	Rock Music Concert	
Pile Driver	100	100		Very Loud
Helicopter	1000	90	Printing Press Plant	Loud
Freight Cars	50	80		
Vacuum Cleaner	10	70	Garbage Disposal	Moderately Loud
		60	Data Processing Centre	
Light Traffic	100	50	Department Store	
Large Transformer	200	40	Business Office	Quiet
		30	Quiet Bedroom	
Soft Whisper	5	20	Recording Studio	
		10		Hearing Threshold

Source: Ganiyu and Ogunsote (2010)

IMPACT OF NOISE

The effect of noise on any human being may be psychological or physiological (Ogunsote, 2010, Adedeji and Folorunsho, 2010). This may range from annoyance to permanent and immediate loss of hearing. Psychological effects of noise may include annoyance, stress, weakness in children, mental fatigue, tension, loss of privacy and so on. The physiological effects include sleeplessness, a paling in the skin, hearing damages that range from temporary threshold shift through permanent threshold shift to deafness. Medical experts, according to Ephraime (2002), believe that noise pollution in cities poses greatest threat to unborn babies and children. Excessive noise exposure can cause both anatomical abnormalities and more subtle deviations in human and metabolic functions. Loud noise is believed to cause dilated pupils, constricts blood vessels, create cardiac and intestinal ailment. Noise interferes with speech, sleep leisure and learning.

Ephraime (2002) asserted that incessant and loud noise is hazardous to the built environment – both life and property. The negative impact of noise on the built environment increases with the noise level and depend on the distance from the source of the noise. The impact also varies with the time of the day as noise level tolerable in the day time may cause significant discomfort at night. The degree of the negative impact may also vary with location since urban dwellers are generally more tolerant of noise than rural dwellers (Ogunsote, 2010). Sudden and very intense noise level will cause more damage than monotonous noise. It should be note, however, that the degree of disturbance and impact caused by noise depends on individuals.

According to Wikipedia(2010) noise can cause hearing impairment, hypertension, ischemic heart disease, annoyance, premature ejaculation, bowel movements, sleep disturbance, death and decreased sexual performance. Changes in the immune system and birth defects have also been attributed to noise exposure. Noise exposure has also been known to induce tinnitus, hypertension, vasoconstriction and other cardiovascular impacts. Beyond these effects, elevated noise levels can create stress, increase workplace accident rates, and stimulate aggression and other anti-social behaviours. The most significant causes these impacts are vehicle and aircraft noise, prolonged exposure to loud music, and industrial noise (Wikipedia, 2010).

Table 2: Psychological and physiological effects of sounds

Noise level	Possible psychological and physiological effects.
65 dBA	Annoyance, mental and physical fatigue.
90dBA	Very long exposure may cause permanent hearing loss.
100dBA	Short exposure may cause temporary damage; long exposure may cause permanent damage.
120 dBA	Pain.
150dBa	Immediate loss of hearing.

Source: Ogunsote (1991)

RESEARCH SETTING AND METHODOLOGY

The Study Area

Oba-Ile is in Akure North local government area of Ondo State. Oba-Ile has played host to the Ondo State Radiovision Corporation (OSRC) at its inception and continues to host the Nigerian Television Authority (NTA), Akure and the Housing Estate among others (Fagbemi, 2011). Coming from Akure, Oba-Ile Housing Estate is located at the entrance of Oba-Ile, a town in the outskirt of the State capital of Ondo State.

Method of Data Collection

The research adopted a survey method of the study area using a structured questionnaire which was administered randomly on some of the buildings along the major streets in the Estate. In this study, simple random sampling was used to administer the questionnaire on one building out of every five buildings along the major streets of the estate. The questionnaires were administered with the help of some the 500level students offering Environmental Control III (Architectural Acoustics and Noise Control). In all, 35 questionnaires were administered and returned for analysis.

The research seeks to find answers to the following questions:

1. What types of buildings are built in the study area?
2. What are the major sources of noise in a typical government housing estate in Nigeria?
3. What is the state of the roads within the estate?
4. What are the impacts of the noise on the residents of the housing estate?
5. What are the noise control measures adopted by the residents of the housing estate?

DATA PRESENTATION AND DISCUSSION OF RESULTS

The data collected through the structured questionnaire were analysis using percentile:

Types of Buildings

The researchers seek to know the major types of buildings found in the Estate. The questionnaire classified the buildings as roomy apartment, semi-detached, detached and multi-storey buildings. The research revealed that there are three (3) distinct types of building in the estate. Table 3 shows that the number of semi-detached buildings is fifteen (15) representing 42.8%, while those of detached buildings is thirteen (13) representing 37.2% and seven (7) duplexes representing 20% . Because majority of the buildings are semi-detached, the ease with which noise from one dwelling unit interferes with the comfort and privacy of the other family is greatly increased. The impacts of both air-borne and structure-borne noises are very significant in semi-detached buildings than detached buildings.

Table 3: Types of Building

Types of Building	Number of building	Percentage (%)
Face-face (Roomy Apartment)	0	0
Semi-detached	15	42.8
Detached bungalow	13	37.2
Duplex	7	20
Multi-storey	0	0
Total	35	100

Source: Researchers' field survey (2011)

Types and Sources of Noise

Two types of sources of noise were identified: i. the external sources of noise and, ii. the internal sources of noise. Respondents identified vehicular traffic, generating sets and pedestrian traffic as the major sources of external noise while grinding machine, electronic appliances, mobile phones and washing machines were identified as the major sources of internal noise. This observation is in line with the submission of Ogunsote (2010). Besides, Plate 1 show a gridding machine situated at the entrance of a residential building which is major source of noise. Since there are no shopping malls within the estate, residents take the advantage to put all sorts of business ventures in front of their houses regardless of the noise implication. Epileptic power supply has become a permanent decimal in the residential areas which has forced everybody to find alternative to NEPA. Household generators (I-pass-my-neighbour), a common feature in the residential estate, do not only generate noise pollution but capable of air and water pollution. Proliferation of mobile phones coupled with lack of phone ethics, especially at night (extra-cool) is one of the major source of noise pollution that can cause stress, sleeplessness and reduce productivity.

Plate 1: Grinding machine: a source of noise in the study area
Source: Researchers' field survey (2011).

State of the Roads

All the roads in the Estate are either graded or tarred (see Plate 2). As a result of the states of roads, cars often move at very high speed thereby generating noise in the neighbourhood. Respondents agreed that there is a relationship between the state of the road and the level of noise been generated within the estate. There are no sufficient buffer zones to minimize the impacts of the vehicular and pedestrian traffic noise in some of the buildings in the study area as demonstrated in Plate 2. Commercial busses which are also allowed to ply within the estate can worsen the vehicular traffic within the estate coupled with their habitual but irritating and noisy horns meant to attract passengers.

Plate 2: A building bounded by a tarred and graded roads with inadequate setbacks Source: Researchers' field survey (2011).

Assessment of the Noise Impact

Of all the sources of external noise examined, respondents submitted that generating set, vehicular traffic; pedestrian traffic and religious buildings were found to have significant impact on the people of the study area (see Table 4). Generating sets of various sizes and ages are often put on at night when residents are supposed to be resting and/or sleeping. The noise emanating from these generators can cause to a lot of negative psychological and physical impacts on the residents. Such psychological impacts can include annoyance, stress and mental fatigue. Sleeplessness, temporary hearing damage, physical fatigues are some of the physical impacts that can arise from regular exposure to such noise. These findings corroborate the observation of Ephraime (2002) that persistent noise is injurious to the built environment. There is neither railway nor factory within the estate that can pose any serious noise threat to the residents. The location of the airport is very far from the estate; hence the impact of the noise is very minimal.

Table 4: Impacts of External Noise on the Study Area

Source of External Noise	Very Significant Impact	Significant Impact	Average Impact	Mild Impact	No Impact
Vehicular traffic	31	4	0	0	0
Pedestrian traffic.	1	6	13	8	7
Train	0	0	0	0	35
Aircraft	0	0	0	10	25
Churches	0	6	13	5	11
Mosques	0	0	7	6	22
Advertising agents	0	0	0	7	28
Factory/Industry	0	0	0	0	35
Generating Set.	24	6	5	0	0

Source: Researchers' field survey (2011).

Respondents identified electronic appliances (television and radio sets), mobile phones/phones and washing machine as sources of internal noise considered to have serious negative impacts. Since generating sets are often put on around the houses, residents are left with no option than to raise the volume of the televisions and/or radio sets if they must hear what is been said. The effect of this is temporary threshold shift in hearing which is often noticed when then residents usually have to lower the volume of their sets the second day. Mobile phone, a technological breakthrough in communication, has become a house property of every hook and harry in the country. The use and abuse of this necessary companion in private and public places has call for a serious concern especially in relation to noise pollution. Residents engage in calls at the top of their voice, even at night when calls are both free or cheaper, thereby disturbing the peace of the environment and infringing on the comfort and privacy of neighbours. The internal noise from electronic appliances and uncultured phone users can cause annoyance, stress and psychological fatigue. This agrees with the submission of Wikipedea (2010) that noise is indeed a significant causative factor to stress and physical fatigue in residential estates. There is need to educate people on the ethics of using telephones/mobile phones within the residential area so as not to constitute nuisance to other residents.

Table 5: Impacts of Internal Noise on the Study Area

Source of Internal Noise	Very serious Impact	Serious Impact	Average Impact	Mild Impact	No Impact
Television	1	8	18	8	0
Radio	8	22	5	0	0
Washing machine	0	7	9	13	6
Door jam	0	6	10	10	9
Foot dragging	0	0	6	24	5
Telephone/mobile phone	11	18	5	1	0

Source: Researchers' field survey (2011)

Noise Control Measures and their Effects

The research seeks to know opinions of the residents on what should be done to control the noise and what impact the control measures has. The result of the respondents is presented in table 6. Majority of the respondents opined that increasing the distance between the noise source and the residents goes a long way to reduce the impact of the noise from outside especially the generator noise. It has been confirmed that the intensity of the noise decreases with increase in distance. Insulating the noise source and providing effective screen will also greatly reduce the external noise, especially the one from vehicular and pedestrian traffic. Provision of adequate setback and creation of sufficient buffer zone between the vehicular road and the buildings will also enhance the acoustic comfort level of the residents. Zoning the estate into relevance zones such as religious zone, commercial zone, etc will eliminate the infringement of the religious and commercial activities on the residential zone thereby reducing the noise from such areas which have been found to have substantial impacts on the residents. Respondents strongly agreed that reducing the noise from source and closing the openings are the most effective internal noise control measures. Most of the internal sources of noise can be controlled by simply tuning down the volume of the gadgets from the source. There is need to create public enlightenment on the use of mobile and land phones. Apart from the fact that this will help minimise the noise emanating from the use of phones, it will also help reduce its other several abuses.

Table 6: Noise Control Measures in the Study Area

Item	Strongly Agree (4)	Agree (3)	Disagree (2)	Strongly Disagree (1)
Close the windows and doors	5	22	8	0
Reduce the noise at source	23	8	4	0
Move away from the source	0	10	9	16
Indifference to the noise	0	0	22	13
Adequate setback/buffer zone	25	8	2	35
Public awareness/ Enlightenment	18	10	7	0
Zoning within the estate	28	7	0	35
Relocate from the area	0	11	22	2

Source: Researchers' field survey (2011)

RECOMMENDATIONS AND CONCLUSION

Recommendations

Based on the above findings, the following recommendations are proposed:

1. Buildings should be sited with adequate setback from the road to minimize the effects of the vehicular and pedestrian traffic noise. Where possible, buffer zones made of fence, trees, hedges and/or shrubs should be provided to reduce the impact of the noise on residents.
2. Shopping malls and/or corner shops should be provided for residential housing estates to discourage the location of grinding machines within the residential area of the estate.
3. Government should ensure regular supply and distribution of electricity to all residential areas, especially at night to discourage the use of generating sets which has become a necessity in every household in Nigeria. The use of generating sets in the residential estates poses a serious health hazard to residents as it does not only serve as noise pollution but also air poisoning.
4. Zoning the religious area away from the residential area will go a long way to reduce noise generated from religious buildings especially at night when residents are expected to take rest after a busy working day. Government should enact laws that will prohibit the use of public address system by religious buildings at night. Government should also constitute special squad for enforcement of the law.
5. There is need to create public awareness to educate the masses on the ethics of using phones and electronic appliances which may induce general negative physiological and psychological impacts on the built environment.

CONCLUSIONS

The aim of this research was to study the major sources of noise pollution in typical government housing estate in Akure, Nigeria and assess the level of its impacts on the residents with a view to proffer ways at minimising the damaging effects of the noise pollution. The findings of the study are applicable to government owned housing estates in the south-western part of Nigeria. The fact that sources of noise pollution in our built environment is growing wider by the day and their impacts taking toll on the lives of residents of built environment can no longer be disputed. For effective control of these impacts, this paper confirmed vehicular traffic, generating sets, religious buildings and pedestrian traffic as the major sources of negative generators of external noise pollution and electronic appliances, mobile phones and washing machine as the main sources of noise pollution from within the building in a typical housing estate in Akure, Nigeria. The study identified vehicular traffic, generating sets, mobile phones and household equipment/appliances as source with serious impact on the residents of the housing estate. The paper finally recommend adequate setbacks, buffer zones, shopping malls/corner shops, constant electricity supply, zoning and law enactment and enforcement as necessary measures towards controlling the negative impact of noise pollution in residential estates.

ACKNOWLEDGEMENT

The authors acknowledge the efforts of some of the 500level students of the Department of Architecture, Federal University of Technology, Akure during field studies and in the collection and analysis of data.

REFERENCES

Ephraime, E. E. (2002) The Decaying City: The Prevailing Instruments of Decay Governments Inaction and Public Attitudinal Posturing. In: *The Decaying City: Architect's Dilemma and Responsibilities.* Edited by Arc. Faworaja *et al*. pp. 16 -24.

Fagbemi S. (2011). The Untold Story of An Ancient Yoruba Town, Oba-Ile (Part 4 of 4) (http://focusnigeria.com/oloba-oba-ile.htm)

Ganiyu, S. A. and Ogunsote, O. O. (2010) A Study of the Sources and Control of Environmental Noise Pollution on a Typical Street in Akure, Nigeria. A paper presented in an International Conterence organised by School of Environmental Technology, Federal University of Technology, Akure.

Gregory, C. T. (1998) “Building Noise Control Applications” in Architectural Acoustics. Edited by William J. C. and Joseph A. W. pp. 100 -150.

Adedeji, Y. M. D. and Folorunso C. O. (2010) Pollution Management in Housing Environment and health of Urban Dwellers. A paper presented in an International Conterence organised by School of Environmental Technology, Federal University of Technology, Akure.

Ogunsote, O. O. (2010) Environmental Control – Acoustics and Noise Control. Unpublished Lecture Notes, Department of Architecture, Federal University of Technology, Akure. (Also available on http://sdngnet.com/Files/Lectures/FUTA-ARC-507/)

Wikipedia (2010) Health Effects from Noise. (http://en.wikipedia.org/wiki/health_effects_from_noise#cite_note-RosenHall1990-1).

AFFORDABILITY ASSESSMENT OF THE HOUSING UNITS BUILT FROM FEDERAL MORTGAGE BANK'S LOANS IN NIGERIA

Musa Nuhu Madawaki[1]

Department of Building, Ahmadu Bello University, Zaria, Kaduna state, Nigeria

Low affordability has been a central concern in Nigeria's housing problem. This is traceable to either insufficient income, excessive cost of Housing, or both. Affordable housing units are ones built within financial abilities of buyers or whose rent or mortgage does not exceed 30 % of gross annual household income (Andrew in Musa-Haddery 2011). Currently, majority of Nigerians cannot afford to own houses even after solutions were attempted by the Federal Mortgage Bank of Nigeria (FMBN) through the grant of loans to developers to construct various classes of housing units and another set of loans through Primary Mortgage Institutions (PMIs) to individuals that contributed to Nigeria's National Housing Fund to buy the housing units produced. The only hypothesis of the study assumed no significant relationship between gross average annual incomes of the low, middle, and high income groups in Nigeria and the costs at which the various classes of housing units were sold. Data was collected via questionnaires administered on FMBN and mortgagors through stratified purposive sampling. Analyses were by ratio tests and Spearman's ranked correlation. Findings revealed acceptance of null hypothesis for relationship between the gross annual income of the lowest paid income group and the costs at which low income housing units were sold. The null hypothesis was rejected each for relationship between the gross average annual incomes of the middle and high income groups and the costs at which the respective incomes housing units were sold. The patronage of local improved materials and improved naira value were advocated.

Keywords: affordability, gross annual income, mortgage loan, naira value.

INTRODUCTION

In most countries of West Africa, the ownership of affordable good quality Housing has being a problem justifying serious public and private sectors intervention (Yao 2007; Karley 2008; Atagher 2008; Cudjoe 2010). For instance, in Nigeria since independence, affordable Housing has been the major policy concern of relevant Housing and Mortgage Institutions (Sanusi 2003; Ahmed 2008; Okereke 2010). However, critics are of the view that despite this policy efforts, only the needs of the middle and high-income classes are met (Ayorinde and Morenikeji 1994; Okonkwo 2004; Sambo 2006; Bala 2007a; 2007b). The current research effort aims to provide additional proof that indeed, all the Housing and Mortgage strategies put in place by the FMBN since 1992 have not yielded significant results in the enablement stride with respect to households earning below US $1.50 a day in Nigeria.

Previous research works indicate poor coordination between intent and action by the Nigeria's Housing / Mortgage Planners and players (Ayorinde and Morenikeji 1994;

[1] musamadawaki@yahoo.com; musamadawaki@gmail.com

Madawaki, M.N. (2011) Affordability assessment of the housing units built from federal mortgage bank's loans in Nigeria *In:* Laryea, S., Leiringer, R. and Hughes, W. (Eds) *Procs West Africa Built Environment Research (WABER) Conference,* 19-21 July 2011, Accra, Ghana, 69-78.

Wahab 1995; Mosaku 1997; Olotuah 2000; Anthonio 2001; Groves 2004; Gomez 2006; Ojo 2009; Okereke 2010). And, failure to produce and distribute low-priced materials and components to people in need as reasons for the poor results in the case of affordable good quality housing for the low-income (Karley 2008; FRCN 2010).

STATEMENT OF THE RESEARCH PROBLEM

Insufficient income and excessive cost of housing are two problems militating against affordable Housing in Nigerian. The country’s low-income earners (persons whose earnings are below US $1.50, or (₦225.00k) per day) appear to be the worst hit. This is because a sizeable portion of the low-income earners are not qualified to access FMBN’s loans on the grounds of earning below the Minimum National Wage of ₦6,750.00k per month (or, ₦81,000.00k per annum). Even the few that qualify, find it difficult to purchase FMBN’s facilitated housing units from the Bank’s loans alone and not even when added to savings.

AIM OF THE STUDY

To evaluate the relationships between the gross annual incomes of low, middle, and high-income mortgagors of the FMBN and the costs at which the Bank’s facilitated housings units were sold to qualified members of the three income groups during the period between 2009 and 2010 in the various states of Nigeria.

JUSTIFICATION FOR THE STUDY

The house is one of three man’s most basic needs that contributes to the health status of its occupants and determines the economic growth of individuals and nations. Currently, less than 25 % of the 150 million people in Nigeria own houses (Atagher 2008). The rest of the population leaves in rented quarters or make-shift residences (NPC 2006). This certainly reflects the severity of Housing stress and inconveniences arising from homelessness amongst Nigerians (Kaltho 2008). Indeed, in Nigeria the low-income group constitute the majority (NPC Op. Cit.) and have the least access to resources for good quality affordable Housing (Bala, 2007a; Adebowale 2007; Stock 2008; Ojo 2009). The consequences of these malfunctions show in haphazard physical development, numerous un-authorized ditches excavated to obtain earth for construction. Most of the ditches become breeding grounds for mosquitoes. And, some of the ditches turn into dangerous ponds. Also, there is open air defecation with consequences for public health in many Nigerian settlements (Sattaur 2004; Musa 2009). Hence, there is the need to resolve the crisis in its entirety.

LITERATURE REVIEW

Affordability is frequently mentioned in most discussions on Housing (Burnett 2006). However, affordability has been viewed from many standpoints. One of the standpoints expressed affordability as a relationship between the level of housing expenditure and household income (Musa-Haddery 2011). This view incorporates elements of Housing within acceptable standards without imposing unreasonable burden on the household income. Andrew (2004) observed that affordability is influenced by a range of factors including salary progression, fiscal and economic policies, and financial market characteristics. And, that the concept affordability in Housing changes over time, depending on such factors as: number of dependants, age, job security, and changes in interest on loans and so on. However, Karley (2008) is of the view that an affordable mortgage loans is dictated by three factors, namely: house price, income and the amount loanable to the mortgagor. The view taken in this paper concerns households' ability to 'reasonably' meet the consumer costs of Housing suitable to their residential needs (Musa-Haddery Op. Cit.). Affordability as used in this study, refers to the ability of the household to meet the monthly amortization or rent payment that approximates to one third of the total household income (Neuteboom 2004; Ural 2006; Karley 2008).

THEORETICAL FRAMEWORK

Philip (2001) observed that: *"**Affordability in Housing is income relative". Also,*** Andrew 2004 argued "affordable housing units as ones built within the financial abilities of buyers or one whose rent or mortgage does not exceed 30 % of the gross annual household income". This view incorporates the elements of Housing within acceptable standards without imposing unfair burden on household income. As such, how affordable were FMBN's facilitated housing units to people within low, middle, and high-income groups that accessed the relevant housing units during the period between 1992 and 2010 in 26 selected states of Nigeria?

RESEARCH METHOD AND DESIGN

This study is essentially comparative. Four sets of data were found and the relationships between them analyzed for significance. The four sets of data are;

(i), the volumes of dual funding to low, middle, and high-incomes' Housing by the FMBN through direct disbursements to the accounts of property developers and to NHF-contributors through their PMIs during the period between 1992 and 2010 in 26 selected states of Nigeria.

(ii), the average costs of low, middle, and high-incomes housing unit in the various states of Nigeria in each of the selected state during the period under review (1992 - 2010).

(iii), the gross average annual incomes of persons that accessed the loans in each income group during the study period (1992 - 2010).

(iv), the character of relationships between the FMBN's averages pooled funding to various incomes Housing and the respective gross annual income of persons that accessed the loans in each income group

The FMBN's average pooled funding to each particular income's Housing in every state was obtained by adding the loans disbursed to developers for each particular class of income's housing units to the loans disbursed to individuals National Housing Fund (NHF) contributors via their PMIs and dividing the sum by two.

DATA COLLECTION

The study relied on historical data sourced from developers, official records of the National Headquarters, and State branch-offices of the Federal Mortgage Bank of Nigeria (FMBN). Also, data was sourced from the National Salaries, Incomes and Wages Commission of Nigeria.

METHOD OF DATA ANALYSIS

Hypothesis of the research work

H_{O1} --- There is no significant relationship between the gross annual income of members of an income group in Nigeria and the cost at which the income's FMBN's facilitated housing units was sold to members of the group during the period between 1992 and 2010.

Tools for Testing the Hypothesis

Ratio analysis and Spearman's ranked correlation were the tools used to test the hypothesis.

Spearman's coefficient of ranked correlation is expressed as: $(r) = 1 - (6 \Sigma d^2 / n^2 - n)$

The coefficient of correlation r determines the strength of the link between paired sets of ranked data. In this analysis, the ranks were assigned from the highest to smallest values for each set of data. The SPSS 13 statistical package was used to carry out the ranking and calculations.

The Decision Rule

(a.) For affordability, Unit cost of housing / gross household income ≤ 30% .When ratio > 30% => House is unaffordable (Andrew 2004, Ural 2006)

(b.) Spearman's coefficient of ranked correlation ranges between $-1 \leq r \leq 1$. A value of r close to zero signifies a weak or no correlation (Spiegel and Stephens 2007).

Table 01: FMBN's ave. pooled loan to gross annual income of mortgagors and unit cost of houses

	average pooled loan per unit of house (Benefit) (₦'m)	Mortgagors' gross annual income (₦'m)	cost of house in market (₦'m)	Ratio of ave. pooled loan to Income (%)	Ratio of unit cost of house to Income (%)	average pooled loan per unit of house (Benefit) (₦'m)	Mortgagors' gross annual income (₦'m)	cost of house in market (₦'m)	Ratio of ave. pooled loan to Income (%)	Ratio of unit cost of house to Income (%)	average pooled loan per unit of house (Benefit) (₦'m)	Mortgagors' gross annual income (₦'m)	cost of house in market (₦'m)	Ratio of ave. pooled loan to Income (%)	Ratio of unit cost of house to Income (%)
1. Abia	1.48	6.00	3.10	24.67	51.67	1.96	42.00	12.00	4.67	28.57	3.44	345.00	37.30	1.00	10.81
2. Akwa Ibom	0.72	0.08	3.20	09.00	53.33	1.93	48.00	11.60	4.02	24.17	3.70	345.00	36.80	1.07	10.67
3. Anambra	0.06	6.00	3.00	01.00	50.00	1.89	48.00	11.80	3.94	24.58	3.00	345.00	38.80	0.87	11.25
4. Bauchi	0.35	6.00	2.60	05.83	43.33	1.85	42.00	10.40	4.41	24.76	3.04	345.00	40.30	0.88	11.68
5. Benue	1.19	6.00	2.40	19.83	40.00	1.50	48.00	11.00	3.13	22.92	2.90	345.00	29.60	0.84	08.58
6. Cross-River	0.81	8.00	3.40	10.13	42.50	1.97	48.00	12.30	4.10	25.63	2.90	345.00	28.90	0.84	08.38
7. Delta	0.81	8.00	2.80	10.13	35.00	1.93	48.00	10.20	4.02	21.25	3.80	345.00	30.20	1.10	08.75
8. Ebonyi	0.72	8.00	3.00	09.00	37.50	1.90	48.00	10.80	3.96	22.50	3.02	345.00	36.90	0.88	10.70
9. Edo	0.54	8.00	2.90	06.75	36.25	2.03	48.00	10.20	4.23	21.25	2.99	345.00	37.10	0.87	10.75
10. Enugu	0.26	6.00	3.20	04.33	53.33	2.05	48.00	12.50	4.27	26.04	3.03	345.00	38.60	0.88	11.19
11. FCT-Abuja	0.13	6.00	4.40	01.63	55.00	2.09	53.00	15.80	3.94	29.81	3.01	345.00	65.50	0.54	11.98
12. Gombe	0.64	6.00	2.60	10.67	43.33	1.99	48.00	10.20	4.15	21.25	3.31	345.00	38.20	0.96	11.07
13. Kaduna	0.81	6.00	2.50	13.50	41.67	2.17	48.00	11.50	4.52	23.96	2.89	345.00	32.80	0.84	09.51
14. Kano	0.35	6.00	2.40	05.83	40.00	2.33	48.00	12.00	4.85	25.00	3.50	345.00	35.00	1.02	10.15
15. Katsina	0.45	6.00	2.60	07.50	43.33	2.27	48.00	12.30	4.73	25.63	2.93	345.00	34.90	0.85	10.12
16. Kebbi	0.39	6.00	2.50	06.50	41.67	1.97	48.00	10.50	4.10	21.88	2.33	345.00	32.80	0.68	09.51
17. Kwara	0.39	6.00	2.50	06.50	41.67	1.78	48.00	11.10	3.71	23.13	3.10	345.00	32.00	0.90	09.28
18. Lagos	0.29	0.08	4.10	03.60	51.25	2.02	58.00	13.00	3.48	22.41	2.74	345.00	54.90	0.79	15.91
19. Nassarawa	0.71	6.00	3.90	11.83	65.00	1.84	48.00	10.70	3.83	22.29	3.48	345.00	30.80	1.01	08.93
20. Niger	0.34	6.00	2.40	05.67	40.00	1.98	48.00	10.80	4.13	22.50	3.04	345.00	30.20	0.88	08.75
21. Ogun	0.16	6.00	2.90	02.67	48.33	2.00	48.00	12.30	4.17	25.63	3.14	345.00	33.20	0.91	09.62
22. Ondo	0.31	6.00	2.90	05.16	48.33	2.15	48.00	11.80	4.48	24.58	2.89	345.00	32.80	0.84	09.51
23. Osun	0.40	6.00	2.80	06.67	46.67	1.95	48.00	11.40	4.06	23.75	3.09	345.00	30.70	0.90	08.90
24. Rivers	0.70	6.00	2.80	08.75	35.00	2.00	58.00	12.20	3.45	21.04	3.35	350.00	35.40	0.96	10.26
25. Taraba	0.83	6.00	2.60	13.83	43.33	1.80	48.00	11.00	3.75	22.92	3.05	345.00	39.80	0.88	11.54
26. Yobe	0.27	6.00	2.50	04.50	41.67	1.80	48.00	10.80	3.75	22.50	3.18	345.00	30.20	0.92	08.75

Comments on the ratios of mortgagors' income to cost per each class of housing units

The ratio tests between gross average annual income, average pooled loan, and unit costs of Houses revealed that the housing units sold to members of the middle and high-income groups were affordable to the two income groups (R < 30 %). However, the case was not same for the low-income group in all the states studied (R > 30 %).

A further analysis was carried out between gross average annual incomes of persons that accessed FMBN's loans and the costs at which the various classes of housing units were sold to the respective members of the low, middle, and high-income groups. In later this part of the study, the tool for analysis is the Spearman's ranked correlation.

Table 02: Unit cost of low-income house in the market to mortgagors' average annual income

	State	Low-income mortgagors' average annual income (₦'m)	Cost of housing unit in market location of Nigeria (₦' m)	X - Ranking	Y - Ranking	$D = R_X - R_Y$	D^2
		X	Y	R_X	R_Y		
1	Abia	6.00	3.10	17.5	08.5	09.00	81.00
2	Akwa Ibom	8.00	3.20	04.5	06.0	– 01.50	02.25
3	Anambra	6.00	3.00	17.5	10.5	07.00	49.00
4	Bauchi	6.00	2.60	17.5	22.0	– 04.50	20.25
5	Benue	6.00	2.40	17.5	26.0	– 08.5	72.25
6	Cross-River	8.00	3.40	04.5	04.0	00.50	00.25
7	Delta	8.00	2.80	04.5	17.5	– 13.00	169.00
8	Ebonyi	8.00	3.00	04.5	10.5	– 06.00	36.00
9	Edo	8.00	2.90	04.5	13.5	– 09.00	81.00
10	Enugu	6.00	3.20	17.5	06.0	11.50	132.25
11	FCT, Abuja	8.00	4.40	04.5	01.0	03.50	12.25
12	Gombe	6.00	2.60	17.5	22.0	– 04.50	20.25
13	Kaduna	6.00	2.90	17.5	13.5	04.00	16.00
14	Kano	6.00	2.70	17.5	20.0	– 02.50	06.25
15	Katsina	6.00	3.20	17.5	06.0	11.50	132.25
16	Kebbi	6.00	3.10	17.5	08.5	09.00	81.00
17	Kwara	6.00	2.80	17.5	17.5	00.00	00.00
18	Lagos	8.00	4.10	04.5	02.0	02.50	06.25
19	Nassarawa	6.00	3.90	17.5	03.0	14.50	210.25
20	Niger	6.00	2.50	17.5	24.5	– 07.00	49.00
21	Ogun	6.00	2.90	17.5	13.5	04.00	16.00
22	Ondo	6.00	2.90	17.5	13.5	04.00	16.00
23	Osun	6.00	2.80	17.5	17.5	00.00	00.00
24	Rivers	8.00	2.80	04.5	17.5	– 13.00	169.00
25	Taraba	6.00	2.60	17.5	22.0	– 04.50	20.25
26	Yobe	6.00	2.50	17.5	24.5	07.00	49.00
	Total	-	-	-	-		**$\Sigma D^2 = 1749.15$**

But, $r = 1 – [6\Sigma D^2 \div n(n^2 – 1)]$

Applying the relevant values, we have: $r = 1 – [6\Sigma D^2 \div (n^3 – n)] = 1 – [6\Sigma D^2 \div (26^3 – 26)]$

$= 1 – [6 \times 1144.00 \div 17550] = 1 – 0.598 = 0.402$

The correlation coefficient $r_{(low\text{-}income)}$ is 0.40 which is positive and week. Therefore, H_{O1} stands accepted.

That is; there is no significant relationship between the gross annual income of members of an income group in Nigeria and the cost at which the income's FMBN's facilitated housing units was sold to members of the group during the period between 1992 and 2010.

But , $r = 1 – [6\Sigma D^2 \div n(n^2 – 1)]$

Applying the relevant values, we have: $r = 1 – [6\Sigma D^2 \div (n^3 – n)] = 1 – [6\Sigma D^2 \div (26^3 – 26)]$

$= 1 – [6 \times 1312.50 \div 17550] = 1 – 0.45 = 0.55$

The correlation coefficient $r_{(\text{middle-income})}$ is 0.60 which is positive and fair. Therefore, H_{O1} stands rejected. This means acceptance of H_1.

That is; there is significant relationship between the gross annual income of members of an income group in Nigeria and the cost at which the income's FMBN's facilitated housing units were sold to members of the group during the period between 1992 and 2010.

Table 03: Unit cost of middle-income house in the market to mortgagors' average annual income

	State	Middle-income mortgagors' average annual income (₦'m) X	Cost of housing unit in market location of Nigeria (₦' m) Y	X - Ranking R_X	Y - Ranking R_Y	$D = R_X - R_Y$	D^2
1	Abia	42.00	12.00	25.5	08.5	16.0	264.00
2	Akwa Ibom	48.00	11.60	14.0	12.0	02.0	04.00
3	Anambra	48.00	11.80	14.0	10.5	03.5	12.25
4	Bauchi	42.00	10.40	25.5	23.0	02.5	06.25
5	Benue	48.00	11.00	14.0	16.5	−02.5	06.25
6	Cross-River	48.00	12.30	14.0	05.0	09.0	81.00
7	Delta	48.00	10.20	14.0	25.0	−11.0	121.00
8	Ebonyi	48.00	10.80	14.0	19.0	−05.0	25.00
9	Edo	48.00	10.20	14.0	25.0	−11.0	121.00
10	Enugu	48.00	12.50	14.0	03.0	11.0	121.00
11	FCT, Abuja	53.00	15.80	03.0	01.0	02.0	04.00
12	Gombe	48.00	10.20	14.0	25.0	−11.0	121.00
13	Kaduna	48.00	11.50	14.0	13.0	01.0	01.00
14	Kano	48.00	12.00	14.0	08.0	05.0	25.00
15	Katsina	48.00	12.30	14.0	05.0	09.0	81.00
16	Kebbi	48.00	10.50	14.0	22.0	−08.0	64.00
17	Kwara	48.00	11.10	14.0	15.0	−01. 0	01.00
18	Lagos	58.00	13.00	01.5	02.0	−00.5	25.00
19	Nassarawa	48.00	10.70	14.0	21.0	−07.0	49.00
20	Niger	48.00	10.80	14.0	19.0	−05.0	25.00
21	Ogun	48.00	12.30	14.0	05.0	09.0	81.00
22	Ondo	48.00	11.80	14.0	10.5	03.5	12.25
23	Osun	48.00	11.40	14.0	14.0	00.0	00.00
24	Rivers	58.00	12.20	01.5	07.0	−05.5	30.25
25	Taraba	48.00	11.00	14.0	16.5	−02.5	06.25
26	Yobe	48.00	10.80	14.0	19.0	−05.0	25.00
	Total	-	-	-	-		$\Sigma D^2 = 1312.50$

But , $r = 1 – [6\Sigma D^2 \div n(n^2 – 1)]$

Applying the relevant values, we have: $r = 1 – [6\Sigma D^2 \div (n^3 – n)] = 1 – [6\Sigma D^2 \div (26^3 – 26)]$

$= 1 – [6 \times 1401.75 \div 17550] = 1 – 0.48 = 0.52$

The correlation coefficient $r_{(\text{high-income})}$ is 0.50 which is positive and fair. Therefore, H_{O1} stands rejected. This means acceptance of H_1.

That is; there is significant relationship between the gross annual income of members of an income group in Nigeria and the cost at which the income's FMBN's facilitated housing units were sold to members of the group during the period between 1992 and 2010.

Table 04: Unit cost of high-income house in the market to mortgagors' average annual income

	State	High-income mortgagors' average annual income (₦'m) X	Cost of housing unit in market location of Nigeria (₦' m) Y	X - Ranking R_X	Y - Ranking R_Y	$D = R_X - R_Y$	D^2
1	Abia	345.00	37.30	14.5	08.0	06.5	42.25
2	Akwa Ibom	345.00	36.80	14.5	11.0	03.5	12.25
3	Anambra	345.00	38.80	14.5	05.0	09.5	90.25
4	Bauchi	345.00	40.30	14.5	03.0	11.5	132.25
5	Benue	345.00	29.60	14.5	25.0	− 10.5	110.25
6	Cross-River	345.00	28.90	14.5	26.0	− 11.5	132.25
7	Delta	345.00	30.20	14.5	22.0	− 07.5	56.25
8	Ebonyi	345.00	36.90	14.5	10.0	04.5	20.25
9	Edo	345.00	37.10	14.5	09.0	05.5	30.25
10	Enugu	345.00	38.60	14.5	06.0	08.5	72.25
11	FCT, Abuja	555.00	65.50	01.0	01.0	00.0	00.00
12	Gombe	345.00	38.20	14.5	07.0	07.5	56.25
13	Kaduna	345.00	32.80	14.5	17.0	− 03.5	12.25
14	Kano	345.00	35.00	14.5	13.0	01.5	02.25
15	Katsina	345.00	34.90	14.5	14.0	00.5	00.25
16	Kebbi	345.00	32.80	14.5	17.0	− 02.5	06.25
17	Kwara	345.00	32.00	14.5	24.0	− 09.5	90.25
18	Lagos	345.00	54.90	14.5	02.0	12.5	156.25
19	Nassarawa	345.00	30.80	14.5	19.0	− 04.5	20.25
20	Niger	345.00	30.20	14.5	22.0	− 07.5	56.25
21	Ogun	345.00	33.20	14.5	15.0	− 00.5	00.25
22	Ondo	345.00	32.80	14.5	17.0	− 02.5	06.25
23	Osun	345.00	30.70	14.5	20.0	− 05.5	30.25
24	Rivers	350.00	35.40	02.0	12.0	− 10.0	100.00
25	Taraba	345.00	39.80	14.5	04.0	10.5	110.25
26	Yobe	345.00	30.20	14.5	22.0	− 07.5	56.25
	Total	-	-	-	-		$\Sigma D^2 = 1401.75$

DISCUSSIONS

• The analyses conducted revealed that all FMBN's facilitated housing units for the low-income group were secured at rates that were higher than 30% of the gross average household income in all the states studied. The ($r_{(low\text{-}income)}$ was found to be 0.40. This value is positive and weak). Hence, null hypothesis (H_{O1}) stands accepted. That is: there was no significant relationship between the gross average annual income of members of the low-income group in Nigeria and the rates at which their respective income's housing units were sold in the states studied.

• In contrast, the middle and high-income groups had secured their respective housing units at prices lower than 30% of the gross average household incomes in each of the states studied. The values of $r_{(middle\text{-}income)}$ and $r_{(high\text{-}income)}$ were 0.60 and 0.50 respectively). These values are positive and fair). This means, the null hypothesis H_{O1} was rejected in each of the two cases. That is, acceptance of the alternate hypothesis H_1: There was significant relationship between the gross average annual income of members of the middle and high-income groups in Nigeria and the rates at which their respective income's housing units were sold in the states studied.

• The study has being identified the need for use of local building materials in low-income Housing (to reduce cost), charge low interests on loans, and greater community involvement in the allocation of resources for Housing to match the needs of the majority in Nigeria. When this is done, the low-income group stands greater chances of access to good quality affordable housing units in the country. Should the mortgage institutions, the public and private estate developers in Nigeria decide to use utilize these criteria hence forth, there would be a surge in construction workload in the country.

• An increased workload for the Construction Industry in Nigeria on top of the current level will necessitate the production of more construction personnel, fabrication of building components, and where necessary, out-right importation of construction tools and equipment.

• However, the industry remains unaware of what happened in the states whose data on the finance disbursed to various incomes' Housing by the FMBN were not made available and therefore, not analyzed. This would invariably affect the planning of anticipated workload in those states.

CONCLUSION

Low-income earners in the 26 states studied had accessed FMBN's sponsored housing units at prices greater than 30% of their gross annual incomes compared to the prices at which accesses were made by the middle and high-income earners during the period between 1992 and 2010. This result has exposed the inability of the Bank's current plan to meet the housing needs of low-income earners in Nigeria. Also, this discovery confirmed the ineffectiveness of the Housing Supply Channels patronized by the FMBN through developers with the support of state governments in meeting the housing needs of the low-income earners. The persistence of the malfunctions confirmed indifference on the parts of the Federal and States' Housing Authorities, the FMBN, and the Nigerian Building and Roads Research Institute (NIBRRI) as agents charged with ensuring solution and hence, complacency on the part of state as arbiter and thus, protection of class interest.

There is a strong need for systematic re-examine of the FMBN's current lending policy with regard to methods for facilitating access to the resources for Housing – particularly as it affects the low-income group in Nigeria. Doing this would stimulate the country's economic growth, revolutionise the construction industry and ensure sustained environmental quality and public health.

RECOMMENDATIONS

From the results of the study, the following recommendations are made;

Specific Recommendations:

(a.) In view of low affordability of FMBN's sponsored housing units to the low-income earners in all the states studied, low interest mortgage and timely release of the loans be considered for first time home buyers. This would encourage greater access to good quality affordable Housing by number of low-income families in all the states of Nigeria.

(b.) NBRRI and other improved local building materials such as stabilised earth, reinforced plastics, bricks, and partially replaced cement etcetera should be patronized to beat the current high cost of Housing in Nigeria.

(c.) NIBRRI should be given the task of monitoring and coordinating the research works, as well as, the dispensing of the improved building materials/components.

General Recommendation:

(d.) Training programmes in Architecture, Housing, and Building Construction should be reviewed to produce sufficient number of persons who are capable of generating designs and the production of truly low-income housing units that are appropriate to the low-income group in Nigeria.

REFERENCES

Adebowale, A. (Ed.)(2007). “Nigeria in 10 Minutes – Save time searching for facts on Nigeria”.Nigeriaguide; http:uK.oneworld.net/guide/Nigeria/development?gclid=CPuG1apm. Retrieved at 4.45 GMT. Tuesday, 16th October.

Ajanlekoko, A. S. (2001). “Sustainable Housing Development in Nigeria – The Financial and Infrastructural Implication”. A paper delivered at an International Conference on Spatial Information for Sustainable Development. Nairobi, Kenya. 2–5 October.

Akinwunmi, A. A. (2009). An Investigation into Factors Affecting Housing Finance Supply in Emerging Economies: A Case Study of Nigeria. An unpublished Ph. D. (Banking and Finance) dissertation submitted to The School of Postgraduate Studies, University of Wolverhampton, Wolverhampton (United Kingdom).

Atagher, M. I. (2008). “Effective Mortgage Financing for Nigerian Workers under the National Housing Fund (NHF)”. A paper presented by the Acting Managing Director/ CEO Federal Mortgage Bank of Nigeria (FBMN) in collaboration with the Nigeria Labour Congress (NLC) on April 7th and 8th, at Zaranda Hotel Bauchi, Bauchi State, Nigeria.

Andrew, I. (2004). Housing Affordability and Income Mobility for the Poor: a Review of Trends and Strategies for Meeting America’s Housing Needs (MAHN). htt:p//www.nlitic.org/index.htm. Downloaded at about 1.15 p.m. GMT. Wednesday; 2nd June, 2004. Pp 1 – 12.

Bala, K. (2007a). “An Analysis of the Loan Disbursements by Mortgage Institutions on Housing Construction, Purchase, and Rehabilitation Works in Nigeria”. The Construction Focus. Journal of the Academy of Building Sciences (JABS), Ahmadu Bello University, Zaria, Nigeria. Vol. 1 No. 1. Jan. Pp 64 -74.

Burnett, J. (2006) (5th Ed). A Social History of Housing 1815 – 1970. Methuen and Co Ltd, London (UK). Pp 1 to 2.

Cudjoe, F. (2010). Ghana: How Affordable is the STX-Ghana Affordable Housing Project? IMANI - The Foreign Policy Magazine of influential think tank in Africa. February.

F.M.B.N., (1998). “Five years Report on the implementation of the National Housing Fund [NHF] (1992 – 1997)”. Housing Today – Journal of the Association of Housing Corporation of Nigeria [AHCN]. Vol. 1; No 2. November/December. Pp 31 to 39.

--- (2008a). “National Housing Fund issued N37bn in 16 years”. The Daily Trust News Paper. The Media Trust Nigeria Ltd, Abuja, Nigeria. Tuesday, 24th June. P 45.

Karley, n. K. (2008). “Ghana residential property delivery constraints and affordability analysis”. The housing finance international publication. Sunday, June 1.

Kaltho, J. B. (2008). “The Development Action Plan 2007 – 2011 as tool for building harmonious cities in Niger State of Nigeria”. Guest lecture on the occasion of the Niger celebration of World Habitat Day held at the U. K. Bello Centre. Minna, Nigeria. 8th October.

Musa, M. N. (2009). “Towards Equity in Access to Mortgage for Housing in Nigeria”. An occasional paper. The Department of Building, Ahmadu Bello University, Zaria, Nigeria. Nov.

Musa-Haddery (2011). An Affordability Value Approach to Housing Design for Federal Civil Servants in Abuja. An unpublished Ph. D, (Const. Mgt.) dissertation submitted to The School Postgraduate Studies, Ahmadu Bello University, Zaria (Nigeria).

Neuteboom, p. (2004). "A comparative analysis of the net cost of a mortgage for homeowners in Europe". Journal of Housing and the Built Environment. Volume 19, Number 2 / June, 2004. The Springer, Netherlands. Pp 169-186. Retieved 15th August 2006 at 10.25 GMT.

NPC [Nigeria-National Population Commission] (2006). "Population Data Sheet 1 of 2006 and Summary of Sensitive Tables Vol. 1. The National Secretariat of the National Population and Housing Commission of Nigeria (NPHC), Abuja (Nigeria).

Ojo, A. O. (2009). The Role of Secondary Mortgage Facility in expanding the availability of funds for Mortgage Finance in Nigeria. A Master of Science thesis submitted to the Postgraduate School, KTH Architecture and the Built Environment University, Stockholm (Sweden).

Okereke, O. (2010). "Nigerian National Housing Scheme: Still in the Lurch". The Economy Magazine on-line www.theeconomyng.com/new56.html. March. Retrieved: December, 2010. At about 3.25 GMT.

Ope, K. M. (2005). Analysis of the Financial Allocation by State Governments to Housing Construction in Nigeria. An unpublished M. Tech. (Const. Mgt.) thesis submitted to the school of postgraduate studies, F.U.T. Minna, Nigeria.

Sattaur, O. (Ed.) (2004). Meeting Every One's Needs . The Nigeria-National Economic Empowerment and Development Strategy (Needs). The National Planning commission in conjunction with the Central Bank of Nigeria, Abuja (Nigeria) 3-31.

Spiegel, M. R. and Stephens, L. J. (2007) (4th Ed.). Schaum's Outline Theory and Problems of Statistics. Tata McGraw-Hill Publishing Company. New Delhi (India). Pp 17 to 436.

Stock, R. C. (2008). "Nigeria- in DVD". Microsoft Corporation, New York (USA).

Vance, I. (2008). "Putting the 'Housing' Back into Housing Finance for the poor: The Case of Guatemala". The Global Urban Development Magazine. Vol 4. Issue 2.

Yao, R. (2007). "A West African perspective of housing as a human right: The case of Côte d'Ivoire". Habitat for Humanity.

AFFORDABLE HOUSING INITIATIVE IN NIGERIA: USE OF COMPOSITE PANELS

Yomi Michael Daisiowa Adedeji[1], Chinwuba Arum[2] and Babatunde Ajayi[3]
1Department of Architecture, Federal University of Technology, Akure, Nigeria
2Department of Civil Engineering, Federal University of Technology, Akure, Nigeria
3Department of Forestry and Wood Technology, Federal University of Technology, Akure, Nigeria

One main challenge facing housing in Nigeria is the rising cost of building construction, which is a factor of the over reliance on the importation of building materials. This study investigates the use of cement-fibres composite panels, a local building material made of cement reinforced with coconut shaft, a by-product of coconut palm, for cost-efficient and low-cost building panels. Data were collected through experimental and survey methods. The empirical survey, conducted among selected leading professionals in the building industry namely architects, engineers, quantity surveyors and builders includes the use of questionnaire, interview methods and observations. Besides, interview schedules administered to building professionals were used to collect information on sampled projects that exhibited the use of the material to elicit opinions on them. The water absorption, thickness, swelling and linear expansion and aesthetical satisfaction of the material were tested. Results from analysis of the field survey on eleven (11) buildings shows that cement-bonded composite panels are comparatively cheaper, sound-proof, durable, lighter-weight and environmentally friendly than the conventional sandcrete blocks and should be a replacement to conventional masonry in housing delivery.

Keywords: affordable, building panels, composite, housing, Nigeria.

INTRODUCTION

This paper focuses on developing a framework for a cost-efficient building system for low-income class in Nigeria through materials initiative. It investigates the application of cement-fibres composite panels made of cement reinforced with coconut shaft, a by-product of coconut palm for affordable building panels for housing delivery in Nigeria.

Housing industry is one of the most important sectors of the Nigerian economy. As a basic human need that comes after food and clothing (FGN, 2004), it is necessary for human privacy, comfort and satisfaction (Fasakin, 2006). Housing is an essential indicator of national, economic, historical, cultural and technological development of any society and a "social desideratum" with a universal appeal (Adedeji, 2007). As reported by Arum (2010), according to the U. S. Green Building Council, in the United States alone, buildings account for 72% of electricity consumption, 39% of energy use, 38% of all carbon dioxide (CO2) emissions, 40% of raw materials use,

[1] yomi_adedejiy2k@yahoo.com
[2] arumcnwchrist@yahoo.co.uk
[3] babatundeajayi2000@yahoo.com

Adedeji, Y.M.D., Arum, C. and Ajayi, B. (2011) Affordable housing initiative in Nigeria: use of composite panels *In:* Laryea, S., Leiringer, R. and Hughes, W. (Eds) *Procs West Africa Built Environment Research (WABER) Conference,* 19-21 July 2011, Accra, Ghana, 79-89.

30% of waste output (136 million tons annually), and 14% of potable water consumption.

Despite the important role of housing and construction sectors to man's economy, the sector is plagued with numerous problems ranging from high cost of building materials; lack of access to land titles and slow implementation of vital policies; reconciling citizens' affordability with agency profitability and rapid decline in competent skilled workers in the housing industry among others (Fasakin and Ogunsemi, 2003). It is however observed that the rising cost of building construction in Nigeria can be attributed to some other factors, which include high transportation cost, devaluation of national currency (Naira), uncontrollable prices of building materials and particularly, the inability of production companies to meet high demand for building materials and the over dependency on the importation of building materials. Locally sourced building materials in Nigeria, which would have facilitated sustainable development remain underdeveloped to a socially and economically acceptable level owing to the underdeveloped state of the economy. Recently, in the most developed countries, it has been verified that the traditional and conventional technologies used for construction and maintenance of buildings are inefficient and resource wasteful due to enormous amount of resources consumed. This situation leads to an increasing demand for further development of their technologies (Ghosh, 2002). More rational constructive processes can be implemented with the introduction of technologies that allow reduction of labour, materials, time and fund. Such reduction becomes possible through the use of materials initiative. This paper seeks to provide information for the provision of cost-effective housing for the teeming population of Nigeria through the use of agro-allied composite materials applied in dry masonry system. Thus, the adoption of this untapped indigenous materials, elimination of bedding mortar and wastages associated with conventional masonry work as canvassed in this research increases housing stock substantially, accelerates construction, reduces labour and wastages thereby reducing cost.

INFLATION AND PRICES OF BUILDING MATERIALS

The decline of the economy started in the early 1980s when the spot price of a barrel of crude oil fell from ₦ 24.00 in 1980 to ₦ 13.50 in 1986 (Giwa, 1992). Prior to this decline, agriculture earned the largest foreign exchange up to 1973 when the Middle-East war propelled crude oil into celebrity. However, in the early1980s a gradual downward trend in the economy began. Oil revenue dropped from ₦ 13.20 billion in 1980 to ₦ 10.02 billion in 1981and ₦ 8.5 billion in 1982. By 1987, the economy was characterized by a high fiscal deficit of 23.93 percent and a low industrial capacity utilization of less than 30 percent (Fasakin, 2006).

With the introduction of the Structural Adjustment Programme (SAP) in 1986 by the Federal Government to arrest the continuous decline of the economy, every sector of the nation was adversely affected. This resulted into a long and unending search for a realistic exchange for the Naira, a search that resulted into unimaginable depreciation of the currency from ₦0.60 in 1980 to ₦135.75 to a dollar in 2003. Inflation rate soared and prices of building materials skyrocketed beyond the reach of many Nigerians. Besides, the dearth of many infrastructure facilities in Nigeria such as electricity (which is a failed project till date), inadequate water supply and poor road networks attributed to unhealthy economic state in the country, thereby forcing many manufacturing firms to fold up or relocate to neighbouring countries with better manufacturing environment. Consequently, the price of cement for example, which accounts for about 65 percent of material cost of construction continued to be on the increase due to some economic factors (Fasakin & Ogunsemi, 2003). It is therefore necessary to search for alternative materials initiative, sourced and renewable locally in ameliorating housing problems.

Development of wood products and cement-bonded composite materials

In recent development, man has gradually improved the technologies adopted in wood processing in order to achieve better products in terms of utilisation for constructional works up till this age (Adedeji, 2010). The forest has always been man's resort for major raw materials needed for constructional, recreational and technological designs and fabrication. This is due to the uniqueness of the major product of the forest (that is timber) in terms of its ability to naturally regenerate itself, its durability, its workability and adaptability to different environmental conditions. This has eventually resulted in increased demand for building materials and wood fibre products. Wood-based products including cement-bonded particle boards, fibre boards and particle boards have facilitated to a great extent, the utilization of logging and the processing of wood wastes. The increasing rate of timber exploitation especially in developing countries, and the huge wood waste generated call for erection and establishment of quick-built, low-cost particle boards' production to serve as substitutes (Ajayi, 2002).

Cement-bonded particle board is more versatile than resin-bonded boards and suitable for interior and exterior uses simply because of its resistant to freeze and thaw, fire, water and rot. It does not contain hazardous volatiles, and the processed dust is non-aggressive. It has a better dimensional stability, does not produce formal dehydes gas and does not release poisons and toxic gases (Moslemi, 2008). Cement-bonded products can be classified into cement-bonded boards, wood-wool excelsior boards and gypsum- bonded boards. The excellent properties of cement-bonded made them useful for ceiling, walling, roofing, flooring, claddings, partitioning and shuttering. Uses of products depend on their reliability and resistance to fire, insect attack during natural disasters such as earthquakes and tropical storms (Remirez-Coretti *et al*, 1998). Wood-cement products are highly resistant against fire, insect and fungi.

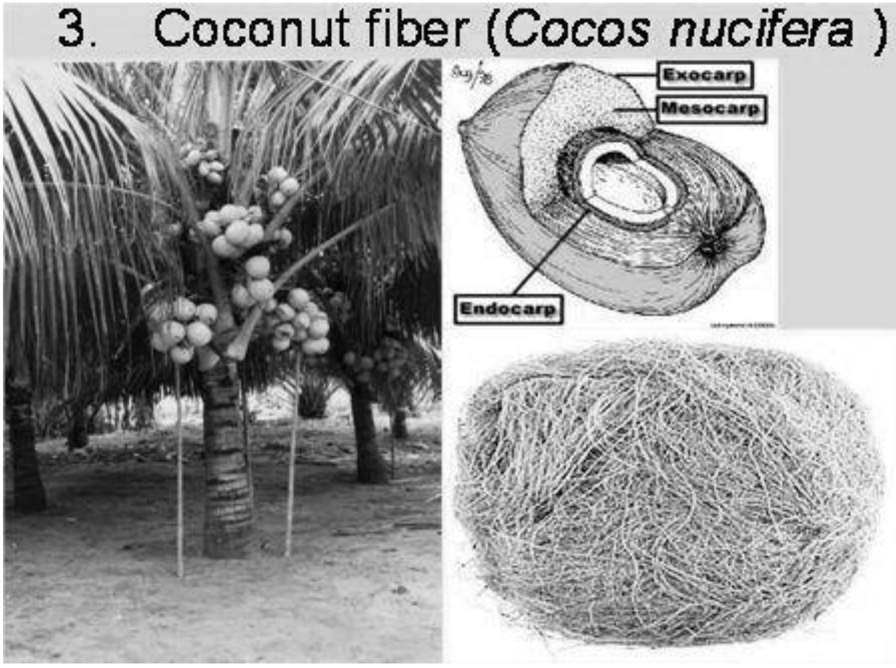
Table 1: Table of yearly Agricultural outputs (Coconut)

Year	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
Coconut	83.0	97.0	86.0	99.0	99.0	99.0	99.0	92.0	92.0	90.0	90.0	100.0
Year	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
Coconut	110.0	100.0	101.0	102.0	104.0	105.0	108.0	110.0	118.0	129.0	135.0	140.0
Year	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	
Coconut	145.0	149.0	151.0	154.0	167.0	175.0	181.0	183.0	187.0	201.1	216.0	

Source: Central Bank of Nigeria Statistical Bulletin, 2004

Cement composites materials are increasingly gaining ground in the construction industry day after day. In the North American markets, fibre cement composites have gained an increasing foothold over the last twenty years. The penetration of these materials into the housing and construction markets has been steady and the level of acceptance of its application has substantially increased as against the use of wood and other materials (Moslemi, 2008). The first mineral-bonded wood composite panels utilised a magnetic binder and were developed in Austria in the early 1900s. These products still exists today mainly for interior applications, and are currently manufactured in Europe and the U.S. by Knauf Insulation and Tectum respectively (Aro, 2008). Architects, builders and manufacturers are becoming more interested in developing products that meets structural requirements, has less of a weight penalty, more elasticity and possessed the attributes of mineral-bonded wood composites.

Usually, cement- bonded wood are produced from strands, particles or fibres wood mixed together with cement and manufactured into panels, bricks, tiles and other products used in the construction industry. This high density product was developed in the 1970s to replace asbestos-cement board for structural applications. The need to use agricultural wastes for the cement-bonded particle board production has been motivated by the availability of cement binder and increased awareness for conversion of the country's wood waste for value added panel products. Moreover, it has the tendency to bust the national economy and gives a sustained income over a long period. This assertion can be supported by annual production growth in Table 1, which increases from 83.0m tonnes in 1970 to 216.0m tonnes in 2004 (CBN 2004). Common uses of this product in Europe are facades, electrically heated and raised floors, permanent shuttering of concrete floors and walls and fire and moisture resistant furniture.



Source: Adedeji and Ajayi, 2008.

The acceptability of these products stems from availability and widespread distribution of raw materials locally. However, the scarcity of the economically wood species, over exploitation of natural and plantation hardwood species, lack of effective utilisation of wood resources due to huge wastes incurred in wood processing industries and encroachment into free and reserved forests by unlicensed timber exploiters call for concerted efforts from all stakeholders to find common solutions to the rapid depletion of wood resources in Nigeria and world-wide (Ajayi, 2011).

MATERIALS AND METHODS

Coconut Husk Fibre (Cocos Nucifera)

Coconut husk fibre is the main material used for this study. Coconut is of two distinct varieties which are: (i) the tall palm and (ii) the dwarf palm. Agricultural residues have been indicated as possible raw materials for cement-bonded boards.

Sources of Raw Materials

An alternative source of raw material to indigenous and exotic hardwood species is from the agricultural sector. The nature of residues used for board production has effect on the final board, so the choice of residues to be used for cement-bonded boards needs adequate consideration. However, the use of such raw materials for the production of panel products suitable as alternative to sawn timber will increase the industrial and economic base of the national development. The major materials are inorganic binder, wood/agriculture wastes and the chemical reagent (Orisabinu, 2007).

Mixing Ratio

The cement mixing ratio gives an indication of the proportion of cement to wood per weight of the board. It is the proportion by weight of cement to wood in a board within a given density range. It is the cement binder that changes in board production. The quality of the cement binder needed to produce board of considerable length appeared to be associated with the density of the wood species used.

Methods

The study employed two (2) research activities: (1) the experimental design method used for production of the cement-bonded boards and (2) the survey method used to collect data on applications of Coconut Composite Panels (CCP) (used in housing construction from different locations in Nigeria) and conventional sandcrete blocks (used commonly in the building industry in Nigeria). The laboratory research work was a collaborative work with the Department of Forestry and Wood Technology, Federal University of Technology, Akure. For the survey method, data were collected through case studies, observations and interview schedules administered to key practising professionals in the building industry that are involved in the use of these materials for building projects in the study area. Descriptive statistics analysis was used to analyse data collected. Cement-bonded boards were produced from mixture of coconut husk fibre and cement. The material was sun-dried for two weeks and later transferred to the laboratory of Forestry Research Institute of Nigeria, Ibadan for processing. The coconut husk fibre was pre-heated with hot water at a temperature of 80^0C for 1 h to remove the inhibitory water soluble chemicals present in the material that are capable of poisoning the cement and thereby slow down the setting and curing of the cement binder (Ajayi, 2008). After 1 h, the water was drained off and the materials were dried to moisture content of approximately 12%. The raw materials were then packed to the laboratory for the production of cement-bonded boards.

Experimental Procedures

The experimental design used in this research is 2 x 2 x 3 factorial experiment in Completely Randomized Design (CRD), the combination that gives 12 treatments. Raw materials include: coconut husk fibre, Portland cement, additives and water, which was calculated based on this formula:

W_t = W (0.30-MC+0.60C). Where W_t= weight of water (g), W= wood drying weight (g); MC= moisture content (%); C= cement weight (g)

The amount of materials required to produce a board of 600 x 600 x 12 mm were calculated and measured out to the level of combination in the experiment as stated below. The following production variables were used:

1) Board density of 1000 kg/m^3, 1100 kg/m^3, 1200 kg/m^3
2) Additive concentration ($CaCl_2$): 1%, 2%
3) Mixing ratio of cement: coconut husk fibre (mass), 2.0:1, 2.5:1

Constant factors are:

4) Board thickness: 6 mm
5) Moisture content: approximately 12%
6) Board size: 600 mm x 600 mm x 12 mm
7) Pressing pressure: 1.23 N/mm^2

Materials were poured inside a plastic bowl and mixed thoroughly until well-blended lump-free mixture obtained. The quantity of additives required was dissolved in the measured quantity of water and mixed together. The water containing chemical additives, calcium chloride was then added and mixed with the material while the mixture is hand-formed into wooden mould. Plastic moulds of varied sizes (600 x 600, 600 x 1200, 600 x 2100) mm were used to cast the furnish into uniform mat and pre-pressed using plastic cauls plate. The steel plate was covered with polythene sheet before board formation to prevent the sticking of the board onto the plates. After board formation, the top plastic plates were removed; another polythene sheet was placed on the mat before placing metal cauls plate. The mat was then moved to the hydraulic press and pressed with the aid of hydraulic jack, under pressing pressure of 1.23 N/mm^2 and left for 24 h. The pressed mat under compression was released, the boards were removed from the cauls and wrapped with polythene sheet and kept in the laboratory environment for 28 days to ensure further curing of the cement. Loss of water from the boards was prevented through proper wrapping of the sheet. Thereafter, the board were stacked for 21 days at a relative humidity of 65 ±2 % while the edges of the boards were properly trimmed.

The water absorption, thickness, swelling and linear expansion were examined. Specimens were cut into size of 152 mm x 152 mm according to the ASTMD1037, (1978). The water absorption test samples were weighed first before soaking and the initial weight recorded. The tested samples were then placed horizontally in a large container of water at a temperature of 20^{0}C. These samples were soaked in water for 24 h; thereafter boards were weighed using weighing balance to determine water absorption. Thickness and linear section were measured using Veneer Calliper to assess thickness swelling and linear expansion.

Plate 1: Cement-bonded Composite Boards

Source: Adedeji and Ajayi, 2008

Components of CCP Initiative

The components of the CCP wall panel is made of lightweight sandwich panels, consisting of 12mm thick layer of Expanded Polystyrene (EP) fixed to boards (600 x1200 to 1200 x 2400) mm ranges and 25mm thickness of composite panel shaft at the centre, finished with two 6mm thick plasterboard at the interior. The panels were factory-made. Installation was done with laminated steel profile. The floor, which composed of cement, sand and kernel shaft of the ratio 1: 3: 6, this can either be obtained from palm tree or any other plants that has similar property. The material which is of tensile property is used to reinforce the cement which is brittle and only good in compression.

RESULTS AND DISCUSSION

The cement-bonded boards of 12mm in thickness were produced from coconut husk fibre / particles. The effect of cement / coconut husk fibre of 2:1 and 3:1, additive concentration of 1%, 2% and 3% and the board density of 1000 kg/m and 1200 kg/m on Water Absorption (WA), Thickness Swelling (TS), Linear Expansion (LE), Modulus of Rupture (MOR) and Modulus of Elasticity were investigated. Boards produced exhibited means values ranging from 33.81 to 47.28% for WA, 0.33 to 1.08% for TS, 0.14 to 0.38 for LE, 0.16 to 1.38 N/mm for MOR and 1.572 to 6436.52 N/mm for MOE.

The mean values for water absorption, thickness swelling and linear expansion ranged between 14.8% and 19.72%, 0.12% and 0.86% and 0.20% and 0.99% respectively. Cement to palm kernel fibre ratio, additive concentration and board density showed the effect on the reaction of boards to water. It was observed that as the board density, additive concentration and mixing ratio increased, water absorption, thickness swelling and linear expansion decreased. This shows that board produced at the highest levels of board density (1200 kg/m^3), additive concentration (2%) and mixing ratio of (2.5: 1) is most dimensionally stable board as the cement content in board is higher. The high concentration of calcium chloride caused retardation of inhibitory chemical substances and increased the exothermic reaction of cement binder to produce highly stable boards. It further shows a lower spring back tendency when the pressure was released from the press and after water immersion treatment. The high compression ratio of board, the presence of less void spaces, better inter-fibre surface contact area may be due to the reduction in water absorption, thickness swelling and linear expansion values and board's spring back (Adedeji and Ajayi, 2008). The highest values for water absorption, thickness swelling and linear expansion at mixing ratio 2.0:1, additive concentration 1% and board density (1000 kg/m^3) may be due to the fact that additive concentration, board density and mixing ratio had strong influence on the boards' physical properties.

The results shows that as the mixing ratio, additive concentration and board density increases, the WA, TS, LE, of coconut husk fibre based cement / coconut husk fibre / particles ratio (3:1), additive concentration (3%) and board density (1200 kg/m) were strongest and most dimensionally stable than those produced at the other levels. Also, the study shows that coconut husk fibre is suitable for manufacturing of board; it further shows that cement-bonded particle boards could be produced from coconut husk-fibre after hot water treatment, all the production variables have significant effect on the properties investigated. The results supports an early research work carried out whereby wood waste is being used to produce floor and wall tiles using cement as binding agent (Adedeji and Ajayi, 2008).

Modular Coordination and Construction

Modular coordination and mass production is an important feature of dry construction system. This refers to simplifying the process of assembly through industrialisation, modularisations, standardisation, and continuous flow processes. The reduction of operations required for a production process means less chance of the occurrence of errors, waste and rework. This follows the same logic that the fewer the number of operations, the higher the quality of the product and a predictive timeline, resulting in cost savings. This is the fundamental principal that ensures that is the most cost effective affordable housing building construction technology and will continuously improve by simply eliminating waste and rework.

Eleven housing projects were selected randomly from the data obtained through case study and interviews of professionals involved in their construction. One of these projects is the Students' hostel, Ambrose Ali University, Ekpoma where the CCP material was extensively demonstrated. In the institution, design of these hostels was of modular system while construction of the sub structure followed the same procedure for wet masonry system up to Damp Proof Course (DPC) level. The over site concrete floors were of the composition of cement, sand and palm kernel shells of 1:3: 5 ratio. CCP wall panels were used for the framed masonry walls (Figure 3). In the case of the super structure, masonry work was carried out through assemblage of pre-fabricated panels produced from the experiment described above. Speed of construction was achieved since materials were produced industrially, modularly coordinated on site and construction process was dry.

Estimates of masonry cost, productive hours and number of labour involved were obtained on the size and rate paid for these operations and compared with other similar housing projects constructed with conventional sandcrete blocks (Table 2).

Table 2: Selected Data from Executed Project Sites

Dry Masonry						Wet Masonry		
S/N	Area (m^2)	Rate (₦)	Cost ₦ (in 1000)	Labour (No per gang)	Pro. Hr. m^2/h	Cost ₦ (in 1000)	Labour (No per gang)	Pro. Hr. m^2/h
1	284	1650	184.7	6	6.40	411.8	28	1.40
2	242	1650	157.3	5	7.24	305.9	20	1.44
3	164	1800	106.6	3	4.71	237.8	12	1.71
4	220	1450	143.0	5	6.5	333.5	18	1.50
5	184	1650	119.6	4	6.14	266.8	16	1,47
6	335	1700	217.8	7	5,65	485.8	24	1.65
7	230	1750	149.5	5	4.78	333.5	16	1.78
8	372	1650	241.8	6	6.61	539.4	27	1.61
9	175	1750	113.8	3	5.52	253.8	14	1.52
10	320	1650	208.0	6	5.72	464.0	26	1.72
11	165	1550	107.3	3	5.42	239.3	12	1.42

Source: Researcher's field survey (2007) in collaboration with Department of Quantity Surveying, Federal University of Technology, Akure

While the productive hours of dry masonry is higher, the cost and number of servers involved in the masonry operations reduced significantly as compared with that of conventional masonry. This further corroborates an observation made by Anand and Ramamurthy (2003**)** on a study carried out on comparison of output from different types of masonry works, where a crew of one person, achieved the productivity of 4.1 m/h with the use of hollow-interlocking blocks.

Furthermore, bill of quantities of a wing of the Students' hostel was prepared and compared with another hostel of the same size in the institution but constructed with conventional blocks. The summary of the bills is as presented in Table 3. The analysis shows a significant difference in the cost of masonry work of interlocking block over the conventional ones, which is the focus of this research. This difference could be attributed to the exclusion of the indirect and non-contributory operations, which are more pronounced in conventional masonry that are reduced to minimum or completely eliminated in interlocking masonry, as they are unnecessary for its construction. (Anand and Ramamurthy 2000) observed that solid-interlocking and hollow-interlocking block systems were developed as part of the efforts towards improving productivity of conventional and interlocking masonry. A similar study carried out by Braganca, *et al* (2002) established similar results. The use of CCP system is therefore cost-efficient, less labour dependent and faster than the conventional as analysed in Table 3.

Table 3: Comparative summary between the bills of quantities of the project constructed with CCP material and that constructed with the conventional materials for the same design

S/ No	Elements' Summary	Conventional	Recommended Model	Difference	% of Difference
1	Substructure	635,650.00	635,650.00	-	-
2	Concrete work	69,050.00	69,050.00	-	-
3	Masonry work	398,750.00	177,375.00	221,375.00	125
4	Roofing	565,000.00	565,000.00	-	-
5	Woodwork	287,243.00	237,777.00	49,466.00	21
6	Metalwork	141,700.00	141,700.00	-	
7	Electrical and Engineering Installations	205,000.00	205,000.00	-	-
8	Plumbing and Engineering Installations	469,570.00	469,570.00	-	-
9	Glazing	65,760.00	65,760.00	-	
10	Floor, Walls and Ceiling Finishes	583,510.00	510,635.00	72,875.00	14
11	Painting and Decorations	217,875.00	139,500.00	78,375.00	56
12	Drainage / External works	250,000.00	250,000.00	-	-
13	Contingencies	194,455.40	86,675.48	107,779.92	
	Total	4,083,563.40	3,553,694.48	529,868.92	

Source: Researcher's data (2007)

CONCLUSION

The adoption of coconut composite panels for provision of cost-efficient housing through dry masonry system as canvassed in this paper is a possibility in proffering solutions to high cost of housing that has made this essential human need unaffordable to many Nigerian. The study revealed that it is possible to produce cement-bonded particle boards using palm coconut fibre with Portland cement binder after hot water treatment. It showed that dimensional stability of cement were influenced by cement/coconut fibre ratio, as board density and additive concentration increased the water absorption (W.A.), thickness swelling (TS) and Linear Expansion (LE) decreased. Also, boards produced at the highest levels cement-coconut fibre ratio of 2:5:1 additive concentration 2% and board density showed the highest resistance to water intake and lowest spring back. Dimensionally, stable boards can be produced from coconut fibre with Portland cement after hot water treatment. The finding is capable of stimulating improved standardised cement-bonded particles boards production from coconut fibre for industrial and economic development. Boards produced could be used as alternative to sandcrete blocks and sawn timber for construction works and furniture.

REFERENCES

Adedeji, Y.M.D. Materials preference options for sustainable low-income housing in selected cities in Nigeria. Ph.D Thesis, Department of Architecture, Federal University of Technology, Akure, 2007.

Adedeji, Y.M.D. (2008). Interlocking masonry: a panacea for sustainable low-cost housing in Nigeria. Pakistan Journal of Social Sciences, 5(8): 744-750.

Adedeji, Y.M.D. and Fasakin, J.O. (2008). Acceptability indices of interlocking masonry for housing construction in Nigeria. Medwell Journals: Pakistan Journal of Social Sciences 5 (7): 696-700

Adedeji, Y.M.D. and Ajayi, B. (2008). Cost-effective composite building panels for walls and ceilings in Nigeria. Proceedings of IIBCC- 11th International Inorganic-Bonded Composite Conference, Madrid, Spain, Nov 4th-7th.

Adedeji, Y.M.D. (2010). Technology and standardised composite cement fibres for housing in Nigeria. *Journal of the Nigerian Institutes of Architects, 1: 19-24.*

Ajayi, B. (2002). Preliminary investigation of cement-bonded particleboard from maize stalks residues. The Nigerian Journal of Forestry 32 (1): 33-37.

Ajayi, B. (2008). Properties of cement-bonded particleboard produced from agricultural by-products. Invited Paper by the Faculty of Forestry and Forestry Ecology, Centre for Tropical and Subtropical Agriculture and Forestry, 9th June 2008. University of Gottingen. Germany.

Ajayi, B. (2011). Durability characteristics of cement-bonded particle boards manufactured from maize stalk residue. Journal of Forestry Research, 22 (1), 111-115.

Anand, K. B., &. Ramamurthy, K (2000). Development and performance evaluation of interlocking block masonry. *Journal of Architectural Engineering; 6*(2), 45-51.

Anand, K. B., and Ramamurthy, K. (2003). Laboratory-based productivity study on alternative masonry system. *Journal of Construction Engineering and Management, (6*), 241.

Asiodu, I.P.C (2001). The place of housing in Nigerian economic and social development. *The Quantity Surveyor, 35*, 2-7.

Aro, M. (2008). Wood strand cement board. Proceedings of IIBCC- 11th International Inorganic-Bonded Composite Conference, Madrid, Spain, Nov 4th-7th.

ASTM. (1978) ASTM D1037-78. Standard Methods of Evaluating the Properties of Wood-base Fibre and Particle Panel Materials. American Society for Testing and Materials, Philadelphia.

Braganca, L., Almeida, M., Mateus, R. and Mendonca, P. (2002). Comparison between conventional and MBT constructive solutions from an economic and environmental point of view. Case study. In O. Ural, V. Abrantes and A. Tadeu (Ed.), XXX World Congress on Housing, University of Coimbra, Portugal.

Moslemi, A L (2008). Technology and market considerations for fibre cement composite. Proceedings of IIBCC- 11th International Inorganic-Bonded Composite Conference, Madrid, Spain, Nov 4th-7th.

Fasakin, J. O. (2006). Asymmetry in philosophy and practice of physical planning in Nigeria. 43rd series of Inaugural lecture, Federal University of Technology, Akure, 11th, April, 2006.

Fasakin, J.O. &.Ogunsemi, D. R. (2003). Modelling the selling prices of residential building in Nigeria. *Journal of Financial Management of Property and Construction, 8 (2),* 111-114.

Federal Republic of Nigeria (2004). (National Housing Policy). Draft Jan, 104-106.

Gallo, H., Arini, R. and Brasil, L. (2002). The earth architecture as a possible sustainable factor. In O. Ural, V. Abrantes and A. Tadeu (Ed.), *XXX World Congress on Housing,* University of Coimbra, Portugal.

Ghosh, S. K. (2002). Low cost building materials. I*n* O. Ural, V. Abrantes and A. Tadeu (Ed.), *XXX World Congress on Housing*, University of Coimbra, Portugal.

Giwa, R.F. (1992). *Thoughts on the Nigerian economy.* Ibadan: Med net Ltd (Publications), 90-99.

Hydraform New information Package Accessed from www.hydraformnigeria.com on 15th November, 2009.

Orisabinu, A.A. (2007). Dimensional Stability of cement bonded particle board produced from palm tree. B. Tech Dissertation of Department of Forestry and Wood Technology, The Federal University of Technology, Akure.

Ramirez-Coretti, G., Eckelman, C. A. and Wolfe, R. W. (1998). Inorganic bonded composite wood panel systems for low-cost housing: A central American perspective. Forestry Proc. J 48 (4): 62-68.

Wahab, K.A. (2006). Federal Government economic reforms, human development and due process. A paper delivered at the first annual lecture of the School of Environmental Technology, Federal University of Technology, Akure.

ANALYSIS OF THE SOCIO-ECONOMIC CHARACTERISTICS AND HOUSING CONDITION IN THE CORE NEIGHBOURHOOD OF AKURE, NIGERIA

Bamidele M. Ogunleye[1]

Federal University of Technology, Akure, Ondo State, Nigeria

The paper highlighted survey on low – income settlements in the core area of Akure, the capital of Ondo State, Nigeria and examined the socio – economic characteristics of the respondent and the physical state of the building they occupy. It gathers field data among residents of low income neighbourhoods of Akure using random sampling technique. The data were analysed using simple frequency and percentage distribution tables. The study revealed that most of the residents are engaged in the informal sector of the economy (self employed), their income level is very low and that household size is very high .The survey carried out on housing revealed that most dwellings were constructed before 1960 and are of monolithic type. They are lacking in essential infrastructures and a large number are unsatisfactory by modern standards. Since the failure of slum clearance scheme suggest that wholesale clearance of substandard housing area particularly those built up during the pre colonial period are not practicable in Nigeria urban areas, and while we are aware of the fact that findings of a study of this type may be more typical of the case than more general to other cities, there is every reason to believe that the issues involved are more national than local. The policy recommendations have therefore been geared to reflect this observation.

Keywords: Akure, city, core neighbourhood, housing, urbanisation.

[1] bamidelemuks@yahoo.com

Ogunleye, B.M (2011) Analysis of the socio-economic characteristics and housing condition in the core neighbourhood of Akure, Nigeria *In:* Laryea, S., Leiringer, R. and Hughes, W. (Eds) *Procs West Africa Built Environment Research (WABER) Conference,* 19-21 July 2011, Accra, Ghana, 91-91.

AN APPRAISAL OF HOUSING CONDITIONS IN RESIDENTIAL CORE AREA OF AKURE CITY IN SOUTH WESTERN NIGERIA: A CASE STUDY OF EREKESAN

Victor Olufemi Adegbehingbe[1]
Department of Architecture, Federal University of Technology, Akure, Nigeria

This paper appraises the condition of housing in residential core area of Akure city in SouthWestern Nigeria taking Erekesan, which consists of Erekesan-Itanla, Eruoba, Afunbiowo, Alakure, Alakure-Ijofi and Iworokosagba as case study. Assessing the quality of existing housing stock, quality of the housing environment, and the availability of the neighbourhood facilities were the major objectives. Data were obtained through questionnaire, personal interview, physical observation of the housing structures and were analysed with appropriate statistical tools. The study reveals a homeownership rate of 40% with average occupancy ratio of 8 persons per household. Only 35.38% of the housing units surveyed have functional wc, 41.31% are with pit-latrine and 23.25% with no toilet facilities. 65.7% of the household depends on well for their domestic water supply while as low as 8.3% use in house taps. 42% of houses were constructed of compressed earth bricks, 23% used mud bricks while 17.5% used cement block. 16.5% of these dwellings were in good condition as against 83.5% with notable defects. About 22.5% households practice planned maintenance but only 16.8% have maintenance budgets, hence most houses do not show evidence of proper maintenance. Only 29.70% of the houses surveyed have access to good urban infrastructures such as road network and drainage system. The paper suggests massive construction of boreholes and pipe borne water, improvement on waste management scheme, engagement of more environmental inspectors, slum upgrading and improvement and direct government investments in urban infrastructure.

Keywords: housing stock, housing quality, housing environment, urban infrastructure, planned maintenance.

INTRODUCTION

Housing, literally is defined as Buildings or other shelters in which people live. A place to live, a dwelling etc and to a nation, is a critical component in social and economic fabric. Housing represents one of the most basic human needs. As a unit of the environment, it has a profound influence on the health, efficiency, social behaviour, satisfaction and general welfare of the community (Onibokun 1998). To most groups housing means shelter but to others it means more as it serves as one of the best indicators of a person's standard of living and his or her place in the society. (Nubi, 2008). It is a priority for the attainment of living standard and it is important to both rural and urban areas. These attribute make demand for housing to know no

[1] victoradegbehin@yahoo.co.uk

Adegbehingbe, V.O. (2011) An appraisal of housing conditions in residential core area of Akure city in South Western Nigeria: a case study of Erekesan *In:* Laryea, S., Leiringer, R. and Hughes, W. (Eds) *Procs West Africa Built Environment Research (WABER) Conference,* 19-21 July 2011, Accra, Ghana, 93-104.

bound as population growth and urbanisation are increase very rapidly and the gap between housing need and supply becomes widen. Despite the significance of housing, adequate supply has remained a mirage to all carder of the society in Nigeria. The situation is very particular to most developing countries where population grow at exponential rate and rapid urbanisation becoming a norm, and discrepancy in housing need and supply is high.

The proportion of the Nigerian population living in urban centres has increased phenomenally over the years. While only 7% of Nigerians lived in urban centers in the 1930s, and 10% in 1950s, by 1970, 1980 and 1990, 20%, 27% and 35% lived in the cities respectively (Okupe, 2002). Over 45% of Nigerians now live in urban centers of varying sizes. The incidence of this population in urban centers has created severe housing problems, resulting in overcrowding in adequate dwellings, and in a situation in which 60% of Nigerians can be said to be “houseless persons” (FGN, 2004).

The desire to live in a house depends on how conducive and attractive the housing unit is. Conduciveness of a housing unit can be expressed by certain factors such as circulation space within the unit, the availability and affordability of basic amenities such as water, electricity, toilet facilities, occupancy ratio etc. attractiveness on the other hand is a function of the neighbourhood facilities (accessibility, shopping centers, schools, security, hospital etc) and quality of the environment (drainage system, method of refuse collection and disposal, road network etc), personal taste, social value and affordability.

Quality of housing and that of the environment have direct bearing on the lives of people in that community because; environmental quality and quality of live are two variables of the same equation. Quality living depends so much on the quality of the environment one lives in. According to Ebong (1983), as reported in Dung-Gwon and Ibrahim (2006), the quality of environment affects not only the well-being of a people, but also their productivity, way of living as well as the ordinary decencies of their lives.

Housing of a good quality in a good environment is prerequisite to quality living. That is for people to have quality life, they need housing in the required quantity and quality in an efficient environment free from disease, robbery, assault etc which facilities their comfort and enjoyment (Fagbohun, 2003; Dung –Gwon and Ibrahim,2006;Sanda and Jambol,2010). Therefore, for people to function as they should, they need adequate housing in a conducive environment; functional housing units in a planned environment accorded the basic necessities for livability (Sanda and Jambol,2010). Assessing the conditions for housing in our cities therefore becomes a necessity in order to determine their functions, conduciveness and livability.

The aim of this study is to appraise the condition of housing in residential core area of Akure city, Ondo State, in South-Western, Nigeria taking Erekesan as a case study. The objectives of the study include the assessment of the socio-economic characteristics of the respondents with respect to their income and household size, the conditions of the infrastructural facilities/amenities, the quality of the existing housing stock in the study area and ascertain the availability and quality of urban infrastructure within the neighbourhood(neighbourhood facilities). Erekesan, is one of the three neighbourhoods that made up of the core area of Akure, the capital of Ondo State,Nigeria. The other two are Idiagba-Ijemikin and Obanla. Most buildings in these neighbourhoods are in very poor state, with only few of them in sound conditions.

LITERATURE REVIEW

Housing Condition:
Housing condition refers to the state of the physical, environmental and the satisfactory level of a particular housing unit measured against some variables of livability at a particular time (Omole, 2001,SandaandJambol2010). These variables include the status of the housing stock, housing facilities, occupancy rates, housing environmental quality, neighbourhood facilities, materials used in construction, age of the dwelling, variety and adequacy of facilities provided in the dwelling, level of satisfaction with housing facilities and spatial location of residential housing (Omole,2001,Sanda and Jambo2010). Others include the maintenance level, social and economic wellbeing.

Housing condition therefore considers the totality of the environment rather than the unit in isolation. In Nigeria and most part of the developing world, due to factors such as insufficient funds, weak mortgage market, and poor delivery mechanisms, attention is centred on raising the physical unit rather than the totality of the housing environment. Developments are carried out without really paying attention to planning details such as material and assembly technologies, development control and planning regulations. The results are town with no space for infrastructural development such as road network and drainage systems, Hence slums become common features at fringes of virtually all Nigerian cities. Sheer neglect, poor maintenance, poor location and inadequate facilities and services as this is compounded by unique characteristics of houses found in Nigerian cities (Augustine, 2005;SandaandJambol,2010).

The condition of housing in Nigeria is so bad that Wahab et al (1990) as reported in Omole (2005) stressed that, most houses (housing environment inclusive) in all the states of the federation require either minor or major repairs. There is therefore the need to embark on this study so as to proffer practical measures for better livability in the study area.

PROBLEM STATEMENT

Buildings are poorly laid out with inadequate roads between them, inadequate drainage and provision for refuse evacuation. There are high densities of buildings, the crowding of large numbers of people into those buildings, lack of space for open air living between houses, Substandard housing and acute sanitary problem (Olotuah, 2009).

Lack of functional in house facilities, and inadequate water supply. Few house hold practice planned maintenance, hence there are evidence of poor maintenance. This clearly shows evidence of poor housing condition in the study area.

In view of the fundamental role of housing in the overall well being and productivity of man, this paper asserts the need to improve the housing condition of the core-area of Akure city, so that residents, who are the least able to afford decent housing, will be able to contribute meaningfully to the economics of Akure city in particular and the National economy in general.

RESEARCH METHOD

The site of the study:
Research investigation took place in the core area of Akure- the administrative and political capital of Ondo State of Nigeria. The city is located within Ondo State in the South western part of Nigeria. It lies within latitude 7 15N and 7 28N north of the

equator and longitudes 5 6N and 5 21'E east of the Greenwich meridian. It is located approximately 700kilometer south west of Abuja, the federal capital of Nigeria and about350 kilometer to Lagos the former capital of Nigeria and it is located within the tropical rain forest region of Nigeria where rainfall is high throughout the year. It became the capital city of Ondo state and a local government headquarters in 1976. The city's morphology has changed over time to assume its present status with its attendant land use problems, as experienced in similar medium sized urban centres in Nigeria . Akure has three kinds of residential settlement patterns: the core area, the peripheral neighbourhood core and the suburbs (Olotuah, 2000,Akin and Oyetunji,2010). The city has witnessed immense growth in size of built up areas, number of immigrants, transportation and commercial activities and has attracted both major investors and private developers into the town (Akin and Oyetunji,2010).. The total area is approximately 41.2km2 and it lies on a relative plain of about 250m above the sea level.

The population of the city grew from 38,852 (Thirty two thousand, eight hundred and fifty two) in 1952 to 71,106 (Seventy one thousand, one hundred and six) in 1963. Its population was estimated to be 112,850 (one hundred and two thousand , eight hundred and fifty (DHV, 1985); 144,544 (One hundred and forty four thousand, five hundred and forty four) in 1987, 148,880 (One hundred and forty eight thousand, eight hundred and eighty) in 1988, 153,347 (One hundred and fifty three seven thousand, three hundred and forty seven) in 1989 and 157,947 (One hundred and fifty seven thousand, nine hundred and forty seven) in 1990 (Ondo State of Nigeria, 1990). The 1991 national population census however, put the population of Akure at 239,124 (Two hundred and thirty nine thousand, one hundred and twenty four and its estimated population in 1996 was 269,207 (Two hundred and sixty nine thousand, two hundred and seven) NPC, 1996. Based on the last census conducted in 2006, the city's population is 353,211 i.e three hundred and fifty three thousand, two hundred and eleven (NPC, 2006).

Akure has three kinds of residential settlement patterns: the core area, the peripheral neighbourhood core and the suburbs (Olotuah, 2000). The study investigated the core area, which consists of the three neighbourhoods, namely Erekesan, Idiagba-Ijemikin and Obanla. Out of the three, the study took place at Erekesan which consists of Erekesan- Itanla, Eruoba and Afunbiowo, Alakure, Alakure -Ijofi and Iworokosagba,.

Research Database: The Primary data was collected by means of questionnaires corroborated with personal interviews and physical observation of the housing structures. Data measured on nominal scale were analysed using descriptive statistics such as frequency distribution and percentages. Mean score were used to analyse data measured on ordinal scale. The study area was divided into six strata, each unit of Erekesan forms a stratum. Data for analyses was collected by the use of a set of questionnaire administered on 600 residents of the core area community. A total of 600 questionnaires were distributed (100 to each sub-unit). 480, (80%) were retrieved and analysed.

Sampling:

Pilot survey was conducted during which layout plan of the area was drawn, since the researcher could not lay his hand on updated ones.The pilot survey was carried out in the month of January, 2011.

In order to gather necessary data from the household of the core area, a pre-determined number of 600 households was decided. The use of a particular mathematical model to determine the sample size may result in a sample size that cannot be easily managed by the researcher. Going by the words of Fasakin (2000), the above is rational and safer since the use of a straight jacket statistical formula to obtain a sample size and proportion is fraught with dangers. Among other things ,samples obtained through such methods invariably fall short of the need for a flexible relationship of sample sizes of particular aggregate populations(Fasakin2000,Emamanuel,2010).

The primary research instrument used was research questionnaire, developed over a month. The reason stated above influenced the decision to administer same number of questionnaire (600) to the study area. The second phase was carried out in the month of February and March, 2011. The number of houses on selected streets was initially obtained in a pilot survey.

Data collection process:
Data collection process was handled by a team comprising the author as principal researcher, a research assistant and twenty four field assistants who are either third or fourth year student of School of Environment Studies (comprising of Architecture, Urban studies, Quantity survey, Estate Management and Industrial Design) of Federal University of Technology, Akure, Nigeria. The field assistants were picked on the basis of their knowledge of the Core area being native of Akure town. While the research assistant and six of the field assistants reside in the research area. They were able to explain the purpose of the survey to the residence in their native language (Akure dialet). Moreover, since some of the research assistants live in this community, the respondents see them as one of them. This is responsible for having a very high rate of response (80%). In addition, The survey was conducted on Fridays, Saturdays, Sundays and Mondays in the months of February and March, 2011. Mondays was included since some residents (mostly farmers) regard this day as a day of relaxation after busy weekend.

Data Analysis:
Out of the 600 questionnaire used for this research, 480 were retrieved and analysed .This represent 80%. The processing of the data analysis involved the use of statistical soft wares named statistical package of social statistics (SPSS) version and Microsoft Excel 2007.

The variables examined took into consideration the relevant data required for the research.

The data were obtained from the household heads. The questionnaire contained 30 questions and four sections. The variables included in the questionnaires solicited information on (a) Socio-economic characteristic (5 questions). (b) Building facilities (10 questions). (c) Structural conditions (10 questions). (d) Physical infrastructures (5 questions).

The socio economic section contains questions on occupation, sex, marital status, income, rent paid.
The building facilities section contain questions on Age of building, type of kitchen, type of toilet, number of toilet, type of bathroom, source of water supply, how regular is electricity supply, number of bedrooms.
The structural condition section contain question on: state of repair of building, materials used for building walls, floors and roof and condition of wall.
The physical infrastructure section contain: Nature of road in the community, type of communal infrastructure, accessibility to other part of the city and type of drainage provided. Date obtained from field survey were analysed using Uni- variate

Analysis. This involved in presentation of data obtained from the field tables to describe the frequency of data obtained and pattern by observed attributes. Because of space, only thirteen variables are presented in this paper. These are: income structure, housing cost (rent paid), number of rooms occupied, condition of housing unit, source of water supply, type of toilet facilities, solid waste disposal method, age of housing unit, income spent on housing, materials used for construction, physical condition of housing unit, type of maintenance in operation and condition of Neighbourhood infrastructure.

RESEARCH FINDINGS AND DISCUSSION

Research findings:

Socio-economics characteristics of respondents and housing condition.

Income structure by respondents:
Table 1 depicts the pattern of income structure of the respondents as obtained from the field investigation. Analysis of table 1 shows that a high proportion of the respondents (75%) earn below N15,000 monthly. In other words, majority of respondents (75.6%) can be classified as low-income earners, while about 20% can be classified as middle-income earners. The remaining householders (6.4percentage f the sampled population) are therefore under the high income group. This results shows that majority of residents of the study area are:

Table 1: Income profile of households' heads

Monthly income in naira	Response	Percentage
Below 5,000	60	12.5
6,000 – 10,000	168	35
11,000 – 15,000	132	27.5
16,000 – 20,0000	36	07.5
21,0000 – 30,000	48	10.0
31,000 – 40,000	36	07.5
Total	480	100

Source: Field survey 2011

low and medium income earners. The implication is that they will not be able to pay high rents on build their own housing and equally be able to meet other necessities of life, when faced with problem of high rents. The few that are of high income earners seems to be attached culturally to the area.

Housing Cost (Rent) paid by respondents:

Table 2: monthly rents on housing units by householders

Monthly income (Naira)	Frequency	Percent
Below 500	95	19.7
501 – 1000	176	36.7
1001 – 2000	101	21.0
2001 – 5000	78	16.3
5001 – 10,000	27	5.6
Above 10,000	3	0.7
Total	480	100

Source : Field Survey, 2011.

The rent paid on housing unit occupied or equivalent if owner occupied is the cost of housing in the study area. Table 2 shows the monthly rent paid by respondents on housing units occupied by them. Analysis of the table shows that the highest number of respondents pays between N500 and N1,000 on housing,. This group accounted for 36.7 percent of the sampled population. Those that paid between N1,000 and N2,000 come next (21%). Others are those that pay below N500. (19.7%). N5,000 to N1,000 (5.6%). A very small proportion of the respondents (0.7%) pays above N10,000 monthly for their housing. Investigation shows that apart from paying for rents, householders also pay other charges like electricity bills, water, sanitation, and refuse disposal bills. All these add up (plus rents) to the total housing cost of householders.

Income spent on housing by respondents:

Table 3 shows the percentage of monthly income of respondent spent on rents. A close observation of the table revealed that a significant proportion (43.62percent) of the sampled respondent pay above 30 percent of their monthly income on rent. However, this figure is less than that of Lagos where average monthly rents is about 60 percent of the national minimum wage as against 20 percent set by the United Nations (FRG, 1977; Fawehinmi, 2000). 43 percent of the sampled respondents pay less than the acceptable 30 percent of their monthly income on housing. This confirms previous studies that the average monthly rent is about 60 percent of the national minimum wage as against the 20 percent set by the United Nations (Adeagbo, 1997). This is a serious problem considering the fact that about 70 percent of the urban low income group live in rented rather than owner occupied houses (National Housing Policy, 1991). The fact that about seven out of every ten urban low income earners spend 60 percent of their monthly salary on rents means that the majority of Nigerians are partly impoverished as a consequence of housing shortage.

Table 3: Percentage of income spent on housing

Monthly income (Naira)	Frequency	Percent
Below 20	89	18.58
20 – 30	120	25.04
30 – 60	177	36.98
60 – 90	85	17.67
Above 90	9	1.73
Total	480	100

Source: Field survey, 2011

Number of rooms occupied by respondents:

The numbers of rooms occupied was used to measure the size of housing unit occupied by respondents in the study area. The result is as depicted in table 4. Analysis of table 4 shows that majority of respondents (31percent) are occupying one room apartment.

Table 4: number of rooms occupied by respondents.

No of Room	Frequency	Percentage
Tenement(compound type)	116	24.19
One Room	149	31.00
Two Rooms	120	24.91
Three Rooms	65	13.53
Four Rooms	25	5.19
Five Rooms	5	1.16
Total	480	100

Source: Field Survey, 2011.

Two rooms apartments follow this with 24.91% and 24.19% of respondents are of tenement type. 13.53 percent of the respondents are occupying three rooms and 5.19% are occupying four bedrooms. While householders occupying five room and above recorded the least number of respondents (1.16percent). The implication of this result when compared with the findings of Aribigbola (2005) that majority of householders prefer flat apartment and previous studies that revealed household size in Nigeria to be six, then the current housing of people in the area is inadequate to meet their needs.

Condition of housing unit:

The overall physical soundness of the sampled dwelling was assessed. The assessment ranges from buildings, which were considered to be physically sound and need no repairs, through those that needed minor or major repairs to make them sound and to those which were regarded poor/dilapidated. The last category was reserved for units which were so defective that the cost of putting them back into service would be greater than the cost of replacing such units altogether (Wahab et al. 1990). Table 5 shows that majority (60%) of building investigated are in poor/dilapidated physical conditions. The fair buildings accounted for 34.2 percent while the good ones only accounted for 5.8% of the sampled buildings.

Table 5: Building conditions:

Condition of Building	Total	Percentage
Good	28	5.8
Fair	164	34.2
Poor	288	60.0
Total	480	100.0

However, since the physical attributes of housing is just one of the variables or bundle of services that made up housing, other parameters of housing condition such as water supply availability and type of toilet facilities and refuse disposal system among others were also examined.

Source of water supply:

Table 6 shows the major sources of water supply in the study area. Analysis of the table show that majority of residents of the study area depend on wells for their water supply. This constitutes 65.7 percent of all residents in all the houses. This is followed by those categorised as others (19.5percent) which include springs, brooks, rain, streams and in some cases public tap. Boreholes and pipe-borne water accounted for 6.0 and 8.3 percents of water supply respectively. The implication of this is that majority of residents depends on water supply from unsafe sources thereby lowering the quality of housing in the study area.

Table 6: source of water supply

Source of water supply	No of Houses	Percentage
Pipe borne water	40	8.3
Boreholes	29	6.0
Wells	315	65.7
None	2	0.4
Others	94	19.5
Total	480	100.0

Source: Field survey, 2011

Type of toilet facilities:

Table 7 shows that the highest percentage (41.31%) of buildings in Erekesan is provided with pit latrine. This is closely followed by water closet (35.38 percent). The table also shows that 23.25 percent of all buildings in Erekesan lack any form of toilet facilities. The fact that 35.38 percent of buildings in the Erekesan and another

23.25 percent of all buildings do not have any form of toilet facilities indicate that majority of buildings in Erekesan is substandard and that many residents of Erekesan will defecate any where and cause environment problems.

Table 7: Type of toilet facilities

Type of Toilet	No of Houses	Percentage
Water closet	170	35.38
Pit latrine	198	41.31
None	110	23.25
Others	2	0.07
Total	480	100.00

Source: Field survey 2011.

Solid waste disposal method: Another indicator of housing quality is refuse collection and disposal system. On method of refuse collection and disposal in the study area, the Waste management Authority is responsible for collection and disposal of waste from 31.2 percent of all the building in the area (see table 8). 55.1 percent and 11.8 percent of waste generated in the city are disposed off by dumping them on dump site and by burning respectively. These methods are not only unhealthy but destroy and pollute the environment.

Table 8: solid waste disposal method

Method of Disposal	No of Houses	Percentage
Waste Management Van/Point	149	31.2
Dump Site	264	55.1
Burning/Incineration	56	11.8
Others	11	1.8
Total	480	100.00

Source: Field survey 2011

QUALITY OF THE EXISTING HOUSING STOCK IN THE STUDY AREA

Building, like human beings have life span which is a function of age, materials used , level of maintenance, usage etc. These factors were investigated into, so as to determine the quality of the existing housing stock.

Table 9: Approximate Age of Housing Units

Age of Structures (Yrs)	Response	percentage
< 10	18	07.5
11 – 20	36	15.5
21 – 30	48	20.5
31 - 40	60	25.0
41 and above	78	35.0
Total	480	100.0

Source: Field survey, 2011

Table 9 present the approximate ages of the building surveyed. Out of 480 households surveyed, 60% are aged between 31 years and above. This explains why most of them are sub-standard, with no designs, and no plan approvals. These type of houses do not give the occupants the desired aesthetics and comfort.

Table 10 shows majority of the residential buildings(65%) are either constructed with compressed earth bricks and mud bricks. Whereas the remaining buildings (35%) are either of combination of cement and mud brick and cement blocks only.

Table 10: Materials used for construction of Housing Units in the study area:

Materials	Response	Percentage
Cement Blocks	84	17.5
Mud Bricks	112	23.0
Timber	00	00.0
Compressed Earth Bricks	200	42
Cement and Mud Bricks	84	17.5
Total	480	100.0

Source: Field Survey 2011

The buildings are showing signs of defects such as cracks in walls, leaking roofs, dampness rising inside the rooms. These reflects the result of the survey on physical Housing Condition in the study area are as presented in Table 11.

Table 11: Physical Condition of Housing Units in the Study Area

Building Elements	Bad		Fair		Good	
	No	%	No	%	No	%
Foundation	115	45.0	100	42.0	24	15.0
Wall-External	108	42.0	96	40.5	36	12.0
Internal	108	44.0	84	32.5	54	20.5
Floor	132	50.0	142	35.0	24	17.5
Roof	120	52.0	115	32.5	42	17.5
Total		46.6		36.9		16.5

Source: Field Survey, 2011

Table 12: Type of Maintenance in Operation

Type of Maintenance	Response	Percentage
Planned Maintenance	108	22.5
Corrective Maintenance	372	77.5
Total	480	100.0

Source: Field Survey, 2011

Table 13: Condition of Neighbourhood Infrastructure

Neighbourhood Infrastructure	Bad		Fair		Good	
	No	%	No	%	No	%
Drainage System	132	50.0	66	27.5	42	25.5
Road Network	126	45.5	78	32.5	36	35.0
Electricity Supply	120	48. 40	109	45.4	11	28.6
Total		47.96		22.34		29.70

Source: Field Survey, 2011

Only 16.5% of the households surveyed are in good condition 36.9% have one form of notable defect or the other. While 46.6% are completely bad, yet they are occupied.

Table 12, presents the result of an investigation into the type of maintenance practised in the study area and shows that only 22.5% households plan for maintaining their houses due to lack of fund. As a result most houses show lack of proper maintenance which affect the life span of the structures.

AVAILABILITY AND QUALITY OF NEIGHBOURHOOD INFRASTRUCTURE:

Urban housing infrastructure was surveyed to determine their conditions and the result is shown on Table 13.The study area lacked functional and necessary urban infrastructure such as drainage systems & Electricity supply as 47.96% houses do not have access to these facilities. They are either not provided at all or the few available ones are not functioning properly. Only 29.70% have access to functional urban facilities,while access by 22.34% can be said to be fair. Houses were build without paying attention to planning details such as set back. Hence most houses are accessible through narrow foot paths, with no allowances for construction of drainage channels. The few channels available have become refuse dumping pits. Hence refuse dumps are common sights in Erekesan and the first rain of the year do wash these waste into peoples' houses making them vulnerable to diseases such as typhoid fever, cholera etc. Based on the assessment of the infrastructure, the study area can best be qualified as a slum. However, through the ongoing State urban renewal program, the quality of infrastructure are now improved when compared with some years ago, especially the road network.

CONCLUSION AND RECOMMENDATIONS

Erekesan is a typical low income settlement marred with numerous housing problems. These are social, environmental and economic in nature. These problems manifest in shortages of accommodation unit, sub-standard building, overcrowding, inadequate and non-functioning social amenities, unsatisfactory and unwholesome environmental conditions and poor quality air circulation. Similarly, the environmental and economic conditions of the study area exhibited the characteristics of slum neighbourhood typical of fringe settlements in most Nigerian towns, characterized by unplanned developments, uncoordinated system of development and long term neglect by the government.

From these findings, the following measures are suggested as means of resolving the deplorable housing conditions in the study area as well as others with similar problems:

Urban development and restoration should be a major concern of governments in order to reduce the environmental stress experienced in the study area. This is achievable with major investments committed to urban infrastructure and services. This however, requires the will of government without undue politicking.

The residents of the study area (Erekesan) which is part of the core area of Akure city are culturally attached to the land, it is impracticable to embark on total clearance and resettlement programme. Slum upgrading and improvement should therefore be aimed at.

Adequate and quality drinking water should be provided through construction of boreholes and pipe-borne water in order to eliminate water borne diseases.

Recently introduced waste management schemes should be improved upon, while more environmental inspectors should be engaged.

Monthly environmental sanitations programme should be improved upon with workable measures of enforcing it in order to keep the environment clean.

Poor housing is in intricately linked with poverty and it is indeed informed by it, thus government has a definite role to play in addressing the high unequal distribution of wealth in the country. The poverty alleviation programmes of government should be stepped up to reduce unemployment rate in the country.

This paper appraises the housing conditions in Erekesan, a part of the core area of Akure city, the Ondo State Nigeria. It assess the quality of existing housing environment and the availability of the neighbourhood facility. The study concludes that the housing condition is very poor and proffers recommendations to improve them.

REFERENCES

Aribigbola A (2005): study of Urban Housing choice in Akure, ondo State, Nigeria. Unpublished Ph.D.Thesis, Department of urban and Required Planning, Obafemi Awolowo University, Ile-ife

Augustine S.T. (2005). Housing condition in Kakuri District, Kaduna. Unpublished M.Sc Thesis in the Department of Geographical and Planning, University of Jos.

DHV Consulting Engineers (1985). Report on Ondo State Urban Development Project. Preparation Study final Report, Amersfourt.

Dung – Givon, J.Y Ibrahim, D.M. (2006) Urban Environment Quality Perception in Gombe Town,

Nigeria. Nigeria journal of Environmental Sciences, Jos 10(1), 89-103

Fagbohun, P.O. (2003). Housing and livability in Nigeria cities: A study into Housing situation in Oshodi, Lagos. A paper presented at a National Workshop on private sector Driven Housing delivery, 30th – 31st July, Lagos, Nigeria.

Fawehinmi, S.A. Government search for Affordable Rental Housing in Nigeria. The mis-step & Rent controls Pp 40-45 in: Effective Housing in the 21st century Nigeria, o.B. Akinbamijo, A.O. Fawehinmi, D.R. Ogunsemi and Olutuah, A (Eds). The Environmental Forum Federal University of Technology, Akure.

Federal Government of Nigeria (2006). National Housing Policy.

Federal Government of Nigeria, FGN (2004). National Housing Policy for Nigeria, Federal Ministry of Works and Housing, Abuja.

National Population commission (1996). Census '91 final results, Ondo state.

Okupe, L (2002): Private sector initiative in Housing Development in Nigeria. How feasible? Housing today, vol 1, no 6 Pp 21-26.

Olotuah, A.O. (2000). Evaluation of suburban Housing conditions in Akure, Nigeria. Africa Journal of Development studies, 2(192). 165.

Olotuah, A.O. S Ajenifujah A.O. (2009) Architectural Education and Housing Provision in Nigeria' In CEBE Transactions. Online Journal of centre for Education in the Built Environment, Cardiff University, UK, 6(1).

Ondo State Government (1990). Digest of Demographic statistics of Ondo State. Ministry of Finance, Budget and Planning, Akure.

AN EVALUATION OF THE TREND OF BUDGETARY ALLOCATIONS FOR INFRASTRUCTURAL DEVELOPMENT IN OSUN STATE, SOUTH-WESTERN, NIGERIA

Opawole Akintayo[1], Jagboro Godwin Onajite and Babatunde Solomon Olusola
Department of Quantity Surveying, Obafemi Awolowo, University, Ile-Ife, Nigeria

Infrastructure development depends substantially on budgetary financing in Nigeria. The budgetary allocations have, however, been criticized to be based on non-procedural approach. While this has necessitated a scientific methodology, research effort in this area is limited. The study assessed the trend of budget allocations for infrastructure projects with the view to examining how the trends have impacted the level of execution of public infrastructure projects. Data for the study were based on archival data of budgetary allocations of five infrastructural projects from ten editions of Osun State budget between1999–2008 and structured questionnaire directed to construction professionals and financial administrators in the public service of the State. These are architects, quantity surveyors, builders, town planners, estate surveyors, engineers (civil, mechanical and electrical), accountants and economists. The infrastructure projects are education, transportation, rural/urban electrification, health, housing and water projects. Data analysis was done through, mean, percentage and time series analysis. Trend functions obtained for each projects were modified by coefficient generated by setting the implementation level of the projects at 100% to generate appropriate models for budget allocation for the projects. These models would serve as tool for predicting the budget allocation for infrastructure development by policy makers in the state. Moreover, findings from the study indicated poor level implementation of public financed infrastructure suggesting the budgeting methodology and consistence level of the trend of budgetary allocations as significant to implementation level of public financed infrastructure in Nigeria.

Key words: infrastructure, budgetary allocation, project execution.

INTRODUCTION

Infrastructure procurement is basically through three financing options. These are public financing, private finance initiative (PFI), and public private partnership (PPP) initiatives (Oyegoke, 2005; Ashwort and Hogg, 2007; and Tsema, 2008). However, the level of private sector participation in infrastructure development is identified to be significantly low in Nigeria with progressive participation only in education and communication infrastructure (Ayodele, 2006; and Ilori, 2006). The Private-Public Partnership (PPP), likewise, is only in the recent gaining popularity in Nigeria (Tsema, 2008). Thus, the financing of infrastructure, like in most developing countries, is traditionally public task through public budgetary allocation in Nigeria. This situation makes public policy makers and the construction industry the major

[1] O.A.tayodk@yahoo.com

Akintayo, O., Onajite, J.G. and Olusola, B.S. (2011) An evaluation of the trend of budgetary allocations for infrastructural development in Osun state, south-western, Nigeria *In:* Laryea, S., Leiringer, R. and Hughes, W. (Eds) *Procs West Africa Built Environment Research (WABER) Conference,* 19-21 July 2011, Accra, Ghana, 105-117.

actors in infrastructure development in Nigeria. However, Mogbo (2001) and Offoreh (2006) see budgetary allocation procedure for infrastructure sector in Nigeria to be based on non-procedural approach. This procedure has been criticised as the reason for lack of connectivity between budget sizes and projects they are intended to finance. In most cases, projects covered by a fiscal year budgetary allocation are not completed or abandoned. This phenomenon though becoming worrisome, could be traceable to deficiency in the previous trend of public budgetary allocations to cope with the desirable level of infrastructure constructions. This has necessitated an empirical evaluation of trend of budgetary allocation for infrastructure development in Nigeria.

PREVIOUS WORK

Although literature abounds on the subject of infrastructural development in Nigeria, limited studies have correlated budgetary financing to level of execution of infrastructural projects (Mogbo (2001; Frank, 2003; Offoreh, 2006)

Oforeh (2006) studied the role of the Nigerian Institute of Quantity Surveyors as an agent of economic development. The study identified poor level profile of infrastructure projects implementation in Nigeria as resulting from low level input of construction professionals in infrastructure policy formulation at the macro-economic level. Studies by Mogbo (2001) and Frank (2003) identified infrastructure projects as projects of high capital outlay. Furthermore, Frank (2003) identified the major causes of poor performance of infrastructure in urban centers in Nigeria as factors relating to high cost of infrastructure provision, failure of government to adopt liberalization policies in dealing with urban infrastructure matters, and inadequate budgeting by the public sector. On the other hand, Mogbo (2001) posits that the low level implementation of infrastructure development in Nigeria could be correlated to level of contribution of the construction professionals in the budgeting process.

Further studies on infrastructure development include Ogunsemi and Saka (2006) and Olayiwola and Adeleye (2005). Ogunsemi and Saka (2006) article is restricted to the New Partnership for Africa's Development (NEPAD) initiative and the challenge of efficient cost management of infrastructure development in Nigeria. Olayiwola and Adeleye (2005) studied the challenges and problems of rural infrastructure development in Nigeria. The study only highlighted the concept of rural infrastructural planning and examined the Nigerian rural infrastructural policies over the years 1960-1990. The major problems and challenges posed by the various rural infrastructural development identified include lack of spatial focus in rural development planning; lack of perceptual focus in the development plans; restriction of means of rural infrastructural provision to public funding; and lack of action and appropriate institutional arrangements for the execution of rural infrastructural programmes.

METHOD

The study area is Osun state, in the South Western region of Nigeria. The choice of Osun state was purposive as almost all infrastructure development in the state is dependent on budgetary financing. A total of seventy-two (72) properly completed questionnaire by 6 architects, 4 quantity surveyor, 6 town planner, 5 estate surveyors, 4 builders, 21 engineers (mechanical, civil, and electrical) and 26 economists/accountants representing a response rate of 70% of total 106 questionnaires administered were completed and returned for the analysis provided quantitative data for the study. Archival data for the study were budgetary allocations from ten editions of the State budget for five types of infrastructural projects between 1999–2008. These are education, transportation, rural/urban electrification, health, housing and water projects. The questionnaire was of two parts. The first part identified the demographic features of the respondents; and the second part relates to the scoring by the respondents of the implementation of the projects in the state on the scale of 0-100% where 0 represents lowest ranking and 100 representing highest ranking. Data analysis was done through mean, percentage and time series analysis. The distribution of the respondents is shown in table 1. Trend function obtained for each project was modified by coefficient generated by setting the execution level of the project at 100% to generate appropriate model for budget allocations for the projects.

DATA ANALYSIS

Table 1 shows the percentage representation of the respondents as 8.3% for architects, 8.3% for town planners, 5.6% for builders, 5.6% for quantity surveyors, 29.2% for engineers, 6.9% for estate surveyors and 36.1% for economists/accountants. This result expressed adequate opinion of the infrastructure stakeholders as both the financial administrators and construction professional are adequately represented.

Table 1: Type of Respondents

Respondents	Number administered	Number collected	Percentage (%)
Architects	8	6	8.3
Town Planners	7	6	8.3
Builders	8	4	5.6
Quantity Surveyors	4	4	5.6
Engineers	40	21	29.2
Estate Surveyors	7	5	6.9
Accountants/Economists	32	26	36.1
Total	106	72	100.0

Table 2 shows that 26.4% of the respondents are holders of Master of Science or Masters of Technology; 44.5% are holders of Bachelor of Science or Bachelor of Technology; 18.1% obtained Post Graduate Diploma (PGD); 9.7% holds Higher National Diploma (HND); and 1.4% holds Doctor of Philosophy. The result shows that all the respondents possess the minimum registration qualification of their various professional bodies in Nigeria and are of adequate academic training to supply reliable data for this study.

Table 2: Academic Qualification of the Respondents

Qualification	Number of the Respondents	Percentage (%)
Ph.D	1	1.4
M.Sc/M.Tech	19	26.4
B.Sc/B.Tech.	32	44.4
PGD (Post Graduate Diploma)	13	18.1
HND (Higher National Diploma)	7	9.7
Total	72	100

In table 3, the mean work experience is estimated at 14 years, which represents the working experience of about 52% of the respondents. With this average working experience, respondents are deemed experienced enough to supply reliable data for this study.

Table 4 shows the professional qualification of the respondents. Sixty-seven (67) respondents representing 93.1% of the total respondents are either associate or corporate members of their various professional bodies. The result shows that the respondents are either associate or corporate members of the various professional bodies or posses some other professional qualification. This shows that the respondents are in the position to supply reliable data for this research.

Table 3: Working Experience of Respondents

Years	Midpoint (X)	Frequency (F)	FX
0-5	2.5	7	17.5
5-10	7.5	10	75.0
1-15	13	4	52.0
16-20	18	13	234.0
20- 25	22.5	27	607.5
Above 26	26	11	286
Total		72	1272

Mean = 14

Table 4: Professional Qualification of the Respondents

Professionals	Number	Percentage (%)
Nigerian Institute of Architects (NIA)	4	5.6
Nigerian Institute of Town Planners (TPL)	5	6.9
Nigerian Institute of Building (NIOB)	4	5.6
Nigerian Institute of Quantity Surveyors (NIQS)	4	5.6
Nigerian Society of Engineers (NSE)	19	26.4
Nigerian Institute of Estate Valuers and Surveyors (NIEVS)	5	6.9
Institute of Chartered Accountant (ICAN)/Association of National Accountants of Nigeria (ANAN)	25	34.7
Others	1	1.4
Non Professionally Qualified (NPQ)	5	6.9
Total	**72**	**100**

Table 5 shows the trend of budgetary allocations for infrastructural development between the years 1999-2008 in Osun state. The mean budget allocation for infrastructure is established as N10, 195.0m which represents 63.2% of the mean capital budget and 47.1% of the mean total budget. The detail of the trend of budget allocation is illustrated in figures 1-8. These results almost agree with the findings of Oforeh (2006) and Ayodele (2008), who identified capital expenditure as staggering between 65 – 70% in the annual budgets of the three tiers of government in Nigeria, with allocation to infrastructure as often responsible for about 50% of the capital expenditure.

Table 5: Budgetary Allocation for Infrastructural Projects in Osun State (Naira, Millions)

Year	Education		Rural Urban Electrification		Health		Transportation		Water		Housing	
	x_1 (%)	x_2 (%)	x_1 (%)	x_2 (%)	x_1 (%)	x_2 (%)	x_1 (%)	x_2 (%)	x_1 (%)	x_2 (%)	x_1 (%)	x_2 (%)
1999	15.38	4.28	1.96	0.63	3.69	1.18	26.66	5.68	7.83	3.81	3.22	0.71
2000	6.31	3.88	0.90	0.51	3.76	2.12	18.94	3.97	48.94	27.88	0.80	0.48
2001	5.62	3.18	0.33	0.20	5.68	3.17	29.02	17.09	29.89	17.88	0.48	0.400
2002	11.76	4.68	1.73	0.88	9.34	5.30	22.72	12.88	20.88	11.82	1.78	0.88
2003	20.05	4.46	0.87	0.29	18.62	5.12	12.62	4.19	10.88	3.61	1.87	0.62
2004	18.77	4.87	2.72	0.89	11.82	4.21	10.48	3.83	14.09	5.14	3.38	0.82
2005	11.30	5.19	0.48	0.22	8.97	4.12	33.81	14.88	4.80	3.48	0.43	0.29
2006	14.26	4.61	1.52	0.62	5.32	3.86	30.86	14.35	3.73	1.74	0.64	0.30
2007	28.53	14.61	3.08	1.06	6.27	3.22	22.22	11.39	3.56	1.82	1.54	0.94
2008	21.82	9.27	3.17	1.36	6.09	2.61	22.30	10.00	3.64	1.56	1.57	0.87
Mean	14.98	6.60	1.56	0.69	7.71	3.39	22.73	10.67	14.89	7.60	1.42	0.62

Table 6 shows the mean budget allocation expressed as percentage of capital budget and total budget. The mean budget allocation expressed as percentage of capital budget for education, rural/urban electrification, health, transportation, water, and housing were established as 14.98%, 1.56%, 7.71%, 22.73%, 14.89%, and 1.43% respectively. On the other hand, the mean budget allocations for education, rural/urban electrification, health, transportation, water, and housing expressed as percentage of total budget allocation were established as 6.60%, 0.69%, 3.39%, 3.39%, 10.67%, 7.60%, and 0.62% respectively.

Table 6: Budget Allocation as Percentage of Capital Budget and Total Budget

Year	Total Budget	Capital Project	Budget Allocation to Infrastructure	Budget Allocation as % of Capital Budget (%)	Budget Allocation as % of Total Budget (%)
1999	4,790.00	1,530.00	850.40	55.58	17.75
2000	11,820.00	6,700.00	5,106.21	76.21	43.21
2001	20,480.00	12,040.00	8,100.75	67.22	39.57
2002	18,870.00	10,710.00	7,292.50	68.09	38.65
2003	14,530.00	4,830.00	2,976.57	61.69	20.48
2004	18,910.00	6,910.00	4,136.72	59.84	21.86
2005	25,220.00	11,630.00	7,085.00	61.00	28.09
2006	29,050.00	13,500.00	7,982.72	58.52	27.48
2007	34,770.00	17,790.00	11,491.68	64.51	33.05
2008	38,010.00	16,310.00	9,719.53	59.59	25.57
Mean	21,645.00	10,195.00	6474.21	63.23	29.57

Author's Calculation (2010) x = % of Capital Budget; y = % of Total Budget.

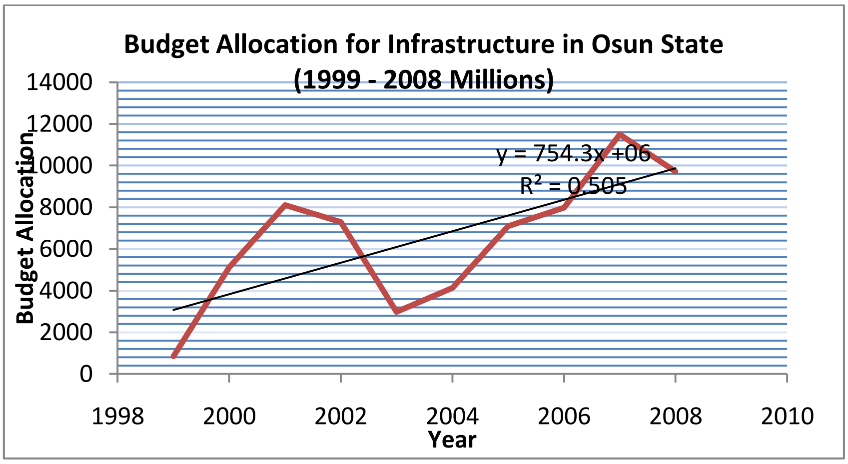


Figure 1: Trend of Budgetary Allocation for Infrastructural Projects in Osun State

The trend of budget allocations for infrastructure between the years 1999-2008 is as shown in figure1. Going by the profile of the graph of allocation versus year, there was an upward increase from N850.4m in 1999 up to N8,100.21m in 2001 and a gradual declining pattern from N8,100.21m in 2001 to N2,976.57m in 2003. This downward trend was, however, reversed in 2003 and steadily climbed to N11,491.68m in 2008. The distortion of steady increase from 1999 to 2008 could be attributed to the fluctuation of the revenue in the same period in Osun state as exemplified by the decline of price of crude oil (Odularu, 2008). Another factor that could be responsible for this volatility is the fact that the political situation was still very much unstable transiting from military rule to civilian democracy. It would be noted that the 'due process' application to procurement of public was also heightened in this period. While these could be considered significant factors, other factors including better institutional framework, population growth and sustained commitment of the state government to improve the state infrastructural base could have been responsible for the upward trend. While the best fit line revealed an average consistent trend defined by the value of R^2 ($R^2 = 0.505$), it should be noted, however, that the value of R^2 (0.505) does not suggest or in any way indicate the adequacy of allocations across the years. The graph presents a statistical trend relationship which is defined by $Y = 754.3x + 06$, where x is the budget year and 06 the intercept on the Y axis.

Table 7: Trend of Sectoral Budgetary Allocation for Infrastructural Projects (Millions)

Year	Education	Rural/Urban Electrification	Transportation	Water	Health	Housing
1999	204.90	30.00	405.00	120.00	56.50	34.00
2000	422.70	60.00	1,060.00	3,260	250.02	53.49
2001	436.00	40.00	3,500	3,600	443.50	81.25
2002	1,260	185.00	2,430	2,230	1,200	187.50
2003	966.68	41.80	609.00	525.20	743.89	90.00
2004	1,300	188.00	724.00	972.50	796.50	155.72
2005	1,310	57.00	3,930	675.00	1,040	73.00
2006	1,920	179.00	4,170	506.70	1,120	87.02
2007	5,080	370.00	3,960	634.08	1,120	327.60
2008	3,560	516.40	3,800	593.94	993.00	256.19
Mean	1646.03	166.72	2458.80	1311.74	756.34	134.58

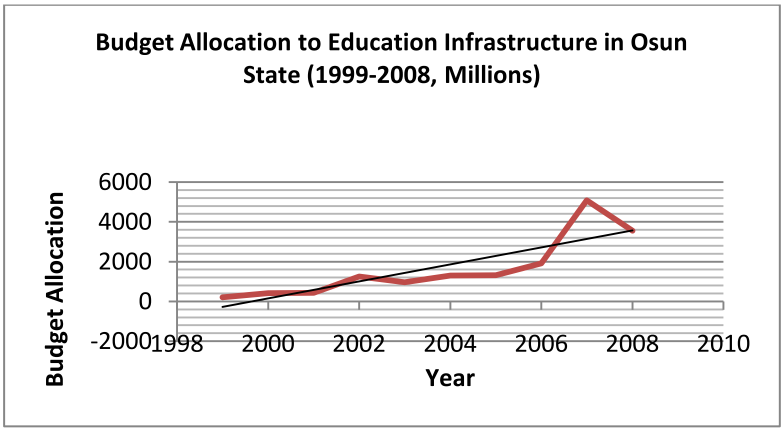


Figure 2: Trend of Budgetary Allocation for Educational Infrastructural Projects

Thus keeping other macro-economic variables constant, the fit yield could be extrapolated to make a projection of allocations for subsequent years, that is years beyond 2008. The gradient of the straight line model produced would, however, require further improvement to adjust for proportionality between the adequacy of the budget allocation and the level of implementation of the projects.

The trend of budgetary allocation for educational infrastructural development between1999-2008 is as shown in figure 2. There was a progressive increase from N204.9m in 1999 to N1, 260m in 2002 and from N966.68m in 2003 to peak value of N5,080m in 2006 which gradually declined to N3,560m in 2008. Distortions were noted in 2003 and 2007. This could presumably be attributed to political factor as dictated by change in government in these periods. On the overall, the trend graph could be represented by best fit line with co-linearity coefficient of $R^2 = 0.707$ which indicate a consistent trend in the allocations and thus establish the increase in the budget allocations over the ten (10) years as statistically significant. The linear trend model produced is represented as Y= 428.4x – 85682.

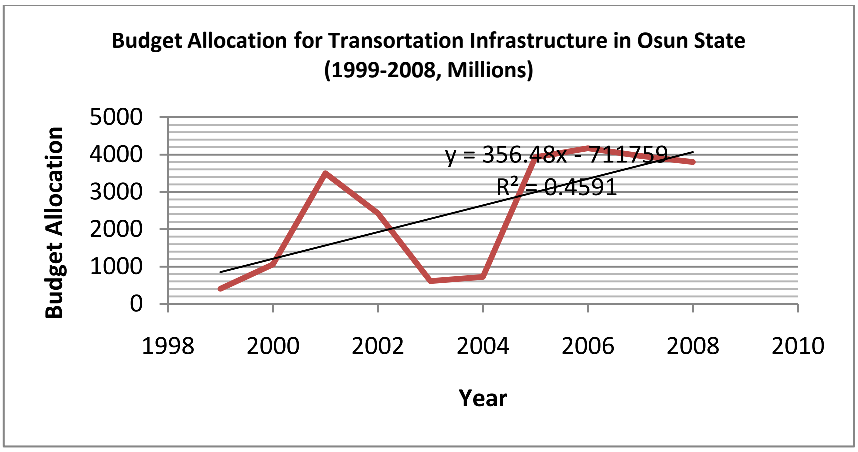


Figure 3: Trend of budgetary allocation for transportation projects

Figure 3 shows the trend of budget allocations for road infrastructure between the years 1999-2008. The allocation rose gradually from N405m in 1999 to N3,500m in 2001. This sharply declined to N609m in 2003. Slight increase occurred between 2003 and 2004. There was, however, a consistent increasing trend from N724.0m in 2004 to N4,170.0m in 2006. This again assumed a gentle declined trend from N4,174.0m in 2006 to N3,800.0m in 2008. Distortions were noticed in 2001, 2003 and 2006. From 2003 to 2008, there was poor consistency in the trend as shown by the graph, though there was significant increase from N724.0m in 2004 to N3,930.0m in 2005 (81.6% increase). The graph on the overall could be represented by fit line with co-linearity coefficient of R2 = 0.459 which indicate low consistency and poor statistical significance among the budgetary allocations over the ten years. A more consistent trend was obtained between 2005 and 2008. This produced an overall model of Y= 356.4x – 71175. The inconsistence in the pattern of budget allocations for this category of infrastructure as defined by $R^2 = 0.459$ suggests absence of macro-economic framework to guide the budget allocations and poor commitment of government to this category of infrastructure. The inconsistence in the budget allocation also suggests projects-allocations imbalance which could have resulted in budget strain during projects execution. Should this trend continue unabated, the state may experience poor level execution of road projects and consequently high profile of road infrastructure decay. This may pose poor rural-urban integration in the state and thus impact negatively on the economic growth of the state. Improved model could, however, be obtained by subjecting the model to further time series analysis, such as stochastic regression.

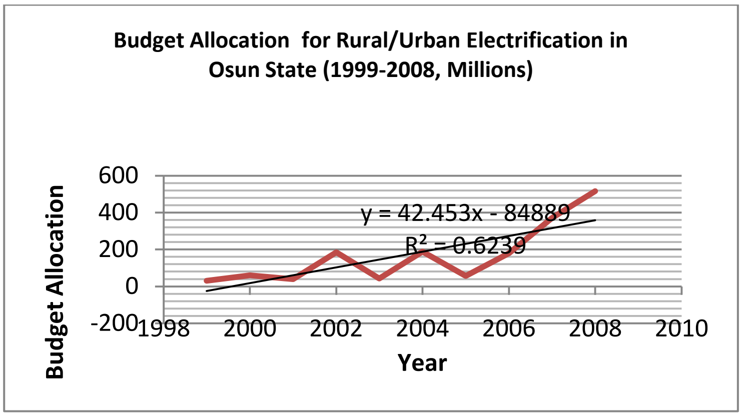


Figure 4: Trend of Budgetary Allocation for Rural/Urban Electrification Projects

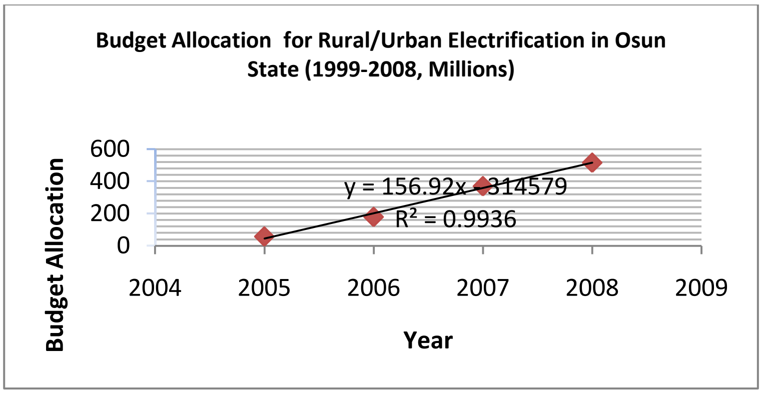


Figure 5: Trend of Budgetary Allocation for Rural/Urban Electrification Projects

In figure 4, the trend of budget allocations for rural/urban electrification remained poorly consistent until 2005. This is evident from the linearity coefficient of the fit line ($R^2 = 0.620$). The pattern, however, assumed almost perfect consistence ($R^2 = 1$) between 2005 to 2008 with the allocations improving from N57.0m to 516.4m, that is, 88.9%. While the model produced (Y = 42.45x – 84889), may seem less predictive for the overall allocations, a better fit line was drawn across 2004-2008. This is shown in figure 5. This produced a linear function Y = 156.9x – 31457 with improved characteristics, that is, gradient (156.9), intercept (31457) and R^2 (0.993).

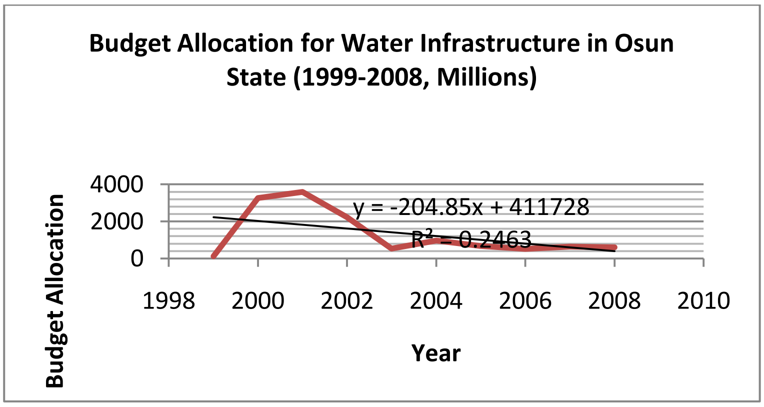


Figure 6: Trend of Budgetary Allocation for Water Infrastructure Projects

The pattern of budgetary allocations for water projects is as shown in figure 6. Budget allocations for this type of infrastructure show a generally declined pattern. Between 1999 to 2002, the allocation rose from N120m to N3,600m (96.7%). This declined sharply to N525.2m in 2003 (585.5% decrease). Between 2004 to 2008, the allocation declined from N972.5m in 2004 to N506.7 in 2006 and remained almost the same value till 2008. Between 2001 and 2008, the allocations dropped by N3,006.0m, that is, 506.1%. The declining trend became worst from 2002 and this continued till 2008. The value of (R^2= 0.250) produced by the fit graph showed the allocations to be statistically insignificant over the ten years. The model produced a negative gradient of -204.8 and R^2 of 0.246. This result suggests very low level of commitment of the state government to water development. It could also be inferred based on this finding that there is absence of macro-economic framework for the development of water infrastructure in the state which is very crucial to people's health and sanitation. It would not be farfetched to say that the state may be ranked very high in prevalence of water-borne diseases like cholera, diarrhoea and dysentery among others.

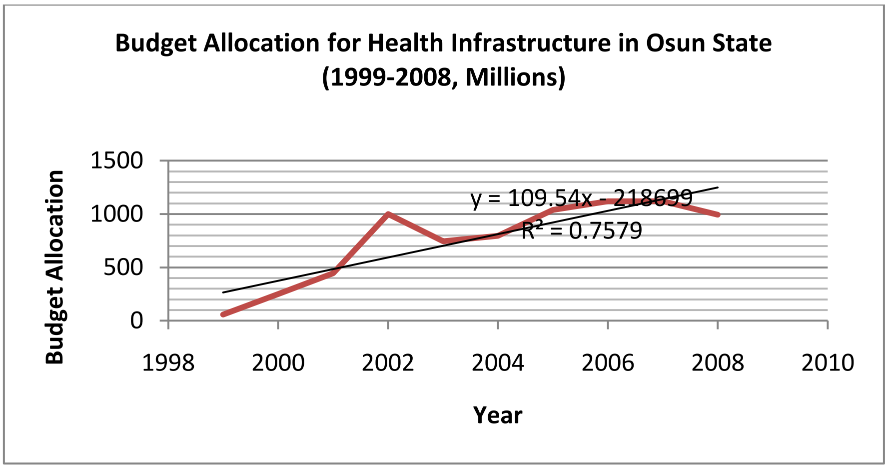


Figure 7: Trend of Budgetary Allocation for Health Infrastructure Projects

Budgetary allocations to health infrastructure as shown in figure 7 seemingly appear to be a success story going by the astronomical jump from N56.5m to N993.00m between 1999-2002. The value of the best fit line revealed a consistent approach in the allocations and thus suggests serious government commitment to this sector of infrastructure. The distortion in the budget allocations between 2002 and 2007, however, suggest different levels of commitment of the government occasioned by two political regimes that were in charge of the state. The value of (R^2= 0.757) produced by the graph showed the allocations to be statistically insignificant over the ten years.

Figure 8 shows the trend of budgetary allocation for housing infrastructure. The allocations were only fairly consistent between 1999 to 2002. The trend galloped between 2002 and 2008 and the fit line defined by Y = 22.24x – 44423 thus produced a low value of R^2. (R^2 = 0.492). This result indicates that budget allocation for this sector is statistically insignificant over the ten years. This suggests indirect withdrawal of the government from housing provision programme presumably due to the failure of previous housing development programmes at both the state and federal levels.

In summary, the linear models of the budget allocations produced for the six types of infrastructure could be represented as Y_T = 356.4x – 71175; Y_E = 428.4x – 85682; $Y_{R/U}$ = 42.45x – 84889; Y_W = 204.8x – 41172; Y_H = 109.5x – 21869; and Y_{HS} =

22.24x – 44423, for transportation, education, rural/urban electrification, water, health and housing respectively, where x is the budget year. However, the model obtainable in this type of analysis has been criticized by Jacque and Koopman (2007) to be less predictive as it is based on fit lines only which may not adequately define the true values of the x variable. The models would, however, provide a better predictor of budget allocations rather than existing procedure which have been criticized to be based on imaginary approach by Mogbo (2001) and rule of thumb by Bamberger (2000).

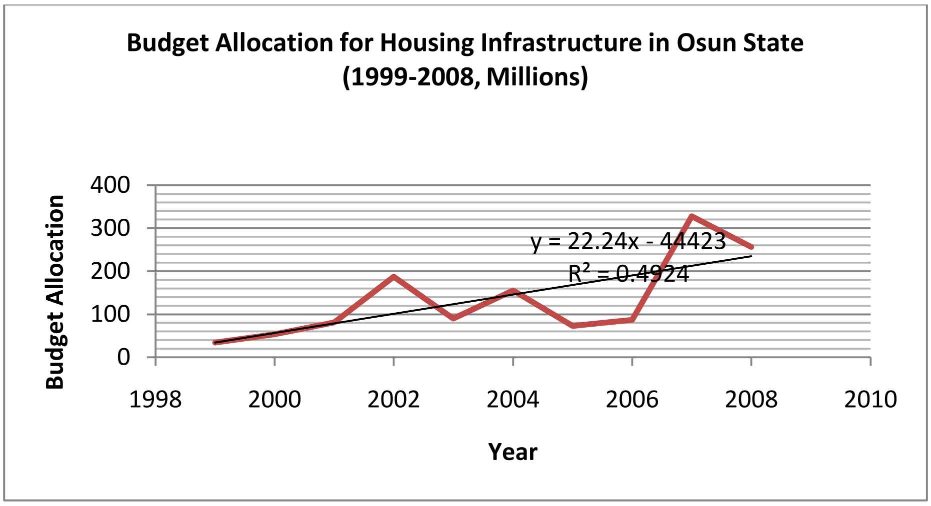


Figure 8: Trend of Budgetary Allocation for Housing Infrastructure Projects

As earlier described in figure 1, these models could only provide tools for forecast on the basis of trend of previous allocations, but may not guarantee the prediction of values of budget allocations that ensures good projects implementation. A way of improving the models, however, is to improve the gradient of fit line in each model. This was achieved by improving the gradients of x variable in the models with the information from the analysis of the implementation of the projects, that is, upward shift of the linear model in each case to the right.

Table 8: Assessment of Level of Execution of Infrastructural Projects in Osun State

Infrastructure	Percentage Implementation (%)											
	0-10	11-20	21-30	31-40	41-50	51-60	61-70	71-80	81-90	91-100	TWV	Mean
Rural/Urban Electrification	4	5	4	10	14	15	5	9	5	1	3554.00	49.36
Transportation	4	4	10	9	18	10	9	4	4	0	3264.00	45.33
Education	1	4	3	8	11	18	15	9	1	2	3865.50	53.69
Health	2	1	4	9	15	15	7	14	3	2	3925.00	54.51
Water	4	2	4	15	22	10	6	7	1	1	3344.00	46.44
Housing	9	10	12	5	18	10	3	4	1	0	2641.50	36.69

Table 8 shows the quantitative assessment of the level of implementation of budgetary financed infrastructural projects on the scale of 0-100% where 0 represents lowest ranking and 100 representing highest ranking. The table shows the highest mean implementation of 54.51% which indicate average for health infrastructural projects. This is followed by education infrastructure with mean percentage of 53.69%. Housing infrastructure; transportation; rural/urban electrification; and water infrastructure projects were rated as executed at 36.69%, 45.33%, 46.44% and 49.36%

respectively which are below average. These results indicate that if this trend of levels of execution continues, the state would continue to witness decline trend of infrastructure development, the adverse effect of which may include reduced quality of education, poor health delivery and high risk of water related diseases among others. This will significantly reduce the standard of living and the economic development in the state.

Table 9: Relationship between Budgetary Allocations for Infrastructure Projects and Projects Implementation

Variable	Education	Rural/Urban Electrification	Transportation	Water	Health	Housing
Mean Budget Allocation (Millions) (X)	1,646.03	166.72	2,458.80	1,311.74	756.34	134.58
Mean Implementation (%) (Y)	53.69	49.36	45.33	46.44	54.51	36.69
Correlation Models	Y_{EI} = 0.0031x+48.58	$Y_{R/UI}$ = 0.243x+8.89	Y_{TI} = 0.012x+15.12	Y_{WI} = 0.056x-27.57	Y_{HI} = -0.050x+92.76	Y_{HSI} =-0.037+41.67
Correlation coefficient	0.0031	0.243	0.012	0.056	0.050	0.037
X_{100} =Estimated Value of x for Y= 100%	16,587.10	374.94	7,073.33	2,272.68	3855.20	1576.49
Improved correlation coefficient= X_{100}/ X	10.08	2.25	2.88	1.73	5.10	11.71

Source: Author's Calculation (2010)

Table 9 shows the relationship between the budgetary allocations for infrastructural projects and level of execution of the projects. The linear relationship between budgetary allocation and percentage execution for each project were generated in each case.

Estimated values of mean budget allocations (X_{100}, in Millions) for Y= 100% were calculated for each infrastructure projects and improved correlation coefficient (K = X_{100}/ X) were computed in each case. The values of K obtained are 10.08, 2.25, 2.88, 1.73, 5.10 and 11.71 for education, rural/urban electrification, transportation, water, health and housing respectively.

The linear models obtained are Y_{EI}= 0.0031x+48.58; $Y_{R/UI}$ = 0.243x+8.89; Y_{TI} = 0.012x+15.12; Y_{HI} = 0.056x-27.57; Y_{WI} = -0.050x+92.76; Y_{HSI} =-0.037+41.67 for education, rural/urban electrification, transportation, water, health and housing respectively.

Thus keeping all other factors influencing the level of implementation constant and assuming a direct proportional relationship between mean budget allocation and level of project execution, the linear models of budgetary allocations earlier established as Y_T = 356.4x – 71175; Y_E = 428.4x – 85682; $Y_{R/U}$ = 42.45x – 84889; Y_W = 204.8x – 41172; Y_H = 109.5x – 21869; and Y_{HS} = 22.24x – 44423, for transportation, education, rural/urban electrification, water, health and housing respectively, in table figures 1-6 were adjusted with corresponding value of K for each project. The models thus become Y_{Tm} = 1026.43x – 71175; Y_{Em} = 4318.27x – 85682; $Y_{R/Um}$ = 95.51x – 84889; Y_{Wm} = 354.30x – 41172; Y_{Hm} = 558.45x – 21869; and Y_{HSm} = 260.43x – 44423, for transportation, education, rural/urban electrification, water, health and housing respectively. The improved models imply an upward shift of the fit lines in figures 1-8.

CONCLUSION

The study showed the mean budget allocation expressed as percentage of capital budget for education, rural/urban electrification, health, transportation, water, and housing as 14.98%, 1.56%, 7.71%%, 22.73%, 14.89%, and 1.43% respectively. On the other hand, the mean budget allocations for education, rural/urban electrification, health, transportation, water, and housing expressed as percentage of total budget allocation were established as 6.60%, 0.69%, 3.39%, 3.39%, 10.67%, 7.60%, and 0.62% respectively. The patterns of the trend of the allocations over the ten years were fairly statistically significant in allocations for education, rural/urban electrification and health infrastructure and statistically insignificant for transportation, water and housing infrastructure. These could presumably be attributed to factor including the fluctuating revenue base of the state, poor commitment by the government to infrastructural development, present political volatility, and absence of macro-economic framework for infrastructural development in the state. The trend of the budget allocations were defined by linear models as $Y_T = 356.4x – 71175$; $Y_E = 428.4x – 85682$; $Y_{R/U} = 42.45x – 84889$; $Y_W = 204.8x – 41172$; $Y_H = 109.5x – 21869$; and $Y_{HS} = 22.24x – 44423$, for transportation, education, rural/urban electrification, water, health and housing respectively, where x is the budget year.

The study established the mean level of implementation of health, education, housing infrastructure, transportation, rural/urban electrification and water infrastructure projects as 54.51%, 53.69%, 36.69%, 45.33%, 46.44% and 49.36% respectively. Based on the relationship between the mean budgetary allocations and percentage implementation of each project, the models were modified as $Y_{Tm} = 1026.43x – 71175$; $Y_{Em} = 4318.27x – 85682$; $Y_{R/Um} = 95.51x – 84889$; $Y_{Wm} = 354.30x – 41172$; $Y_{Hm} = 558.45x – 21869$; and $Y_{HSm} = 260.43x – 44423$, for transportation, education, rural/urban electrification, water, health and housing respectively. These models would serve as tool for predicting the budget allocation for infrastructure development by policy makers in the state.

REFERENCES

Ashwort, A. and Hogg, K., (2007), Willis's Practice and Procedure for Quantity Surveyor. Blackwell Publishing Ltd, Oxford, UK.

Bamberger, R.J. (2000), Infrastructure Support for Economic Development. In: Infrastructure and Economic Development. Publication of National Transportation Library, U.S.A. (MetroPlan 2000), 2-18.

Frank, I. (2003), The State of Urban Infrastructure in Nigeria. In: Urban Finance and Infrastructure Development in Nigeria. First Edition. pp 35-48.

Ilori, M.O. (2006), The Role of the Government in the Development of Basic Infrastructure. www.centbank.org/OUP/PRODUCTION Retrieve on 7th of June, 2008.Jacques, J.F. and Koopman, S.J. (2007), Practical Econometrics: An Introduction to State Space Time Series Analysis. Oxford University Press Inc. New York, 2-8.Mogbo, T.C. (2001), the Construction Sector and the Economic Growth of Nigeria, 1981-1995. Journal of the Nigerian Institute of Quantity Surveyors, Vol. 35, No.2, pp 8-13.

Odularu G.O. (2008), Crude Oil and the Nigerian Economic Performmamnce. www.ogbus.ru/eng/authors/odularu/odularu_1.pdf . Retrieved on 15th of Feb., 2009.

Oforeh E. C., (2006), The Nigerian Institute of Quantity Surveyors as an Agent of Economic Development. Paper Presented at 22nd Biennial Conference and General meeting of the Nigerian Institute of Quantity Surveyors, 22nd-25th Nov.,2006 at Channel View Hotel/Conference Centre, Calabar, Cross River State, Nigeria.

Ogunsemi, D. R., and Saka, N (2006), The NEPAD Initiative and The Challenge of Efficient Cost Management o f Infrastructure Development n Nigeria. Paper Presented at 22nd Biennial Conference and General meeting of the Nigerian Institute of Quantity Surveyors, 22nd-25th Nov.,2006 at Channel View Hotel/Conference Centre, Calabar, Cross River State, Nigeria.

Olayiwola, L.M. and Adeleye, O.A. (2005), Rural Infrastructural Development in Nigeria: Between 1960 and 1999-Problems and Challenges. Journal of Social Science 11 (2), 91-96 (2005).

Oyegoke, A.S. (2005), Infrastructure Project Finance and Execution Development Strategies. Journal of The Nigerian Institute of Quantity Surveyors, Vol.52, No 3, Pp 11-19

Tsema, O.S.T. (2008), Public Private Partnership (PPP) Agreement and Negotiation Processes Within the Context of Millennium Development Goals (MDG). Paper presented at the 23rd Biennial Conference of The Nigeria Institute of Quantity Surveyors, Hamdala Hotel, Kaduna, Nigeria. 5th-8th November, 2008.

AN INTEGRATED RELATIONSHIP AND SUPPLY CHAIN MANAGEMENT FRAMEWORK FOR IMPROVING ENGINEERING AND DESIGN SERVICE DELIVERY TO BUILDING CONTRACTORS IN GHANA

Nenyi K. Orgen[1], Divine K. Ahadzie[2], Joshua Ayarkwa[3], Edward Badu[4]

[1]*Department of Building technology, Kumasi Polytechnic, Box 854, Kumasi, Ghana*

[2] *Centre for settlements studies, college of Architecture and planning, Kwame Nkrumah University of Science and Technology, Kumasi, Ghana*

[3,4]*Department of Building Technology, Kwame Nkrumah University of Science and Technology, Kumasi, Ghana*

The culture of construction industry is well noted as being very competitive, fragmented, having little cooperation and being full of mistrust. Besides, in the review of relevant literature, the traditional supply chain relationships are criticized as adversarial and thus lack effective communication. Many research interventions both local - Ghanaian contract relationship development efforts such as public procurement act, suggested mergers and foreign efforts like relationship management (RM) and supply chain relationship (SCR) approaches are being increasingly developed. The construction industry maturity level to cope with such interventions is identified to be of four levels of relationships which can help the integrated relationship guidelines; for the transformation of the existing non collaborative and adversarial situation and for the improvement of EDSD work which seems to be worse in Ghana. The justifications offered for the Ghanaian situation that seems to have worse of such culture are inadequate, poorly articulated designs, delay in payment, strong adherence to the traditional system of procurement, inconsistent, uncoordinated control of projects, failure to capture clients requirements in tender document and lots of variations in the construction phases. There is little of such integrated research approach of exploring change of the culture and collaborative relationship levels concepts together to transform the construction industry. This PhD research is to find an integrated relationship management - supply chain relationship approach to improve engineering and design service delivery (EDSD) to contractors in Ghana. Management and supply chain relationships concepts for improvement concerning how to achieve improved service delivery, the expected useful academic and industrial outcomes are explored.

Key words: engineering/design service delivery, integrated approach, relationship management, supply chain relationship.

INTRODUCTION

There is sufficient evidence in literature which indicates that the construction industry has fragmented culture that accounts for its poor performance over the years (Latham,

[1] nenyio@yahoo.co.uk
[2] divinedka10@yahoo.com
[3] ayarkwajosh@yahoo
[4] edwardbadu@yahoo.com

Orgen *et al.* (2011) An integrated relationship and supply chain management framework for improving engineering and design service delivery to building contractors in Ghana *In:* Laryea, S., Leiringer, R. and Hughes, W. (Eds) *Procs West Africa Built Environment Research (WABER) Conference,* 19-21 July 2011, Accra, Ghana, 119-129.

1994; Egan, 1998; Bresnen and Marshall, 2002; Naoum, 2003; Baiden et al. 2006; Bresnen, 2007; Pryke, 2009). Besides, the industry is recognized as full of mistrust, more self-interested and competitive. Further, lack of effective communication has resulted in adversarial relationship (Latham, 1994; Chan et al. 2004; Pryke, 2009). The quest to transform the varying negative characteristics of the industry (Cheung and Rowlinson, 2005) as in the developing countries like Ghana calls for proactive integrated relationship improvement approach. The relationship management (RM) and supply chain relationship (SCR) concepts which have engaged the attention of the developed economies and have been successful for some time now are identified for the improvement of engineering/design service delivery (EDSD) purpose. This paper investigates to confirm through literature review the adversarial working relationship situation that seems to exist amongst EDSD practitioners and between them and constructors on the supply chain of information flow (SCIf). Also, it is to explore the possibility of integrating RM & SCR concepts and models to improve traditional non collaborative and adversarial relationship that seems to characterize the EDSD activities. Further, to indentify the appropriate relationship attitudes and behaviours which will improve inter-EDSD practitioners and inter-EDSD organisational relationships for improvement and the continuous improvement of EDSD works. The paper is structured as follows; first, a background to the proposed research is presented. The definition of EDSD is provided to help clarify the content of the study. The problem statement is then presented followed by a rigorous literature review of the theoretical bases that would be considered. The next section describes how the theoretical framework would be applied in Ghanaian context including what could be the expected outcome. The paper concludes with a summary of issues discussed.

BACKGROUND AND CONTRIBUTION BY OTHER RESEARCHERS

It is very clear in the literature that the non collaborative working and adversarial relationship have existed in the construction industry for many years. The situation is exacerbated by mistrust, inward looking attitude by similar organisations, lack of commitment for the success of others and full pursuance of individual professional agenda. These may account for the poor performance of the construction industry. Realizing how bad the state of adversarial relationship is and the effect on the performance of the industry, many researchers have made wonderful strives through various interventions to break down the barriers and cycles of the harsh or adversarial culture.

Many interventions including relationship management concepts development (Chenng and Rowlinson, 2004; Smyth and Edkins, 2007) and the construction supply chain management principles have engaged the attention of a number of researchers (Yeo and Ning, 2002; Pryke, 2009; Meng, 2010). Also teams' integration or integrated teams are similar efforts embarked upon to break down barriers to effective collaborative working (Baiden et al. 2006; Smyth, and Fitch, 2009; Pryke, 2009). Baiden et al. (2006) observed that none of the project teams as per the case study projects covered by their research was completely fragmented. Pryke (2009) compared the current state of the construction industry to Stevens's (1989) model of transition of firms and concluded that the vast majority of the industry falls in the baseline category; ie the traditional fragmented state. This is a manifestation that the adversarial cultural relationship has not seen much change. Meng (2010) in his efforts to deal with the adversarial relationships distinguished four clear levels of construction cultural relationships for assessment of relationship levels: traditional, transitional, short-term and long-term.

Public Procurement Act (Act 663) was enacted in 2003 to reform contract works, goods and consultancy services and to improve investor relationships in Ghana. It was also to correct inefficiencies in the Public Procurement system. However, a probe into the Act revealed that the Act cannot achieve effective culture change for value for money due to disputes and wastes associated with the traditional procurement system as stated by the Act 663. Aside that, there is persisting spectre adversarial contracting relationships that have other serious implications including quality of construction workforce (Anvuur, 2006). The argument was carried further that there was the need to allow the adaptation of other procurement methods with guidelines if effective value for money was to be realised (Anvuur, 2006). Similarly, it is on record that contractors in Ghana face varying difficulties, which create harsh relationship that call for arbitration and mediation and also get very late payment for work done without interest (Laryea, 2010). As a way of improving relationship it was recommended that there should be change through right strategic, proper development of professionalism and seeking mergers with other firms with similar organizational values (Laryea, 2010).

From the discussion, non collaborative and adversarial relationship in construction activities in Ghana seems to be persisting and real collaborative cultural change in the industry is still not in sight. The various interventions given seem not to have engendered the expected changes in the adversarial relationship for improvement of EDSD to contractors. There are many questions unanswered that call for change of 'mind set' in a developing country like Ghana, which wallows in a culture of fragmentation and adversarial relationship. This situation is exacerbated by fiscal and monetary constraints and corruption (Anvuur, 2006). It seems there is a lack of relationship knowledge and no relationship learning taking place among the individuals, groups/ organizations that can cause required change. Increased knowledge implies not encountering the same problems over and over again and not reinventing solutions to problems (Mensah, 2007). Learning process must be made to include the practice of taking feed backs from executed projects. In support of this practice, Loo [2003] stresses that taking feedbacks from projects and learning from experiences improve performance of a project. There should be a culture change of the adversarial relationship through a change of 'mind set' towards collaborative and non adversarial relationship to allow for an improved and continuous improvement of EDSD to building contractors.

ENGINEERING/DESIGN SERVICE DELIVERY (EDSD)

In this study, EDSD covers the work of professionals (EDSD practitioners) trained in project management, architecture, civil engineering, quantity surveying, geometrics engineering, estate management and facility management who produce information flow. It also includes the handling of the use of information flowing from initiation, planning, executing, controlling to closing of a project. EDSD practitioners are professionals who are either in-house or external consultants working for clients. These are professionals who form part of clients' organization and need to develop the appropriate culture (Cheung and Rowlinson, 2005); or, are agents of principals (clients) who run agencies for EDSD work which are produced for selected contractors. The EDSD practitioners provide the supply chain of information flow

(SCIf)which is different from other supply chains such as the flow of materials, labour, plant and equipment including temporary work (Hatmoko and Scott, 2010).

This supply chain of information flow consists of documentations such as drawings, specifications, contract conditions, explanations and clarifications which form the basis of all activities in the project (Edum-Fotwe et al. 2001).The EDSD work of providing SCIf is for decision-making, which affects planning, executing, controlling and closing of projects. Thus it is obvious that EDSD practitioners are responsible for all other conduct of sharing information between the supply chain members. This information sharing among members is seen as key to effective supply chain management of projects (Titus, 2005; Hatmoko and Scott, 2010) It is also worth noting that delay in the information flow may slow down decision-making of all the project teams, which is identified as the main cause of delay in projects delivery (Chan and Kumaraswamy, 1997).

So, it is out of the EDSD work to contractors that almost all the construction SCIf originates for construction project works. Therefore, the object of the on-going PhD research paper is to carry out an in-depth study of how to use an integrated RM and SCR approach to achieve non adversarial and collaborative relationships. This is in order to improve the EDSD to contractors in Ghana, specifically. The dimensions for the change of culture will be drawn from the strength of both RM and SCR concepts: (a) to change behavioural relationship among the EDSD practitioners in organizing and producing timely SCIf (b) to improve the relationship between practitioners and contractors for continuous improvement of EDSD to contractors (suppliers).

THE PROBLEM STATEMENT AND JUSTIFICATION FOR THE STUDY IN THE CONTEXT OF GHANA

An extensive literature review reveals strong indications that Ghanaian contractors face a number of EDSD problems which end in harsh or adversarial relationship. Anvuur (2006) and Laryea (2010) confirm the harsh conditions prevailing in the construction industry in Ghana. This situation has been attributed to inadequate and poorly articulated designs, delay in payment, the traditional system - ‘one way procurement system’, failure to capture clients requirements in tender document and lot of variations in the construction phases (Anvuur, 2006; Laryea, 2010). Beside, information flows which are inconsistent and lack coherence with law and best practices result in non collaborative and adversarial relationship (see case no 8, PPA, 2009). In other developing countries the construction industry does not look different from that of Ghana. Odusami et al. (2003) provided strong evidence that in the Nigerian construction industry it is not uncommon to observe uncoordinated information flows for EDSD activities and instructions. These come as a result of lack of proper allocation and location of authority amongst the EDSD practitioners. Many a time, one such problem which results in a non collaborative behavioural culture and adversarial relationships in some developed economies like UK, is cost cutting of tender figure or projects cost. This is done either through bullying or at best through transaction –based relational contracting that soon limits continuous improvement agenda (Skitmore and Smyth, 2007). This also seems to be happening in developing countries like Ghana and Nigeria. Besides, contractors in Ghana face sceptics and actions of unscrupulous clients and their agents (EDSD practitioners), which leads to abandonment of partnering – collaborations (Alderman and Ivory 2007).

The problems are compounded as shown by a research carried out into causes of cost overrun, which indicated that five out of eight problems indentified were design management related. The problems include non compliance of design with planning or statutory requirement, incomplete design at the time of going to tender, lack of co-ordination, ambiguity of risk allocation and inadequacy of management control (Odusami et al, 2003). Who leads the project team or who leads the EDSD practitioners' team is another major issue that could lead to a controversy, non co-operation and adversarial relationship amongst the EDSD practitioners where actors who are not project managers claim to be one. Uncoordinated and inconsistent instructions from EDSD practitioners often lead to mistrust, lack of commitment, and poor or no communication leading to frustration, difficulties and adversarial relationship between them and contractors. The adversarial relationship occurs due to wrong, abuse or acting contrary to the Law and authority in the construction industry in Ghana (see no 7 PPA, 2009). These problems are all contentious issues that mostly develop into harsh or conflicts situations that end in adversarial relationships between mostly EDSD practitioners and building contractors in Ghana. It is on this basis that the integrated RM and SCR concepts are being explored to determine whether their integration can help change the non collaborative and adversarial culture to achieve the required improvement in EDSD to building contractors in Ghana.

LITERATURE REVIEW THE SIGNIFICANCE OF RELATIONSHIP MANAGEMENT IN THE CONSTRUCTION SUPPLY CHAIN MANAGEMENT

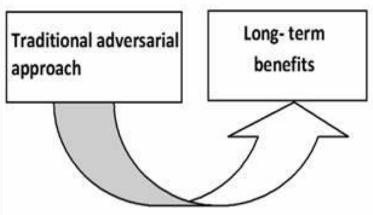


Figure I : Change of "Mind set"
Source. (Cheung and Rowlinson, 2005)

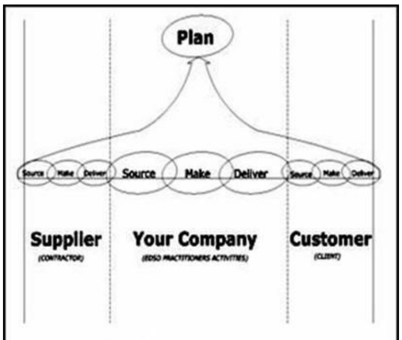


FIGURE II. SCOR MODEL
SOURCE. (Yeo and Ning, 2002)

The relationship management (RM) is a very broad pragmatic concept which makes use of all important possible traditional and non traditional (innovative) methods to change individual and organizational attitudes, behaviour, systems and strategies towards achieving a non adversarial relationship. But, the RM concept is not without weaknesses and is based on these that integration with the construction supply chain management (CSCM) becomes very useful. The essence of integrating RM with CSCM is to enable the supply chain relationships (SCR) engender effective or strong performance by introducing some available developed models and concepts. Supply chain relationships (SCR) concepts are among the three components of the supply chain management (CSCM). The CSCM is a management process and has

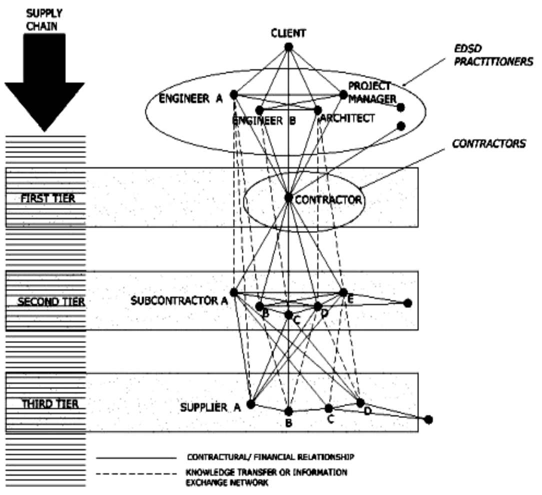


FIGURE III. SUPPLY CHAINS AND NETWORKS
SOURCE. (Pryke, 2009)

information system management and strategic material management as its remaining two components (Yeo and Ning, 2002). The developed models and the concepts will enable proper assessment of relationships, maturity levels of individuals, groups or organizations in question for change of ‘mind sets’ from adversarial culture towards long-term benefits, as in figure I, to be assessed and analysed. Such models include Capability Maturity Model (CMM) for example, is Maturity Systematic Assessment Framework (MSAF), which is one of the most current frameworks (Meng, 2010). The model provide the RM concept with guidelines for the determination of change of ‘mind set’, culture, attitudes and behaviour as human centred approach. Further, integrating the RM concepts in the CSCM enables these concepts to be aligned in supply chain forms to check their preciseness with the Supply Chain Council's SCOR model.

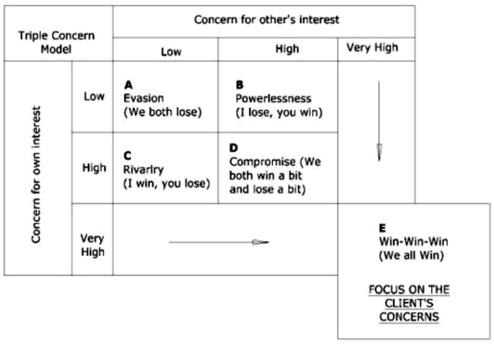
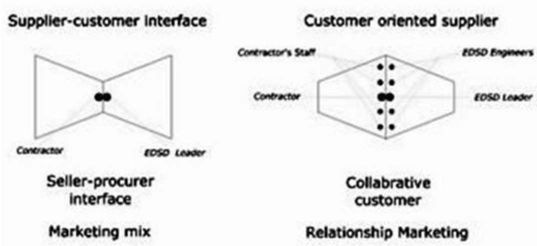


FIGURE IV. TRIPLE CONCERN MODEL
SOURCE. (Pryke, 2009)

The Supply Chain Operational Reference (SCOR) model describes the business activities associated with all phases, satisfying a customer’s demand. The SCOR in figure II above suggests that the Plan-Source-Make-Deliver building blocks can be used to describe supply chains that are very simple or very complex using a common set of definitions (Yeo and Ning, 2002). It is then possible for the EDSD activities or work to be relationally assessed as supply chain of information flow. Thus, the attitudes and behaviour of the EDSD practitioners and their SCIf work can be placed in proper perspective or context of plan-source- make-deliver for an effective investigation based on dimensions of relationships. This will enable the relationship situation and improvement amongst the EDSD practitioners and between them and the building contractors to be assessed on the supply chain and networks. These helps to indicate the specific nodes or tiers where work/activities or investigation is/are concentrated and the specific actors under investigation. This then allows the EDSD work and actors to conform to literature information of which the supply chains and networks have three distinct divisions called first, second and third tiers, which are marked with nodes and may follow client’s organization, contractor, subcontractor or suppliers respectively (Beach et al., 2005). Figure III indicates the location of the EDSD practitioners and the contactors both circled, providing where the relationship study for improvement of EDSD is focused on the network.



FIGUREV: SUPPLIER-CUSTOMER INTERFACE
SOURCE. (Suryth and Fitch, 2009)

The nodes are connected by linkages which entail knowledge transfer, information exchange, directions and financial and contractual relationships (Pryke, 2009). According to Pryke and Smyth (2006), the networks are transitory and the flows are iterative (Pryke, 2001). Like neural networks, the nodes are continually linking and disconnecting depending on the EDSD project function to be performed. Another significance of integrating RM with CSCM is to have a model to regulate the generic cultural concept of win-win-win (we all win) in project(s) procurement. This involves developing cultural and collaborative changes in relationships that can be social capital /investment for the parties involved to experience integrity and concern for each other's interest, which will lead to both parties, in an exchange, gaining great increase in performance. Win-win-win relationship and concern for all, which will be realized among EDSD practitioners (client's organizational members) and between them and building contractors can then be properly classified and measured as traditional (adversarial), short–term or long-term in accordance with relationships dimensions for improvement. These relationships articulated in many ways, have become evident that trust, which is argued as a measure of relationship strength, a critical success factor in partnering projects (Kadefors, 2004) and a good surrogate measure for relationship strength, can no longer be excluded from any analysis of relationships. (Smyth, and Edkins, 2007). Researchers such as Bennett and Jayes (1995); Kadefors (2004); Cheung and Rowlinson (2004) have concentrated on diverse aspects of trust and processes of trust development.

Rosseau et al (1998) defined Trust as a psychological state comprising the intention to accept vulnerability based upon positive expectations of the intentions or behaviour of another. Also, this is what Smyth, and Edkins (2007) had to say, in project context: Trust is a disposition and attitude concerning the willingness to rely upon the actions of or be vulnerable towards another party, under circumstances of contractual and social obligations with the potential for collaboration. An extensive review of literature revealed the following features of trust (Smyth, 2003) summary: i. Characteristics of trust, ii. Components of trust, iii. Conditions of trust, iv. Levels of trust, v. Operational basis for trust, vi. Evidence of trust, vii. Trust in the market, (Baier, 1994; McKeeman, 2002). Other important factors for relationship strength are confidence (Smyth, and Edkins, 2007) loyalty (Smyth and Fitch, 2009), communication, commitment, alignment of objectives, and problem solving (Meng, 2010). These would be achieved in each project execution though the appropriate integrated strengths of RM and SCR concepts including the most extensive and comprehensive work of Gummesson (2001). Whose work knocked down the gauntlet to challenge the marketing mix as given by Borden (1964), the so called 4Ps, product, place, promotion and price (McCarthy, 1964) and its parameters. A substitution of a minimum of thirty relationships (30Rs) subdivided into four groups were offered as: i. Classic Market Relationships ii. Related supply chain management delivery channel iii. Mega Relationships and iv. Nano Relationships (Smyth and Fitch, 2009). Finally, by an effective use of a facilitator (Cheung and Rowlinson, 2005) working within a human agency such as EDSD organization(s) a transformation of the adversarial working culture is expected. The agency would as well help to achieve the right relationships by asserting that expense should be made on critical events basically known as the moments of truth, during EDSD interface activities, meetings of personnel –suppliers - customers from the two parties as may occur as shown in figure V. above, for such issues as claims and orders (Smyth and Fitch, 2009)

RELATIONSHIP MANAGEMENT (RM) IN THE CONTEXT OF GHANA

Relationship Management derived its development from relationship marketing (Gronroos, 2000; Gummesson, 2001; Ford et al. 2003; Smyth, 2008). This management concept is a paradigm shift from adversarial behaviour towards more collaborative practices which have their conceptual origins in relational contracting

(Smyth and Fitch, 2009). Thus, from the issues raised in the problem statement the individuals, EDSD practitioners and the EDSD organizations in the construction industry in Ghana need attitudinal or behavioural change. They have to develop a culture that willingly accepts criticisms, objective confrontation for holistic change of 'mind set' as in figure I towards a win-win collaborative relationship and not the traditional win-lose or one off project culture (Cheung and Rowlinson, 2005). In the developing countries, like Ghana, most often, project procurement is seen following the traditional adversarial relationship trends with least resistance. This is due to the difficulty for most humans to accept change voluntarily. In spite of the fact that some old practices are barriers to the development of collaborative culture and non adversarial relationship, the losing party or parties almost always block the change towards the non adversarial of win-win relationship cultural change through change of 'mind set' for long term benefits, which RM concept ensures (Cheung and Rowlinson, 2005).

In Ghana, the RM will help to introduce the behavourial aspects in addition to the required systems and strategies for the particular project(s) under execution. The essential project management structures, systems or strategies that will not be a barrier to collaborative culture and non adversarial relationship in construction industry in Ghana will be preserved. Thus, the RM adopts systems and strategies that are essential for effective execution of project(s); paying uttermost attention to behaviourial and attitudinal relationship that can lead to collaborative relationship by reduction or elimination of discords, disputes conflicts and for improved performance. In this sense, it is the project management behavioural and attitudinal practices that generate non collaborative and adversarial relationship. This situation needs to change during adversarial cultural transformation of the EDSD practitioners in the Ghanaian construction industry. This adversarial cultural change through RM is aimed at achieving win-win-win situation for all parties – that is Ghanaian construction actors or players showing concern for others in the field which will generate valve for money in project execution. The most common procurement system used in Ghana is the case where design is separated from the construction -the traditional system. The industry seems to prefer and accept this old system rather than any other procurement system or innovative changes or reformation/ transformation. Yet it is the weaknesses of the persisting adversarial contracting approach (Anvuur, 2006), full of non collaborative and adversarial relationships that have consumed the good manners, joy and concern for others in the EDSD to contractors. It is the loss of collaborative relationship culture that RM seeks to address by the appropriate relationships from the thirty relationship (30Rs) (Gummesson, 2001). That apart, the systems that evolved from the relational contracting arises from the structure of the market. A positive atmosphere in this context is resultant upon structure rather then agency and thus management has a passive or reactive role (Smyth and Edkins, 2007). In this regard, partnering and alliancing, for example, cannot be used for completely behavioural and attitudinal change towards collaborative and non adversarial relationship culture in the construction industry in Ghana. They are discords, disputes and conflicts prone to some extent. The RM is a procurement approach which thrives by building a right relationship and breaking down barriers by the right relationships development. RM is viewed differently by different individuals and organizations but it can be applied to any project delivery systems (PDS). The role of RM is not "mates rates" approach; "you are my mate you should give me the variation" is a misconception. Rather RM is to proactively manage a project in order to maximize progress (and quality) while minimising disputes among project team members (Cheung and Rowlinson, 2005).

So the RM in Ghanaian construction industry will make it free from political, economic, social, religious or ethnic ties or any other affiliation and rather strive toward non aligned contracting of win-win-win and not win-lose (concern for others) situation (Pryke, 2001). That is why in Ghana, the EDSD practitioners who are knowledgeable and can accept confrontation with understanding, errors, omissions from feedbacks and manage relationship changes through change of ‘mind set’ better for the improvement of EDSD, have become the target for investigation and adoption in this research.

THE EXPECTED OUTCOME AND BENEFIT TO ACADEMIA AND INDUSTRY

The integrated relationship and supply chain management framework studies will provide information or data of the type of relationship and maturity level that exist among highly educated professionals and between them and contractors in Ghana. Integrated conceptual guidelines will be developed to improve collaborative culture and relationship which will reduce or eliminate adversarial relationship, foster trust, commitment, confidence, alignment of objectives and problem solving among EDSD practitioners and between them and the contractors. In addition, the study will produce an integrated framework that will offer open channel for regular free flow of EDSD practitioners’ peers’ and contractors’ feedbacks for improvement of EDSD to contractors in Ghana. The marketing and negotiating skills will improve for repeat and referral business. Such a situation will move the industry towards a win-win-win situation instead of the existing win-lose situation. This situation will bring continuous improvement, through learning and acquiring knowledge to show concern for others, which yield long-term benefits in the construction and improvement in the EDSD to Ghana contractors.

On the industrial front, the integrated relationship and supply chain management framework will offer information that will help to improve collaborative culture and relationship and maturity levels in order to achieve improvement in the EDSD to contractors in Ghana. This will help to obtain proper estimates, contract conditions, specifications from properly articulated drawings with all the essential detailing. These will then be used to achieve realistic tender figures or projects cost that will not call for cost cutting and reduce or eliminate resultant variations. Also, minimum variations will help to produce projects on budgets and make savings. Further, improvement in the EDSD will help project executors (contractors) to deliver projects with less or no disputes. There will be high level performance through collective problems solving which will help realize value for money for clients. The study, due to expected collaborative and relationship changes emphasizes on trust, commitment, confidence and alignment of objectives and collective solution to problems. These will save time to help in the completion of project on schedule, achieve good quality and of the right health and safety standards. The integrated relationship and CSCM framework is expected to break down barriers of either political, economical, social, religious or ethnic ties or affiliations in winning contracts. Contracts would then be won on non-aligned basis only by proper relationships, business attitudes and behaviourial standards.

Academically, the framework and other data acquired during the study can be used as bases, guide or reference for further collaborative culture and relationship management studies. Also the studies can be repeated or replicated between other tiers and nodes on the construction supply chain and gather data for analysis to improve collaborative culture and relationship management gradually through out the supply chain network. The records of feedbacks from the contractors and the EDSD practitioners and peers will be a useful guide for improving, strengthening and underpinning professional requirements during teaching and learning. Further, the study will create awareness among students and staff that professional competence can be more beneficial to the individual or organization(s) when right relationship behaviours and attitudes for repeat and referral business have been mastered/acquired. Besides, it will free young academicians' and professionals' minds from thinking of having ties or affiliation before getting a good building contracts after school.

CONCLUSION

In the literature, it was obvious that adversarial relationship and mistrust were rooted in the construction industry for a very long time. The EDSD practitioners (as intermediaries or agents of the clients) seem trusted and for that matter, their EDSD activities seemed to have avoided investigation. There is little evidence in the literature about investigation of their relationship with contractors. The investigation showed that non collaborative and adversarial relationship existed amongst the EDSD practitioners and between them and the contractors in Ghana. It is also evident that out of the four relationship maturity levels identified as traditional adversarial, transitional term, short term and long term relationships, a majority of the industry is still in the baseline level of the traditional adversarial relationship situation. Besides, the exploration revealed that behavioural attitudes such as showing concern for other parties through trust, loyalty, confidence, problem solving, objectives alignment, communication, openness for feedbacks are essential for managing the appropriate thirty relationships (30Rs). This will result in constant flow of free feedbacks for developing and improving of the EDSD to contractors. Further, it is obvious that structures, strategies and systems of project management and other procurement processes are still characterized by discords, disputes and conflicts. So, the integrated intervention of RM and SCR has a dual focus on the one hand to achieve discords, disputes and conflicts free relationship and on the other, to channel the constant free flow of feedback to improve EDSD to contractors based on the relationship level obtained.

REFERENCES

Anvuur,A. and Kumaraswamy, M. M. (2006)Taking Forward Public Procurement Reforms in Ghana. CIB

W107 Construction in Developing Economies International Symposium, *"Construction in Developing Economies: New Issues and Challenges"* January 18th – 20th –Santiago Chile.

Bresnen, M. (2007) Deconstructing partnering in project-based organization: Seven pillars, seven Paradoxes and seven deadly sins. *International Journal of Project Management*, 25, 365 – 374.

Bresnen, M. and Marshall, N. (2002) The Engineering or evolution of co-operation? A tale of two Partnering projects. . *International Journal of Project Management*, 20, 497 – 505.

Baiden,B.K.,Price,A.D.F. and Dainty A.R.J. (2006) The extent of team integration within construction projects. *International Journal of Project Management*, 24, 13-23. Chan, D.W.M. and Kumaraswamy, M. M. (1997) A comparative study of cost overruns in Hong Kong construction projects. *International Journal of Project Management*, 15(1) 55-63.

Cheung, F.Y.K. and Rowlinson, S. (2005) Relational Contracting: The way forward or just a brand name? research by Australian Cooperative Research Centre for *Construction Innovation.*

Chenng, F.Y. K. and Rowlinson, S. (2004) A review of the concepts and Definitions of the Various Forms of Relational Contracting. International Symposium of the CIB W92 on Procurement Systems "Project Procurement for Infrastructure Construction "7-10 January, 2004, Chennai, India.

Edum- Fotwe, F.T.,Thorpe, A. and McCaffer, R. (2001) Information procurement practices of key actors in construction supply chains. *European Journal of Purchasing and supply management*, 7, 1 55-64..

Gronroos, C. (2000) *Service Management and Marketing*, John Willy and Sons, London. Gummesson, E. (2001) Total *Relationship Marketing*. Butterwort-Heinemann, Oxford.

Hatmoko, J.U.D. and Scott, S. (2010) Simulating the impact of supply chain management practice on the performance of medium-sized building projects. *Construction Management and Economics*, January –March 2010, 28, 35-49.

Kadefors, A. (2004) Trust in project relationships – inside the black box. International Journal of Project Management 22, 2004, 175-182.

Laryea, S. (2010) Challenges and opportunities facing contractors in Ghana. West Africa Built Environment Research (WABER) Conference, 27-28 July 2010, Accra, Ghana, 215-226.

Mensah, S. (2007) The Effect of Project Management Practices on Building Projects Performance: The of three organisations. Master of Science thesis in construction management submitted to Kwame Nkrumah University of Science and Technology, Kumasi, Ghana.

Meng, X. (2010) Assessment framework for construction supply chain relationships: Development and evaluation, *Int.Journal of Project Management*, 28, 695-707.

Odusami, K.T., Iyagba, R.R.O. and Omirin M. M. (2003) The relationship between project leadership, team composition and construction project performance in Nigeria. *International Journal of Project Management,* 21, 519-527.

PPA (2009) Public Procurement Authority's, Finding of case No. 8. Accra, Ghana, ppaghana.org. PPA, (2009) Public Procurement Authority's, Finding of case No. 7. Accra, Ghana, ppaghana.org.

Pryke. S. (2009) *Construction Supply chain Management Concepts and Case Studies,* Oxford UK, Blackwell publishing Ltd.

Rosseau, D.M.,Sitkin. B., Burt, R.S., Camerer, C.(1998) Not so different after all a cross-discipline view of 22trust. Academy of Management Review 23(3); 393-404.

Smyth, E. (2008) The credibility gap in stakeholder management: ethics and evidence of relationship management. *Construction Management and Economics,* April -June 2008, 26, 633-543.

Smyth, H. and Edkins, A. (2007) Relationship management in the management of PFI/PPP projects in UK. *International Journal of Project Management*, 25, 2007, 232-240.

Smyth, H. and Fitch, T. (2009) Application of relationship marketing and management: a large contractor case study. *Construction Management and Economics,* April – June2009, 27, 399-410.

Yeo K. T. and Ning, J. H.(2002) Integrating supply chain and critical chain concepts in engineer-procure-construct (EPC) projects. *International Journal of Project Management*,20, 253-262.

AN INVESTIGATION INTO THE ACTIVITIES OF THE ENVIRONMENTAL PROTECTION AGENCY (EPA) IN THE GHANAIAN CONSTRUCTION INDUSTRY: A CASE STUDY OF SEKONDI-TAKORADI METROPOLIS

Emmanuel Opintan-Baah[1], P.P. Yalley[2], P. Kwaw[3] and G. Osei-Poku[4]

1,4 Building Technology Department, School of Engineering, Takoradi Polytechnic, Takoradi

2,3 Civil Engineering Department, School of Engineering, Takoradi Polytechnic, Takoradi,

A study was conducted with the purpose of investigating into the activities of the Environmental Protection Agency (EPA) in order to ascertain the extent of enforcement of the Environmental Protection Agency Act in the Ghanaian Construction Industry. A literature review focused on environmental management and impact assessment, the Environmental Protection Agency Act and their relationship with the construction industry. Closed-ended and open-ended questions were posed and sent to purposive sampled construction industry stakeholders in the Sekondi-Takoradi Metropolis. Also a structured interview was conducted for an official from the Environmental Protection Agency in Sekondi-Takoradi. It emerged from the studies that more than 50% of the stakeholders, most of who were in the building sector, had never obtained an Environmental permit. Again it was noted that most of the stakeholders in the construction industry were aware that obtaining an Environmental permit was not a prerequisite for the execution of building projects. It was concluded that it was a fact that a lot more had to be done by the EPA regarding monitoring of construction activities and the enforcement of the Environmental Protection Agency Act. The strict enforcement of the Environmental Protection Agency Act, increase in publicity on Environmental Management, reduction in the duration between applying for an environmental permit and receiving it and banning the use of environmentally unfriendly materials were the recommendations made after the research; as these would help improve environmental quality in the Ghanaian Construction Industry.

Keywords: Environment, Environmental Protection Act, Environmental Protection Agency, Ghana, Sekondi-Takoradi.

INTRODUCTION

Environmental Management involves the controlling of human interaction with the environment with the aim of preserving and sustaining the environment. One of man's major interactions with the environment is construction, which has never stopped since creation. Construction's lifecycle begins when raw materials are extracted from the earth, followed by manufacturing, transport and use, and ends with waste management including recycling and final disposal.

[1] opintanbaah@yahoo.com

[2] ppyalley@gmail.com

Opintan-Baah, E., Yalley, P.P., Kwaw, P. and Osei-Poku, G. (2011) An investigation into the activities of the Environmental Protection Agency (EPA) in the Ghanaian construction industry: A case study of Sekondi-Takoradi Metropolis *In:* Laryea, S., Leiringer, R. and Hughes, W. (Eds) *Procs West Africa Built Environment Research (WABER) Conference,* 19-21 July 2011, Accra, Ghana, 131-141.

The building and construction sector is a significant consumer of raw and natural materials. It also produces wastes that contribute to the emission of greenhouse gases which are potentially damaging to the natural environment. Construction and post-construction activities generally consume 50% of global material resources and specifically, 70% of global timber products. In addition, 45% of all energy generated is used to heat, ventilate and light buildings and 40% of water is used for sanitation and other uses in buildings. The current population increase of 73 million per year will also place higher demands on the consumption of raw and natural materials (Wyk, 2009). This therefore calls for the need to study into the activities of The Environmental Protection Agency so as to ascertain how the Environmental Protection Agency Act is being enforced in the Ghanaian construction industry.

This study delves into Environmental Management in the Ghanaian construction industry in order to ascertain compliance with any laid down environmental management procedures in the planning and execution of building projects; and also suggests ways of improving compliance of the Environmental Protection Agency Act in Sekondi-Takoradi in the Ghanaian construction industry. This will be done through the following objectives:

- To appraise the Environmental Protection Agency Act of Ghana and its enforcement with regard to the construction industry.
- To find out if the stakeholders in the Ghanaian construction industry are aware of environmental management procedures and are complying with the Environmental Protection Agency Act, and
- To suggest means of improving the enforcement of the Environmental Protection Agency Act of Ghana in the construction industry by the Environmental Protection Agency.

ENVIRONMENTAL MANAGEMENT

Occurrences in the world today suggest that environmental management involves more than biophysical manipulation and control. It concerns the mutually beneficial management of the humankind-nature interaction to ensure environmental and social equality for future generations (Carley and Christie, 2000).

Construction is directly or indirectly involved in all aspects of mankind’s existence on this earth. No wonder the construction industry is seen to consume a great chunk of the natural resources and to contribute greatly to the emission of global warming gases. Apart from the statistics given in the introduction, Šelih and Vrtnik (2005) also confirm that the major impact associated with construction activities stems from the consumption of materials, many of which are nonrenewable.

Some major trends in the world today include population growth and land conversion and degradation due to urbanization, industrialization, deforestation, desertification and soil degradation, conversion of wet lands and valleys and many others (Carley and Christie, 2000). A careful consideration of each of these trends revealed the involvement of the construction industry in one way or another. For example the growth in population would mean the need for more houses and other infrastructure to be provided by the construction industry; urbanization and industrialization requires construction; deforestation, desertification and soil degradation could be as a result of extracting raw materials to be used in the construction industry etc.

In the UK and other European countries all organisations are to comply with certain standards and are closely monitored by many institutions and laws, some being general and others being for specific activities and organisations. In Ghana apart from the EPA it is usually only the local authorities that are involved in some way to ensure compliance with environmental management in the construction industry. Since construction is seen to cut across almost every activity on earth it becomes very necessary for any organisation which is to monitor and enforce environmental management to pay critical attention to all that goes on in the construction industry. The onus therefore falls on the EPA of Ghana to structure its activities such that all construction activities from the extraction of materials for manufacture to the actual usage and after can be closely monitored to ensure effective environmental management.

ENVIRONMENTAL MANAGEMENT LEGISLATION IN GHANA

There is the need to briefly review literature on environmental management in the construction industry in Ghana and the Environmental Protection Agency Act in Ghana. Ghana established the Environmental Protection Council (EPC), as a public institution with oversight responsibility for the environment in 1974 through the National Redemption Council Decree, (NRCD) number 239. However, NRCD 239 was porous in the opinion of the researchers in that, it made no reference to environmental impact assessment. The closest that decree 239 came to this concept was in Section 2, which among other things, required the Environmental Protection Council to ensure the observance of proper safeguards in the planning and execution of all development projects including those already in existence that are likely to interfere with the quality of the environment.

In March 1989 a government directive was issued that required that, the EPC be consulted on development proposals and that a “certificate of clearance” be issued indicating that adequate provisions had been made in the project proposals to contain potential adverse environmental impacts.

By the 1990s, awareness on environmental issues had risen to such an extent that all over the world governments of countries had to formulate policies and enact laws to ensure environmental management in all activities. For most governments, environmental management became an objective. Ghana therefore enacted the Environmental Protection Agency Act which established the Environmental Protection Agency (EPA) to enforce and monitor environmental management. According to the institute of environmental management and assessment (IEMA), the environmental regulation of businesses and other organisations is intended to protect human health and the environment from harm within the context of sustainable development

In 1994, Ghana enacted the Environmental Protection Agency Act, 1994 (Act 490) (GEPAA 1994). This act created a body corporate called the Environmental Protection Agency (EPA) to replace the EPC. This agency has been in existence and in charge of environmental issues to date. Among its functions the EPA was mandated to “ensure compliance with any laid down environmental assessment procedures in the planning and execution of development projects, including compliance in respect of existing projects.”

The vision of the lawmakers with respect to regulations was realized in the Environmental Assessment Regulations, 1999 (L. I. 1652) which came into force on the 24th of June 1999. The L. I. 1652 deals with the various procedures to be followed prior to the grant of a permit, procedures for filing complaints, offences and penalties.

Act 490 together with L. I. 1652 establishes the Environmental Assessment Systems in Ghana which briefly comprises Registration, Screening, Environmental Impact Assessment and Environmental Management Planning.

Although, Act 490 and L. I. 1652 exist there are still a lot of environmentally unfriendly activities going on in the construction industry in Ghana such as, wrongful use of land (for example building in water ways); improper disposal of construction and demolition waste; improper storage and use of chemicals; destroying of natural flora and fauna and pollution and emissions, just to mention a few. What is happening with these laws? This study aims to find out.

OVERVIEW OF THE ENVIRONMENTAL MANAGEMENT SYSTEM IN THE CONSTRUCTION INDUSTRY IN GHANA

In practicing Environmental Management, Ghana has made Environmental Assessment a requirement for specific Undertakings. The word "undertaking" is defined here as "any enterprise, activity, scheme of development, construction, project, structure, building, work, investment, plan, programme, any modifications, extension, abandonment, demolition, rehabilitation or decommissioning of such undertaking may have a significant impact in its implementation (GEACap 2001).

The undertakings required by law to conduct Environmental Assessment in Ghana fall under the following sectors: Agriculture, Energy, Forestry and wildlife, General construction and services, Health, Manufacturing industry, Mining, Tourism and Transportation (GEPAA 1994).

Environmental Impact Assessment (EIA) takes care of the planning stage of an undertaking, while an Environmental Management Plan (EMP) covers the implementation or operational phase of the undertaking (GEACap2001). Any undertaking approved for development by the EPA is required to submit an Annual Environmental Report (AER), Environmental Management Plans (EMPs) and Environmental Impact Statements. Also management of an undertaking is required to conduct periodic, systematic and objective evaluation to assess the environmental effectiveness of the operational and management systems of the undertaking. The management of the undertaking may appoint an independent expert to conduct the audit in order to be fully informed of the true status of the environmental management programme in place.

However, the EPA is charged with the responsibility to conduct its own audit termed "Compliance Audit", to verify and inform itself about the compliance status of an undertaking (GEPAA, 1994). This in the opinion of the current researchers is tantamount to conflict of interest.

Environmental Impact Assessment

This is section 12 of the Act 490 and it has two subsections. The first subsection states that; "the Agency may, by notice in writing, require a person responsible for an undertaking which in the opinion of the Board has, or is likely to have, adverse effect on the environment to submit within the period specified in the notice, an Environmental Impact Assessment (EIA).

The second subsection stresses that when the Agency issues such a notice (that mentioned in the first subsection), it would have to inform any governmental body in charge of the issuance of a permit, license, consent or an approval for the undertaking affecting the environment (that the notice has been issued). This is done so that the governmental body would not grant the permit, license, consent or approval until it is informed in writing by the Agency that the notice it (the Agency) issued has been complied with. If the above provisions are there why do we see siting of building structures in wrong locations like water ways?

Besides the above provision there is also an Enforcement Notice where the EPA considers that the activities of an undertaking pose a serious threat to the environment or to public health has the to prevent or stop the activities. Such an enforcement notice is required to specify; the offending activity, the steps required to be taken, the time within which the steps shall be taken and the immediate cessation, where necessary, of the offending activities. Here it is also made clear that anyone who acts contrary to an enforcement notice, will have committed an offence and would be liable to a fine and in default a term of imprisonment not exceeding one year or both the fine and the imprisonment. This aspect of the Act is what this study will concentrate in its investigation to ascertain the effectiveness of the Act 490.

RESEARCH METHODS

Combination of quantitative and qualitative research methodology was used in this research. Data obtained for this research was limited to stakeholders in the construction industry namely: Clients, Contractors, Engineers, Quantity Surveyors, Architects, and Site Supervisors in the Sekondi-Takoradi Metropolis through questionnaire survey. Structured interview was conducted for personnel from the Environmental Protection Agency (EPA), the implementing agency of the Environmental Protection Agency Act.

The sample for the questionnaire was selected by the Stratified Random Sampling procedure; where the population was divided into clients, contractors, engineers, etc. and from these groups, respondents were selected randomly. A sample size of thirty was therefore selected for the administration of the questionnaire.

For the interviews the sample was selected by the purposive sampling method. This was because officials of the EPA in the opinion of the researchers were the most suitable source of information since they are the enforcers and monitors of environmental management. Here, a sample size of two was selected.

Survey Questionnaire

To elicit credible information for analysis, a questionnaire was designed to be answered by stakeholders of the Ghanaian construction industry. The questionnaire consisted of four sections in the following order.

Section A: The background of the respondents, this section of the questionnaire was to gain general information about the respondents

Section B: Assessment of the awareness of the respondents on environmental management in the Ghanaian construction industry. Questions were to help the researchers to determine the degree of awareness of respondents of environmental management procedures in the Ghanaian construction industry.

Section C: The adequacy of environmental management in the Ghanaian construction industry. Questions were structured to assess the knowledge of respondents on environmental management in the Ghanaian construction industry and also to find out if respondents were complying with the Environmental Protection Agency Act.

Section D: Suggestions of steps to be taken to improve environmental management in the Ghanaian construction industry. The questions were framed to obtain information on the opinion of the respondents on how to improve environmental management in the Ghanaian construction industry. Using a Likert scale from ‘strongly agree’ to ‘strongly disagree’, respondents were given the options to suggest how to improve environmental management in the construction industry in Ghana. Details of the statements and their responses are tabulated in Table 4 of the next section.

Structured Interview

Structured interview questions were designed for the officials of the EPA to obtain first-hand information from the professionals in charge of environmental management in Ghana.

RESULTS AND DISCUSSION OF RESEARCH DATA

The results from the fieldwork (the questionnaires and the interview) are presented and analysed in this section.

Analysis and discussion of Data obtained from the Questionnaire

In all, 30 questionnaires were distributed to potential respondents who are stakeholders of the construction industry. Out if these, 20 were received representing 67%. The respondents were made up of the following: three clients, five Contractors, three Engineers, three Quantity Surveyors, two Architects, and four Site Supervisors.

Section A of the questionnaire

This Section was mainly meant to categorise responses. Table 1 records the details of the responses to Section A of the questionnaire. It could be seen from Table 1 that some respondents had been involved in more than one of the project categories. However, the larger proportion about 95% of the respondents had been involved in building projects. It could be said that a very large proportion of the respondents (95%) had been involved in building projects for the past five to fifteen years.

Table 1. Questions and Responses obtained in Section A of the questionnaire

Questions	Purpose	Number of respondents and their Reponses.		
Which of the following project categories have you been involved in?	To help in classifying the respondents.	Building projects	Major Civil Eng. Projects	Minor Civil Eng. Projects
		19 (95%)	**2(10%)**	**8 (40%)**
How long have you been involved in the construction industry?	This question will elicit how long a person has been working.	1-5yrs	6-15yrs	<15
		7 (35%)	**10 (50%)**	**3 (15%)**
In which category does your position in your organization fall?	The objective of this question is to find out whether environmental awareness exists at all the levels indicated as response options.	Top level	Middle level	Artisans
		8 (40%)	**12 (60%)**	**0**

On the position of respondents in their respective organizations, it came out that the sample was made up of only Top and Middle level management, with the greatest proportion (60%) being middle level management. Though the researchers wanted to have a sample covering all three levels indicated in Table 1, there were some difficulties in getting respondents who were artisans or site operatives. This level of respondents was not ready to participate in the survey for various reasons.

Section B of the Questionnaire

From Table 2 a greater proportion of the respondents (55%) had never obtained an Environmental Permit from the EPA. Relating this to the responses in Table 1 it could be deduced that a greater number of stakeholders in the building industry, had never obtained any environmental permit for projects executed for the past five to fifteen years. Also, while only 10% of the respondents had dealt with the EPA in relation to construction activities, there was a tie between those who had seldom dealt (45%) with the EPA and those who had never dealt (45%) with the EPA. This does not augur very well for effective environmental management in the Ghanaian construction industry.

It was also revealed that the majority of the respondents (55%) were aware of the procedure for obtaining an environmental permit for construction projects, but they were also aware that it was not a requirement to obtain an environmental permit for their activities.

Table 2. Questions to assess the Awareness of Environmental Management in the Ghanaian Construction Industry

Question	Purpose of the Question	Answer options		
Have you ever had to obtain an environmental permit from the Environmental Protection Agency (EPA)?	A response to these questions will be analysed against a response to question three of section A to evaluate the respondents' awareness of environmental management.	Yes 9 **(45%)**	No 11 **(55%)**	
How many times have you had to deal with the EPA in relation to construction activities?		Often 2 **(10%)**	Seldom 9 **(45%)**	Never 9 **(45%)**
Are you aware of the procedure for obtaining an environmental permit for a construction project?	These two questions will be analysed together to determine a respondent's true awareness since the right answer to question 4 is well known by the researchers. Therefore the two answers must correspond.	Yes 11 **(55%)**	No 9 **(45%)**	
In Ghana, is it a requirement to obtain an environmental permit for all construction activities?		Yes 6 **(30%)**	No 13 **(65%)**	

In summary, Section B was meant to evaluate the respondents' degree of awareness of the environmental management requirements in the Ghanaian construction industry. From the results it could be concluded that the respondents had some awareness of environmental management. At least majority of the respondents knew the procedure for obtaining an environmental permit but also knew it was not a requirement to get a permit for all construction activities.

Section C of the Questionnaire

For an assessment system to be seen as adequate, the one being assessed should at least be aware of the parameters used for the assessment, hence this section was designed to find out the level of awareness of the parameters for Environmental Assessment. It came out that only 15% of the respondents were fully aware of these parameters, although the majority of the respondents, 60% had a fair idea of the parameters for environmental assessments. This was deemed a positive sign in the opinion of the researchers.

Table 3. Questions to assess the extent of awareness of Environmental Management Assessment parameters in the Ghanaian Construction Industry

Question	Purpose of the Question	Options		
To what extent are you aware of the parameters on which construction projects are assessed environmentally?	This question tries to verify knowledge of the assessment procedure by the one being assessed.	Fully Aware 3 **(15%)**	Have a fair idea 12 **(60%)**	Not aware 5 **(25%)**
How often do EPA officials visit your site(s) to ensure compliance with environmental management procedures?	This question verifies the frequency of visits by officials of the EPA to construction sites.	Often 0	Seldom 10 **(50%)**	Never 10 **(50%)**
Do you see the environmental assessment procedures in the construction industry to be fair to all parties?	This question is to test the fairness of the environmental assessment procedures to all parties involved in construction.	Yes 12 **(60%)**	No 6 **(30%)**	
How would you rate the duration between putting in an application for an environmental permit and receiving it?	The responses to these two questions would also aid the researchers to judge the perception of respondents in terms of the adequacy of environmental management in the construction industry	Fast 2 **(13.3%)**	Slow 9 **(60%)**	Very slow 4 **(26.7%)**
How would you describe the EPA during an environmental assessment?		Co-operative 4 **(20%)**	Not co-operative 2 **(10%)**	Fair 14 **(70%)**

Another important characteristic of an adequate environmental management system is frequent visitation of sites by the assessor to monitor and ensure compliance. The researchers posed a question to find out whether EPA officials paid frequent visits to construction sites. The responses indicated a tie between EPA officials paying visits seldom and never. It would therefore not be wrong to say that the EPA had more to do in relation to site visitation to monitor and to ensure compliance with environmental issues. Even though, a greater proportion of the respondents (70%) said that the Environmental Assessment by EPA was fair, about 60% of the respondents were of the view that the process was slow.

Section D of the Questionnaire - Steps to be taken to Improve Environmental Management in the Ghanaian Construction Industry

This section was to solicit the views of the respondents on possible steps to be taken to improve environmental management in the Ghanaian construction industry. Nine steps were suggested on a Likert scale of ‘strongly agree’ to ‘strongly disagree’. The respondents were given the choice to express their degree of agreement or disagreement on a particular statement.

A total of 20 respondents were asked to read each statement carefully and tick in the spaces provided, the response that accurately represented their opinion. In all cases at least 75% of the respondents agreed that publicity, amendments of the Act, and building laws, good assessment methods, fast tracking of the permit processes, tougher penalties for none compliance of the Act and banning the use of unfriendly materials were some of the ways that could be used to improve environmental management in the construction industry. It should be noted that, more than 12 of the 20 respondents laid emphasis on publicity of the activities of the EPA, reducing the duration of obtaining the environmental permit and banning of hazardous materials, by strongly agreeing to statements in items 1, 5 and 9 (Table 4.)

Table 4 suggested statements on improving the environmental management in the construction industry

Items	Steps to be taken to improve environmental management in the Ghanaian construction industry	RESPONSES STRONGLAGREE	AGREE	NEUTRAL	DISAGREE	STRONGLY DISAGREE
1	Increase in publicity of environmental management	16	4	0	0	0
2	Revision or amendment of the EPA Act and the environmental assessment regulations	4	11	2	2	0
3	Revision of Building Regulations	7	9	1	3	0
4	Developing specific assessment methods for the construction industry	5	14	1	0	0
5	Reducing the duration between putting in an application for an environmental permit and receiving it	13	5	2	0	0
6	Increasing or strengthening penalties for breaking environmental laws	9	10	1	0	0
7	Making environmental management a contractual requirement for contractors when tendering	7	10	0	3	0
8	Learning from other countries, like the UK, which are doing better in environmental management	7	11	1	1	0
9	Banning the use of environmentally unfriendly materials	14	5	0	1	0

DATA OBTAINED FROM THE INTERVIEW

It was in the research programme to interview two officials from the EPA (one from the field level and the Metropolitan Director of the Sekondi-Takoradi EPA). Nonetheless, the researchers were able to interview only one person; the Senior Programmes Officer. This was because the Metropolitan Director was very busy and the fieldworkers (Inspectors) were out on assignments.

The first question posed was on how the EPA was faring with environmental management in the Ghanaian construction industry. To this the EPA official answered that they were doing quite well but as usual there was more room for improvement. He went further to outline the environmental assessment procedure to the researchers. He also stressed that the EPA would have to do more monitoring to ensure compliance of the environmental laws, which was a confirmation of what the stakeholders of the construction industry strongly agreed to (Table 4).

Asked whether the EPA's activities covered all sectors of the construction industry, the official replied in the affirmative with an exception of residential buildings. The researchers also wanted to know why environmental permits were not required for residential buildings. The EPA official explained that they were not mandated by law to issue permits for residential buildings, but the Town and Country Planning Department together with the Environmental Health and Sanitation Department of the District Assemblies were responsible of issuing of other permits for residential purposes. The officer further explained that it was the duty of these departments to ensure that, environmental management policies were adhered to before the permits were issued.

The next question was on whether some changes or revisions to the EPA Act and L. I. 1652 would be helpful to achieve efficient environmental management in the Ghanaian construction industry. To this the EPA official answered 'yes'. When asked to recommend changes, he recommended that certain aspects of the Act and L. I. 1652 be revised for example introducing environmental assessment for residential buildings in Ghana as is done in the UK and the EU countries.

Finally, the EPA official stated that previously they used to carry out a lot of publicity but that had reduced in recent times. It is therefore necessary to increase publicity as stated in the issues that arose from the questionnaire to stakeholders. On the whole the interview was very enlightening and confirmed some of the issues that came out during the administering of the questionnaire.

CONCLUSION AND RECOMMENDATIONS

A study was conducted on the activities of EPA in the construction industry in Ghana, using Sekondi Takoradi Metropolis as a case study area. A combination of quantitative and qualitative research methodology was used in this research. Data obtained for this research was limited to stakeholders in the construction industry namely: Contractors, Engineers, Quantity Surveyors, Architects, and Site Supervisors in Sekondi-Takoradi Metropolis through questionnaire survey. Structured interview was conducted for personnel's from Environmental Protection Agency (EPA).

It emerged from the studies that more than 50% of the stakeholders, most of who were in the building sector, had never obtained Environmental Permits. The study concluded that lack of specific enforcement of the Environmental Protection Agency Act in the building construction industry and the lack of frequent visits by the EPA to building construction sites are major factors affecting effective environmental management in the Ghanaian construction industry. Since the EPA is responsible for every aspect of environmental management, this means a second look should be taken at their activities.

It is therefore recommended that, EPA should increase publicity on environmental issues and their various activities related to environmental management; embark on regular visits to construction project sites and come out with environmental management procedures specifically for the building construction industry in Ghana.

ACKNOWLEDGEMENTS

The Authors are very grateful to staff of the Environmental Protection Agency in Sekondi-Takoradi for being very supportive and co-operative during the study.

REFERENCES

Environmental Protection Agency, Ghana (2001), Ghana Environmental Assessment Capacity Development Programme (GEACap), Environmental Assessment Administration Systems manual, unpublished

Llewellyn van Wyk, (2009) CSIR investigates use of natural fibre composites in construction [http://www.scienceinafrica.co.za], 24th May 2009

The Parliament of Ghana (1994), The Environmental Protection Agency Act, 1994 (Act490), Ghana Publishing Company, 1994, Accra.

National Redemption Council Decree, (NRCD) number 239, Ghana Publishing Company, 1974, Accra.

Environmental Assessment Regulations, 1999, Legislative Instrument 1652 (L. I. 1652), Ghana Publishing Company, Accra.

Naoum S.G. (2007) Dissertation Research and Writing for Construction Students second edition, Elesevier, Hungary

Carley, M and Christie, I (2000), Managing sustainable development second edition, Earthscan Publications, UK

Šelih, J and Vrtnik, G (2005) Quality and environmental management systems in Slovenian construction companies, Report No. PR36, Faculty of Civil and Geodetic Engineering, Slovenian Construction Cluster of Slovenia, Ljubljana, Slovenia.

Hemming, C (2005) Effective compliance management, the environmentalist, issue number 33, Decenber 2005

IEMA, (2005) Managing compliance with environmental Law: a good practice guide Practitioner, volume 6, December 2005.

AN INVESTIGATION ON WHY ADJUDICATION IS NOT A POPULAR DISPUTE RESOLUTION METHOD IN THE GHANAIAN CONSTRUCTION INDUSTRY

Eric Baffour-Awuah[1], Charles Bentum Vroom and Peter Kweku Otchere
School of Engineering, Takoradi Polytechnic, Ghana

Adjudication as a method of dispute resolution in the Ghanaian construction industry is almost non-existent, mainly due to the fact that no legislative instrument has been passed in relation to it [1]. The contrary can be said about arbitration, which attained parliamentary ascent in 1961. Adjudication and arbitration as construction dispute resolution methods were compared to ascertain why the latter is more popular once a dispute arises during the execution of a construction contract, despite the fact that the time frame for making an award on an arbitration case is almost unlimited[2], whilst a case referred to adjudication (according to the UK technicalities) should last no more than 28 days (or a maximum of 42 days if the adjudicator makes a request and both parties agree)[3]. In all, 50 questionnaires were administered to construction experts consisting of 30 contractors, 10 quantity surveyors and 10 architects. The survey consisted of 15 statements that measured the parties' attitude and opinion in relation to their perception of adjudication and arbitration as construction dispute resolution tools in the Ghanaian construction industry, with the respondents indicating their level of agreement of each statement on a 5 level scale. It was found from the survey conducted, that adjudication is not as popular as arbitration because there is not enough knowledge on it. Therefore a conscious effort must be made by all major stakeholders affiliated with the Ghanaian construction industry to disseminate information about adjudication to its members.

Key words: construction dispute, adjudication, construction contract, award.

INTRODUCTION

Most parties that are involved in the construction industry believe that conflicts are bound to arise during the execution of the project. Many of these parties believe that this is promoted by the standard forms of contracts used [4]. For all parties bound by a construction contract though, the main objective is common – a structure. The motivation for providing the structure mostly has to do with the profit each respective party is due. The client and the contractor can make a profit in a diverse number of ways. If a situation arises that compromises the profit any party is due, conflicts are inevitable. The potential for claims and disputes is eminent and all parties must take cognizance of this fact before any contractual relationships commence.

In *Sindall versus Solland* (2001), His Honour Judge Lloyd QC sheds light on what a dispute is pertaining to the construction industry by asserting that [5],

[1] e_baffour69@yahoo.com

Baffour-Awuah *et al.* (2011) An investigation on why adjudication is not a popular dispute resolution method in the Ghanaian construction industry *In:* Laryea, S., Leiringer, R. and Hughes, W. (Eds) *Procs West Africa Built Environment Research (WABER) Conference,* 19-21 July 2011, Accra, Ghana, 143-151.

"For there to be a dispute…it must be clear that a point has emerged from the process of discussion or negotiation that has ended and that there is something which needs to be decided."

Another point to be taken is that before a case can be referred to arbitration or adjudication, there must be dispute between the contracting parties. A mere claim is insufficient grounds for a case to be referred to arbitration or adjudication. If for example a contractor simply sends the client a letter complaining of monies owed for alleged delays, the contractor cannot immediately conclude that a dispute has arisen [6].

"It crystallizes into a dispute when I have had a reasonable opportunity to consider the complaint, so I can "take a position". If I tell you to go to hell, ignore you or shilly-shally, the claim automatically metamorphoses into a dispute."

Simply put, a dispute does not arise until it is affirmed that the claim made by the referring party is not accepted by the responding party. There are various circumstances that can mean that a claim has been dismissed or rejected by the responding party, however Mr. Justice Jackson in the case *Amec versus The Secretary of State for Transport* (2004) enumerates the following: [4] An express rejection; Silence; Prevarication; Delay in response to the claim

ARBITRATION

Arbitration can be traced back to the Egyptian times and the Middle Ages. It was incepted to resolve disputes that arose between parties and its prime objective was to provide a speedy means of dispensing justice using a simple procedure, especially since the courts were becoming more and more constrained by procedural formalities. Infact, the first English statute on arbitration was in 1698 [7]. In a nutshell, arbitration can be said to be a process whereby the parties to a dispute agree to have the dispute settled amicably [8]. An independent third party has to settle the said dispute and the decision he/she makes must be legally binding on the parties involved. The decision to refer a dispute to arbitration can be entered into after the dispute has arisen or may be written into the contract by way of a clause referring any future disputes that may arise during the execution of the project to arbitration. The third party may also be chosen by general consensus between the contracting parties or may be appointed by a person (or a professional body) named in the contract.

Arbitration is mostly selected as a means of dispute resolution mainly due to the facts that;

- Arbitration is private – i.e. involves only the disputing parties and the arbitrator.
- The arbitrator is familiar with the technicalities of the construction field.
- Due to the familiarity of the arbitrator with the technicalities of the dispute, time and money are saved (in relation to litigation).
- Arbitration does away with the intrinsic long delays associated with the courts.
- The decision of the arbitrator (the award) is final and binding on the disputing parties.

As time went on though, the reputation of arbitration as a cheap and quick tool of dispute resolution in the construction industry (especially in the UK) began to get tarnished. Prior to 1998 though (in the UK), most standard forms of contracts (with the exception of the New Engineering Contract (NEC) 2nd Edition, Institute of Chemical Engineers (IChemE) and the Institute of Civil Engineers (ICE) forms of contract) ensured that all disputes were settled using arbitration [4]. In 2006 for example, an arbitration case was reported to have lasted for nine years and cost an average of £54,000; although this case was quite extreme, the report went on to say that an average case last for 14 months [9]. Apart from the nine year case, the second longest recorded case lasted for four years and four months [10]. According to Leneham (2006)[10], arbitrations involving claims larger than £500,000 last for an average of 27 months whilst those worth up to £50,000 last for up to 9.6 months. Claims that ranged between £50,000 and £500,000 last for an average of 11.2 months. These harrowing facts about arbitration in the UK were previously being experienced in Australia. A report stated that [13];

"... arbitration has broken down as a cheap and efficient means of resolving construction disputes..."

It must also be noted though, that the arbitrator is not a courtroom judge (who is financed by the state), but an independent professional who is widely adept with not only the arbitral process, but also in technical knowledge of the matters spelt out in the dispute, thereby differentiating the arbitral method from the litigation process.

2.1 Arbitration versus Litigation

Litigation as a process however is slow mainly due to the fact that the procedures that have to be followed are lengthy meaning that a considerably large amount of time must elapse before a dispute reaches the court. A great advantage of litigation over arbitration is that the services of the judge and the accommodation of the trial are provided by the state. Over a period of time, litigation has attracted a lot of bad press. Hibberd and Newman (1999) [4] make mention of the fact that a survey conducted of top 400 companies in the UK by *The Times Top 1000* to sample the opinions of respondents pertaining to litigation exposed the fact that 70% of the respondents were of the view that the whole process took too long whilst 40% thought the costs associated with litigation were *"far too high"* [9]. Also, the former chairman of the Construction Industry Council (CIC) in the UK was quoted saying, [10]

"You can't win if you go to court. The high legal costs are part of it. Litigation is long and repetitive. The legal system is abysmal and inefficient."

THE GHANAIAN CONSTRUCTION INDUSTRY AND ARBITRATION

In Ghana, almost all developmental projects are funded by international bodies like The World Bank, the International Monetary Fund (IMF), and the International Development Agency [1]. As such, all Conditions of Contract are written in accordance with these bodies' requirements.

Also, any differences in opinion that may ensure between parties are mostly settled amicably and the project in hand can be completed on time. In some situations though, these differences cannot be settled amicably and will result in either the contractor claiming on the grounds of an extension of time, or the client/employer claiming for liquidated damages. When a dispute erupts between the contracting parties, the case must be settled using dispute resolution tools or the courts. Of these forms of dispute resolution, arbitration is the most popular tool employed to settle disputes. Most contracts are written to make provision for arbitration should a dispute erupt, with other contracts being written in such a manner that disputes are avoided altogether.

The construction industry is generally known as the world's most litigious industry (Ghana Highway Authority, 2008) [1] and the ASCE Journal (2007) [12] states that in the USA, nearly $5billion is used up on arbitration and litigation alone. The Ghana Highway Authority (GHA) [1], 2008 states that, *"…a dispute occurs when parties actively disagree about or debate* (over) *a matter of opinion."* It furthermore goes on to say that, *"a contract dispute arises as a result of disagreement in opinion about a term of contract, which interpretation places a burden, confers a right or obligation on one party."*

The unending demand to deliver projects in less time, at lower costs, but at high qualities and the infinite complexities, adversarial operating environments, the contractor's request for compensation not anticipated in the terms of the original contract and finally the client/employer's request for compensation for the contractor's failure to meet contractual terms are also noted as secondary contributors to disputes in the Ghanaian construction industry.

3.1 The Ghana Arbitration Act, 1961

The Ghana Arbitration Act, 1961 was published in schedule with the United Nations Convention on the Recognition and Enforcement of Foreign Arbitral Awards adopted at the Headquarters of the United Nations in New York on 10th June, 1958. The Act is the thirty-eighth Act of Parliament of the Republic of Ghana, and it attained parliamentary assent on the 16th day of March 1961 when it was enacted by the President of Ghana and the National Assembly. Its prime objective is to *"…regulate the settlement of differences by arbitration and to provide for the enforcement of awards."* (Ghana Arbitration Act, 1961).

The Act defines arbitration as *"…the reference of a difference between two or more parties to a person other than a court for determination after hearing the parties in a judicial manner."* The Act states that before arbitration can be used as a method of dispute resolution, an 'arbitration agreement', which is a contract and in writing must stipulate that any present or future differences that may come about (in the project), must be referred to arbitration irrespective of the fact that an arbitrator is named in the contract or not. Furthermore, the Act (1961), goes on to say that, *"an arbitration agreement may relate to any issue arising between the parties to it which is capable of being the subject of a civil action but an arbitrator is not entitled to make an award in the nature of a judgment in rem, that is, a decision affecting the status of a person or thing or determining any interest in property except as between the parties themselves".*

The final decision of an arbitrator (or umpire) appointed by, or by virtue of the arbitration agreement, is also irreversible, and only the Court (i.e. the High Court) can revoke a decision.

3.2 Time for making an award

"The time, if any, limited for making an award, whether under this Act or otherwise, may be enlarged by order of the Court (the High Court) whether that time has expired or not…an arbitrator or umpire may make an award at any time." (Ghana Arbitration Act, 1961). This means that there is no specified time frame laid down for an arbitrator or umpire to make an award.

Adjudication

Adjudication as a method of dispute resolution in the construction industry was introduced in the UK as a result of a recommendation by Sir Michael Latham in 1994. Sir Latham, in his report, Constructing the Team HMSO, 1994, made the recommendation that [15];

"Adjudication should be the normal method of dispute resolution for main contract and sub-contractor disputes. Appeals to Arbitration or the Courts should be after practical completion unless immediate or exceptional issues arise for the Courts; like either party refusing to implement the award of the adjudication."

With this recommendation, on May 1 1998, Part II of the Housing Grants, Construction and Regeneration Act 1996 (specifically Section 108(1)) now means that every party to a construction contract has a legal right to refer any dispute that arises under the contract to adjudication under a procedure stipulated or in accordance to the Act. Since then, disputes referred to adjudication include liquidated ascertained damages, additional cost and loss, variations, extensions of time, measurement, workmanship, contractual interpretation, negligence claims as well as the principal issue of payment. Dancaster (2005) summarizes adjudication by asserting that [3];

"What is adjudication? It is a process whereby a dispute arising between the parties to a contract is referred for the decision of a third party. That in itself does not sound much different from the existing processes of arbitration and the courts. In actual fact, in its basic concept it is not. Adjudication is all to do with the rights and obligations of the parties. It must therefore be a Judicial process. The big difference is in the time scales imposed on the adjudicator. He has to reach a decision within 28 days of the dispute being referred to him. There is therefore insufficient time for detailed statements of case, discovery and all the other procedural matters beloved of the legal and arbitral establishment."

Once the dispute has been referred to the adjudicator, he/she has up to 28 days (the adjudicator can request for another 14 days and this can be granted as long as both disputing parties agree) to make an award. To commence an adjudication case, the referring party has to serve a Notice of Adjudication which defines the nature of the dispute to the adjudicator and the responding party. After the Notice is sent, the responding party has seven (7) days to mount a defense after which, the hearing commences. Louch (2000) comments that, *"Adjudication, the low cost, fast-track means of resolving disputes and getting cash flowing through the contractual chain…is proving phenomenally popular."* [16]. These sentiments were evident in the number of cases that were being referred to adjudication. Between 1998 and 2002, the Royal Institute of Chartered Surveyors (RICS) recorded more than 1,050 cases [15], whilst Richards (2005) also notes that between May 1998 and 2003, an estimated 2,500 cases were recorded [17].

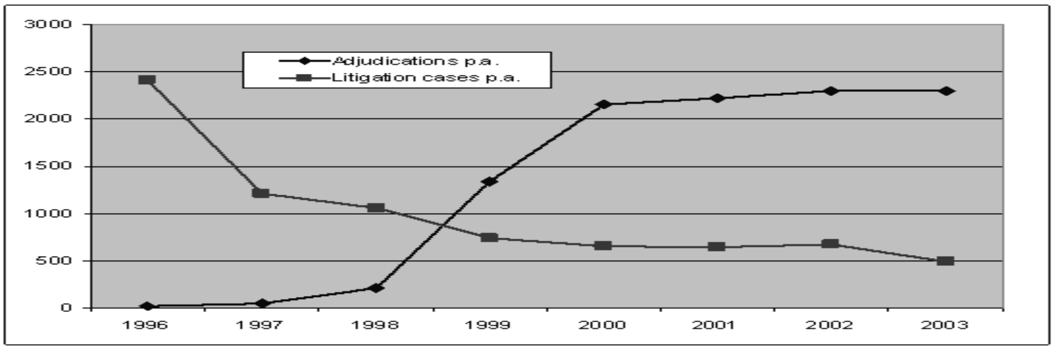


Fig. 1 Trend of adjudication and litigation cases (1996-2003) in the UK construction industry (Source: Fenwick Elliott **, 2006)**

David Blake, the founder of QS Blake Newport and a practicing member of the company's specialist dispute resolution business unit was quoted saying [12];

"I don't think arbitration has recovered from the adjudication onslaught. Most people are seeing the benefits of adjudication."

Methodology

The information gathered from the literature review was used to design a questionnaire containing 16 statements. The questionnaire attempts to determine the attitudes of the respondents about the following in relation to construction disputes: 1) knowledge on arbitration and adjudication; b) allocation of risk; c) disputes and dispute resolution methods.

Table 1 Categorization of statements

Knowledge on arbitration and adjudication	Statements 7,8,11,12,13
Allocation of risk	Statements 4,5,6,14
Disputes and dispute resolution methods	Statements 3,9,10,15

A final statement (statement 16) requires the respondents to put in statement from their perception (if any) as to why adjudication is not popularly used as a dispute resolution tool in the Ghanaian construction industry. The statements were devised to measure the respondents' view by registering them on a 5-point scale ranging from either 'strongly agree' to 'strongly disagree', 'very broad' to 'very narrow' or 'always' to 'never' pending on the question at hand.

Sampling method

The sampling technique used was the non probability sampling method i.e., purposive sampling under which, the expert sampling was utilized. Expert sampling comprises of the assembling of persons with acknowledged experience and expertise in a particular area or field. This sampling method is useful in situations where a targeted sample should be reached quickly and accurately as possible and the 'experts' can provide the feedbacks accurately and quickly. Thus architects, quantity surveyors and contractors became the targeted group and for the sake of this research, the 'experts' since disputes normally arise due to either a design problem or pricing and are always between the contractor and the client. These 'experts' were selected from the cities of Kumasi, Accra and Takoradi mainly because major construction activities were observed to be undertaken in these metropolitan areas and they were chosen from private firms, Architects and Engineering Services Limited (AESL), Department of Urban Roads, Department of Feeder Roads and the Department of Works and Housing.

DISCUSSION OF RESULTS

The questionnaire designed was given to a total of 30 contractors, 10 architects and 10 quantity surveyors in the 3 metropolitan areas mentioned above, but only 18 contractors, 8 quantity surveyors and 9 architects responded. Each of the three categories of the statements stated in the methodology was discussed.

The numbers in the boxes represent the total number of respondents for each statement of the questionnaire.

Knowledge on arbitration and adjudication

From the results in Table 2, it is evident that 80% of the respondents had extensive knowledge on arbitration whilst 77% of the respondents had little knowledge on adjudication. Also, 74% of the respondents were not too sure of the advantages arbitration had over other dispute resolution methods. This could stand for the fact that they were mostly used to the use of arbitration as a dispute resolution method in comparison to the others.

Table 2 Results for Knowledge on arbitration and adjudication

	Strongly Agree/Always/Very Broad	Agree/Mostly/ Broad	Neutral/ Sometimes/ Intermediate	Disagree/ Seldom/ Narrow	Strongly Disagree/ Never/Very Narrow
Knowledge on arbitration	8	20	6	1	0
	80.00%		20.00%		
Knowledge on adjudication	2	2	4	7	20
	23.86%			77.14%	
Advantages of arbitration over other dispute resolution methods	2	7	26	0	0
	26.71%		74.29%		
42 days enough to make an award for adjudication	5	20	4	6	0
	71.43%		11.43%	17.14%	
Unlimited time limit for arbitration advantageous	1	2	2	13	17
	8.57%		5.71%	85.71%	

Over 71% of the respondents though had little knowledge of adjudication, were of the view that the 42 maximum day period makes dispute resolution quicker and thus will have more advantages as compared to arbitration, which takes much longer than this. Lastly, almost 86% of the respondents agreed that the almost unlimited time limit associated with arbitration in Ghana was severely disadvantageous and this could affect the project at hand. This mainly has to do with the profit due at the end of the project – if the arbitration takes too long a time to be settled, this could protract the cost associated with it i.e. payment of the arbitrator, cost of materials etc, thus reducing the profit.

Allocation of Risk

Table 3 Results for Allocation of Risk

	Strongly Agree/Always/ Very Broad	Agree/Mostly/Broad	Neutral/ Sometimes / Intermediate	Disagree/ Seldom/ Narrow	Strongly Disagree/ Never/Very Narrow
No clauses for dispute resolution method in contract agreement	10	19	6	0	0
	82.86%		17.14%		
Contracts written to favour all parties	6	22	7	0	0
	80.00%		20.00%		
Contracts are a breeding ground for disputes	2	3	9	21	0
	14.29%		85.71%		
All parties are involved in selection of arbitrators	5	21	8	1	0
	74.29%		25.71%		

From Table 3, between 74% and 86% of the respondents were of the view that allocation of risk is shared equally between the client and the contractor because the type of dispute resolution method to be adopted should a dispute arise is always and mostly specified in the contract documents and this favours all parties involved. They also agreed that the drafting of the standard form contracts by clients did not in any way lead to the eruption of disputes and that should a dispute arise, all parties are involved in the selection of the arbitrator.

Disputes and Dispute Resolution Methods

From Table 4, even though the standard form contracts were not a breeding ground for disputes, 80% of the respondents however were of the opinion that disputes are likely to erupt during the execution of the project and that once the dispute has arisen, 89% of the respondents agreed that arbitration is used the most. 74% of the respondents were also of the view that because adjudication is not incorporated into standard form contracts, it is hardly used as a dispute resolution tool. Lastly, majority of respondents (83%) agreed that projects are not necessarily abandoned because disputes were not settled amicably and that one way or the other, disputes are mostly settled.

Table 4 Results for Disputes and Dispute Resolution Methods

<table>
<tr><th></th><th>Strongly Agree/Always/Very Broad</th><th>Agree/Mostly/Broad</th><th>Neutral/ Sometimes/ Intermediate</th><th>Disagree/ Seldom/ Narrow</th><th>Strongly Disagree/ Never/Very Narrow</th></tr>
<tr><td rowspan="2">Disputes inevitable in Ghanaian construction industry</td><td>5</td><td>23</td><td>7</td><td rowspan="2">0</td><td rowspan="2">0</td></tr>
<tr><td colspan="2">80.00%</td><td>20.00%</td></tr>
<tr><td rowspan="2">Arbitration mostly used in Ghana</td><td>4</td><td>27</td><td rowspan="2">0</td><td>4</td><td rowspan="2">0</td></tr>
<tr><td colspan="2">88.57%</td><td>11.43%</td></tr>
<tr><td rowspan="2">Adjudication mostly used in Ghana</td><td rowspan="2">0</td><td>4</td><td>5</td><td>7</td><td>19</td></tr>
<tr><td>11.43%</td><td>14.29%</td><td colspan="2">74.29%</td></tr>
<tr><td rowspan="2">Projects abandoned in Ghana</td><td rowspan="2">0</td><td>6</td><td>29</td><td rowspan="2">0</td><td rowspan="2">0</td></tr>
<tr><td>17.16%</td><td>82.86%</td></tr>
</table>

The last statement of the questionnaire required each respondent to give their perception as to why in their opinion, adjudication is not popular in Ghana. Out of the 18 contractors, 13 of them (representing 72%) believed that there is not enough information or knowledge on adjudication. The remaining 5 contractors however, were of the opinion that there is no legislative instrument on adjudication with one of them stating that, "Most of the judgment proceedings are not in line with the constitution of…Ghana…so parties…feel reluctant to resort to adjudication…" 3 architects stated that adjudication takes a longer time and costs more because it has to go through the courts (of course, this is false) and 4 architects were of the view that there is little information on adjudication. It can be observed here that out of the 9 architects, 7 (representing 77.80%) believe that there is little information on adjudication. Lastly, out of the 8 Quantity Surveyors, 3 were of the view that adjudication involves the courts whilst 3 were of the view that there is very little information with the remaining 2 being of the opinion that arbitration is good enough. Here too 6 of them (representing 75%) were of the view that there is little information on adjudication. In all, it is evident that 74% of the respondents stated (either directly or indirectly), that they had little knowledge on adjudication.

CONCLUSION

It can be observed from Table 4 that disputes are inevitable in the Ghanaian construction industry. Once a dispute arises during the execution of the project, arbitration is mostly used to settle the dispute. Table 1 also sheds light on the fact that the general knowledge on adjudication as a dispute resolution medium is minuscule. The fact that personnel (experts) in the Ghanaian construction industry know so little about adjudication as a quick and relatively cheap tool of dispute resolution is noticed to be the reason why it is not being utilized. Arbitration attained parliamentary assent in 1961 but there is no Act of Parliament on adjudication. Statement 16 of the questionnaire (see Appendix I) required the respondents to give their perception as to why adjudication is not popularly used in the Ghanaian construction industry and the statement which kept on being reverberated by the respondents was that there was not enough knowledge on the subject. The conclusion can therefore be drawn that the reason why adjudication receives very little patronage is simply that those involved in the construction industry in Ghana simply do not know anything about it.

RECOMMENDATION

Adjudication attained royal assent in 1998 in the UK and has since then been very popular in resolving construction disputes. Lord Latham was commissioned by Her Majesty the Queen to write a report and as part of his recommendation, adjudication was incepted. It is recommended that all major stakeholders in Ghana who are directly or indirectly involved in the construction industry make the effort to educate all involved in the construction industry on adjudication. This might seem like a daunting task since there even is no Act of Parliament on it but they say a journey of a million miles, starts with one step.

REFERENCES

[1]Baffour-Awuah, E. (2009), An investigation to find out why adjudication is not a popular method of dispute resolution in the Ghanaian construction industry, A dissertation submitted to the HAN University of Applied Sciences in partial fulfillment of the award of Master's in Construction Project Management.

[2]The Ghana Arbitration Act, 1961.

[3]Dancaster, C. (2003) "Special Report: Dispute Resolution", Construction Manager. pp 19-21

[4]Hibberd, P. and Newman, P. (1999), ADR and Adjudication in Construction Disputes, Blackwell Science p1, pp16-18.

[5]Glover, J. (2005), "What is a dispute?" Fenwick Elliot Review, p9.

[6]Bingham, T. (2001), "Looking for trouble." Building 23, p5.

[7]Rutherford, M. and Sims, J. (1997), Arbitration Act 1996: A Practical Guide, Sweet and Maxwell, p3.

[8]Powell-Smith, V., Sims. J. and Dancaster, C. (1998), Construction Arbitrations (2^{nd} Edition), Blackwell Science, pp1 – 5.

[9]Survey by the law firm, Herbert Smith, The Times, January 1995.

[10]Building, 7 February 1992, p9.

[11]Coles, D.C.H. (2009), Course Reader on Construction Contract Claims, Extension of Time and Construction Dispute Resolution Technique (Course Reader 5), HAN University of Applied Science.

[12]Leneham, E. (2006), "The Arbitration Files.", Feature, 3 February 2006, pp 14 – 15.

[13]National Building and Construction Council Joint Working Party (1989), "Strategies for the Reduction of Claims and Disputes in the Construction Industry" – a research report (various authors). NBCC, Canberra.

[14]Murdoch, J. and Hughes, W. (2008), Construction Contracts –Law and Management (4^{th} Edition), Taylor-Francis, pp 375 -380.

[15] Coles, D.C.H. (2009), Lecture Notes on Dispute Resolution Methods, HAN University of Applied Sciences.

[16]Louch, R. (2000), "How to prepare a case for adjudication", ASI Journal, p 37

[17]Richards, D. (2005), "Let's settle this", Construction Manager, p 18.

AN INVESTIGATIVE STUDY OF THE IMPACT OF DISTANCE AND DEMOGRAPHIC VARIABLES ON THE PRICE OF CEMENT

D. O. Mac-Barango[1]

Department of Quantity Surveying, Rivers State University of Science and Technology, Port – Harcourt, Nigeria

Distance appears to be the major obstacle to overcome in most economic activities, since spatial disparity occurs between the points of demand and supply. Cement a core construction material has to be transported from points of manufacture to final consumption locations. The impact of locational variations on total cost of construction products, is a solemnly inputed factor at bidding and tendering stages, tender figures are fixed with reference to administrative headquarters, even when the projects are in other locations. The study investigates the impact of the following variables on the price of cement: (i) The distance from administrative capital (Port Harcourt) to other locations. (ii) Population (iii) Geographical size (iv) The population density of these locations. The research methodology obtains data of mean price values of cement, in locations outside the administrative quarters through primary sources. Data for the variables of distance, population and geographical sizes of locations are effected through secondary data source. The research employs the statistical tool of regression, for the analysis of data. The research concludes that variables, did not significantly impact on the prices of cement and that price necessitated by spatial disparities of locations are explainable by other variables. It recommends that cement availability should take into cognizance the volume of construction and other economic activities.

Keywords: demographic variable, economic variable, price of cement, transportation.

INTRODUCTION

The retailers of cement deposit the material principally on depots and outlets situated in the state capital, from where local consumers are supplied. The depots within the state capital get their supply principally from Lagos Port, complimented by supplies from Onne port in the case with direct imports from overseas. Some of the principal manufacturing companies include Ibeto cement, the Eagle cement in Port Harcourt environs, others include Ewekoro, Nkalagu, Elephant cement companies. Some of these companies have shut down operations principally due to their over dependence on imported material component for manufacture. The concept of distance from Depot (within Port-Harcourt) to towns in the local government areas becomes an issue, since there is spatial disparity. The research appraises the impact of spatial disparity on the price of cement. This is with a view to developing models that establish the relationships between the prices of cement and the variables of (i) Distance (ii) Population (iii) Geographical size (iv) Population density. It therefore seeks to serve as predictive models for determining the prices of cement and use such

[1] dumomac@yahoo.com

Mac-Barango, D.O. (2011) An investigative study of the impact of distance and demographic variables on the price of cement *In:* Laryea, S., Leiringer, R. and Hughes, W. (Eds) *Procs West Africa Built Environment Research (WABER) Conference,* 19-21 July 2011, Accra, Ghana, 153-166.

outcomes as tools for decision making during bidding, tendering and implementation stages of future projects resultant of these factors. Some other economic and environmental factors that influence the prices of cement (from the state capital to locations outside it) would also be revealed.

BACKGROUND OF STUDY

Those charged with the responsibility for setting cost limits on public sector building, most notably in the field of housing, have been able to apply effective regional allowances and revise them on occasion to reflect changing regional conditions. Regional allowances calculated for local authority housing in England and Wales have shown that expensive areas produce tender levels in the order of 20% above the lowest. Mainland Scotland excluding Orkney and Shetland and the Western isles show a similar range, but whereas in England tenders for housing appear to be highest in the major urban areas, in Scotland they are highest in parts which are remote from the main areas of activity. In view of the obvious importance of local cost influence, uncertainty and anxiety often surround the cost control of work in unfamiliar locations especially if they are remote where there is experience of similar work. (Avery 1982a). Bello (1997), has asserted that the differences in costs of the construction materials (cement, aggregate, tender and reinforcement) do not depend on transport in Kaduna state. Transport cost of building materials is not consistent with the average distance covered. Wemegah (1998), collaborates that distance from Lagos does not significantly influence cement prices in Nigeria. This could be due to depot system operated by cement-producing/importing companies. Cost due to distances are figured into the price of cement on a uniform basis all over Nigeria. The study also shows that there is no significant relationship between the cost of cement, from Minna (a state capital) to selected local government areas of the state. There is however, a departure from the outcome of Olatejus (2000), result which shows that there is significant relationship between the prices of selected building materials and the distance from Kaduna metropolis. He stated further that some extraneous variables collectively account for a great percentage of the variation. The results of research finding indicate that cement, timber, roofing sheet and granite had R-square values of 50.2%, 28.3%, 32.3% and 74.7% respectively. In conclusion therefore, the relationship between the price of building materials (cement, timber, roofing sheet and granite) and the distance were significant enough form to the basis for predicting the prices of materials in Kaduna state. Mogbo (2002a), produces empirical evidence that regional variations in the prices of imported building materials in Nigeria are not influenced by the distances of retail depots from the major warehouses located in Lagos or Onitsha which are the points of distribution to the retail outlets from they are purchased and used for construction. The survey result generally indicates R^2 value below 50% for all material except nails. Importantly also, except for ceiling board, reinforcement bars and nails, the results indicate that generally, the further the distance were from Onitsha, the higher the prices. The generally weak correlation suggests that the possible increases in prices were accounted for by other variables except distance. He further posited that such factors may be principally due to the forces of supply and demand, weight of the materials and packaging. He concludes from the study that distance plays a minimal role in the variation of prices of building materials. Other factors which influence the cost of building materials should be explored so as to determine the role of each factor in the regional variations of prices of building materials. Areas of high population densities may likely induce high volumes of construction works necessitating high demands for building materials.

Mac-Barango (2006), also buttresses that the economic variables of supply and demand factors, population; population density and the volume economic and construction activities are potent factors that could necessitate locational differentials in materials costs. Environmental influences are considered also paramount.

According to Mogbo (2002b), prototype projects (such as hospitals, dispensaries, post offices, schools and colleges), have always been designed and tendered for by the government at Federal, State and Local government levels. The government normally awards such contracts to contractors of equal capacity. The problems had always been how to mark-up prices to reflect regional variations. For example, during the execution of the petroleum (special) Trust Fund's project between 1996 and 1999, the Fund was confronted with such problems and it had to order the various project consultants to establish necessary benchmarks for awarding contracts for projects located in urban and rural areas as well as those sited in the riverine communities. Kawu, (1994), has noted that the greatest problem of the construction industry in Nigeria is finding a ready source of cost information that will cover convenient geographical locations throughout the country. Lagos has remained the major entrance port of all building materials and equipment. Recently, it has become particularly difficult to establish, other sales depots else where other than Lagos which would have made pricing exercise for estimators much easier.

JUSTIFICATION OF STUDY

It is hoped that more detailed understanding of locational differences in tender levels will have practical applications. Detailed assessment of locational influence would help to explain the underlying reasons for allowances calculated by governments or others for defined types of building. Early cost forecasts, whether for broadly similar work or work with distinctly different characteristics cold then be made with greater confidence. It seems that there will always be a need for more information about the influence of locality on individual elements and specific forms of construction for cost planning. (Avery 1982b). Harris and Mc Caffer (1983), have opined that greater attention to material control may pay important dividends in the form of increased profit. There is a growing evidence that losses due to materials are often significantly higher than those due to other causes. According to Adegboro (1992), construction materials are expensive in Nigeria because, they are mostly imported as finished goods and raw materials have to be imported for the materials manufactured in Nigeria such as cement, steel, aluminum, etc. By the time they get to the market, the consumer is probably paying six or seven times the cost at source. One of the primary weaknesses of the construction industry is undoubtedly that of price communication. Research into building price trends and building cost forecasting will go a long way in standardizing cost projections. (Ajanlekoko, 1987). Dayyabu (1994), posits that, cement is the most expensive material used in producing mortar for block work and concrete for either plain or reinforce concrete. Despite the high cost of cement, it still remains as one of the most commonly used and most important in the construction industry, which itself is a very significant sector of any type of economy. He further revealed that in frame structure the combined cost of block work and concrete work consumed more than forty percent (40%) of the total cost of construction in four bedroom flats. While in three bedroom bungalow, the combined cost consumed between twenty five to thirty percent (25-30%). Yusuf (2004) has buttressed that concrete constitutes a large percentage of components required for a building, particularly high rise building. The cost of concrete is about 54% in relation to openings (18%) finishing's (17%) wall (9%) and excavation (2%). Holmes (1995), has stated that cement is the most expensive ingredient in concrete and although assumed to be the most reliable, since it is very carefully controlled during manufacture, should be sampled and tested. Onukube (2000), has observed that the physical resources on a given project can run from 40 to 60 percent of total installed project cost. The overall philosophy for controlling the physical material budget is to start with an estimate of the physical materials cost and convert it into budget that becomes our baseline for buying them.

DISTANCE AND TRANSPORTATION

Distance, is the space between two points. Ullman (1957) posits that a spatial disparity occurs between supply and demand points such spatial interactions are influenced by distance. Distance thus is the main barrier to be overcome. Transport cost, has to be incurred in moving person or commodity over distances. Robinson (1975), submits that the most important consideration in transport are: the cost of carriage, the speed of carriage and the quality of load factor. The use of route is primarily determined by cost of carriage, which are attributed to four factors. The distance over which goods have to be transported, the means of transport used for carriage, the obstacles and handicaps of free movement and the nature of the goods carried.

THE MEANS OF TRANSPORTATION

Ataev et-al (1980), asserted that transportation and handling operations account for 25-35% of the total construction and erection costs, whereas labour costs 40-50% of the total necessary amount. Prefabricated structures are generally delivered from construction industry plants without additional handing and erected directly from the transport vehicles. At the same time, a large proportion of such loads as inert materials, cement, alabaster, concrete, wood (timber), woodwork, small-piece wall material and others are supplied from manufacturers and base depots with inevitable additional handling. Transportation and handling costs may be lowered and operations speeded up by a judiciary chosen combination of transportation and handling machines when determining the most efficient kind of transport and choosing transportation means, the transportability of loads should be taken into account. In construction application, truck haulage has many advantages over rail transport, such as relative simplicity and independence of operation and high gradient capability and manoeurability. This explains why motor vehicles are the most versatile transport means and one most employed in construction. Adeniyi (1987), observed that in contemporary Nigeria the distribution of building materials and towns within the country is mostly done with lorries and tippers. Avery (1982c), has posited that remoteness is of course, an imprecise term and its effect on the cost of materials needed for a project is by no means a constant. Apart from the fact that various materials are likely to come from different places freight charges will be influenced by volume or weight and size of order. Further costs are likely if materials are dangerous, fragile or difficult to handle. Heavy materials with low initial cost such as sand and gravel tend to be worst affected by distance and difficult transport conditions. Martin (2000), has averted that consultants should access the effects of locations of a project on pricing level.

THE INFLUENCE OF LOCATION ON PRICE

The cost of building affected is by its location, in addition to a whole range of design factors and localized variables which include market factors such as demand and supply of labour and materials, workload, taxation and grants and the physical characteristics of the site-its size, accessibility and typography. While all these factors are particular to a time and place, certain areas of the countries tend to have different tender levels to others. It is stressed that even within countries or large conurbations, there are considerable variations in tender levels and these may outweigt the effect of general regional factors. (Seeley 1983). In a similar vein, Zubair (2005a), submits that projects in the Niger Delta region are more difficult to execute because of the peculiarities of the region. The weather could be considered to be harsh and the terrain difficult thereby making logistics very difficult. In some cases, because of the difficult access, labour force and materials are difficult to source locally. Even within the Niger Delta region. There is the factor of upland and Riverline areas. The terrain of the Riverine areas is generally very difficult, the mode of transportation is through the rivers that criss-cross the delta and the weather very harsh. In some places materials are not available locally necessitating its importation from the upland through the rivers with the attendant risk of losing some through boat mishaps and multiple handling. Hence materials are therefore transported solely by boat and towed barges. This creates multiple handling of the materials with its attendant cost implication. The waste factor crated thus is high.

Vandalism is not entirely confined to known locations but risks in some areas are clearly higher than others. Protection against vandalism is more likely to be needed in urban areas than remote country ones and costs can again be quantified. Security is an increasingly important overhead cost in many urban areas but one which hardly ever features in tenders for work away from the major conurbations. (Avery 1982D). The storage of materials require proper planning in-order to provide adequate protection, reduce waste and damage. Materials may even be stored in a raised platform. Materials with high tendency to damage as a result of high humidity are planned for short duration of storage at site. (Zubari 2005b).

DEMOGRAPHIC AND SOCIAL VARIABLES THAT INFLUENCE PRICE

A planned socio-economic development decision of nation cannot be carried out without the population factor being inclusive. The population density is also a determinant factor in the allocation of road networks. The geographical areas (size) of an area determines the total length of the road network to be allocated to the area. (Hoyles 1988). Transportation provides the channel through which some interactions take place along which information flows. The need for transportation is an integral facet of everyday life. Its efficiency, contributes largely to the level of productivity, economic growth and thus the standard of living (Bala 1976) and (Ratcliffe, 1981). The growth and development of every society is dependent on the efficacy of its available road networks. Without road transport, it would be apparent that there would be a dislocation in its economic transactions (Nwoji, 1995). The contribution of road transportation to the development of the country is decisive in the sense that changes occur in the pattern of internal communication to meet the demands of an independent self-sustaining economy (Udo, 1980) and (Kuhn 1995). The development of a nation and transportation are closely tied especially when one considers the crucial role of transportation in the socio-economic development of any nation, a well planned, adequately maintained, efficiently managed and properly operated transport system is a pre-requisite to the development in all sectors of national economy. (Salter 1977), (Caparetis 1991) and (Kulin, 1995). Economic growth will be enhanced by lower transport cost for the industry through reduced travel times, improved access to port and manufacturing facilities, and higher productivity through increased and dimension units. The tourism industry is enhanced by improved access and travel conditions through increased and dimension units. (Mc Quillen 1996).

ECONOMIC VARIABLES AND THE PRICE OF CEMENT

Spatial disparity in material economics of cement, detects that the economic and demographic variables of population, the size of the user location (its geographical size and the market, the quantum of cement needed visa viz the volume of construction activities in the user location and the manufacturing/sale points be given due cognizance in the evaluation of decision matrices bordering on cement. These variables propensity to influence the price mechanism of cement, within localities and time frame depend on the prices of substitutes and compliments, the purchasing power of buyers, the psychological tastes preferences, and the numbers of buyers within a time period. This is influenced by the quantities sellers are willing to place out per time period. (Sharp and Register 1988) and Shutt (1988a).

Supply is a measure of flow, of how much firms are willing to sell, and it measures as so much per period of time. The collective behavior of all firms in a particular market is determined by the price of the commodity, the goals of the firms, the state of technology. Collolarity, the total quantity demanded in any market depends on the price of the commodity being sold, on the prices of all other commodities, on the total income of all the households buying in that market, on the distribution of that income among the households and on tastes. (Lipsey 1983), (Powell 1989a) and (Begg et-al 1991).

Fundamental to monetarism is the belief that the levels of public spending must be used as a policy instrument to achieve control over growth of the money supply. Government uses its fiscal policy instruments for the overall management of the economy in pursuit of whatever are its economic objectives. (Powell 1989b).

Government through its fiscal and monetary instruments attain certain economic objectives. Monetarist policy, stimulates or retards the supply of money. Fiscal policy is achieved through the instrument of taxation. (Shutt 1988b).

In periods of inflation, the general level of prices that is enough commodity, prices are rising so that on the average, prices in general are rising. During inflation some commodities may be falling in price and some may be rising, but the commodities in price are dominant and they exert upward force on the general price level. (Sharp and Register, 1988b).

According to Jagboro (1992) the normal economic concept of the law of demand and supply applies to the building industry like any other industry. When materials are available in large quantities price will tend to be lower than in case of scarcity. Other factors that affect the prices are the capacity of the industry relative to the demand currently being placed upon it and the ability of industry to forecast the level of activity so as to budget for future requirement. Some imported materials like cement, reinforcing bars and sanitary wares fluctuate as a result of the exchange and monetary policies.

RESEARCH METHOD

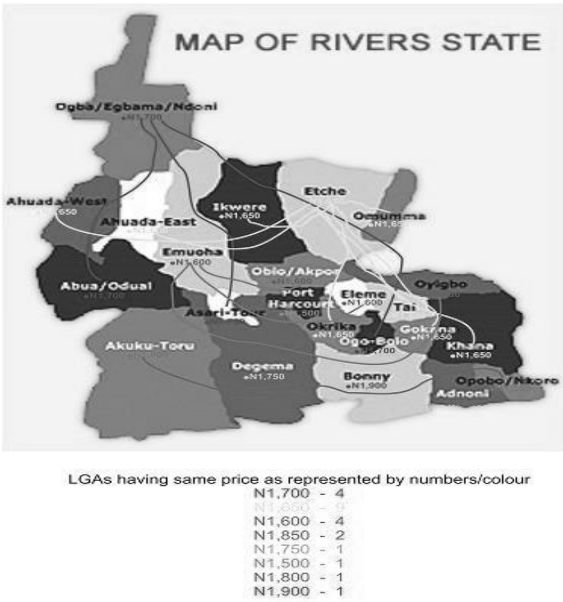
This research examines the influence of distance on the price of cement, from Port Harcourt to locations in other local governments areas. Data collected was also differentiated between local government areas that use land and water transportation means.

The parameters of interest include distance from Port Harcourt, the population, the geographical sizes and the prices of cement in the local government areas outside the state capital. Primary data source obtains values for price of cement, while secondary data is used to obtain demographic variables of population, geographical sizes of the local government areas. The prices of cement were obtained from vendors, the National population via the internet was the source of the demographic variables.

A sample population of 23 locations, representing the local governments areas of the state are obtained. The mean values of the totals each of the parameters (distance, population, geographical size and price), for the 23 (twenty-three) locations are collated, this forms the basis of analysis.

The value of the parameter of price, are actually the mean values obtained from a minimum of (5) five towns in each local government area; this represents a better representation and reflection of prices that would have ordinarily be obtained from the local government headquarters alone.

Tools (Analysis technique): The statistical tool of regression analysis, determines the relationship existing between variables. The co-efficient of determination (R2) determines the extent of the relationship between two or more of the parameters of interest. The Fcal, Ftab, and P-values establish, the significance levels of the relationship, put at 5%. It also determines the decision to accept or reject the Null or alternative hypotheses. Statistical computer package (spss), analyses the data. Descriptive Analysis: Graphs and charts illustrate and establish trends and pattern between the parameters, during the study period. Contours of Isocost of cement prices of locations are established and superimposed on map of the study domain, as shown below:



MAP of Rivers State showing contours of Iso prices of Cement in Local Government Areas.

PRESENTATION, ANALYSIS OF DATA AND DISCUSSION OF RESULTS

The study, investigated the impact of distance and other demographic variables on the price of cement in Rivers State, using inferential as well as descriptive statistics.

Table 3.10: Summary of Raw Data used for Analysis:

Location (L.G.A.)	Distance from Port Harcourt City (km) to 22 L.G.A in R/S	Price of Cement Per Bag N	Population	Area km^2	Population Density	L.G.A. Headquarter
Abua/Odual	104	1700	282,998	704	402	Abua
Ahoada East	77	1650	166,747	341	489	Ahoada
Ahoada West	98	1650	249,425	403	619	Akinima
Akuku Toru	49	1850	156,006	1,443	109	Abonnema
Asari Toru	37	1700	226,106	113	1,948	Buguma
Andoni	62	1800	211,009	233	906	Ngo
Bonny	41	1900	215,358	642	355	Bonny
Degema	45	1750	249,773	1,011	247	Degema
Eleme	26	1600	190,884	138	1,383	Eleme
Emuoha	30	1600	201,901	831	243	Emuoha
Etche	48	1650	249,454	805	310	Okehi
Gokana	45	1650	228,828	126	1,816	Kpor
Ikwerre	40	1650	189,726	655	290	Isiokpo
Khana	57	1650	294,217	560	525	Bori
Obio/Akpor	13	1600	464,789	260	1,788	Rumuodo
Ogba/Egbema/ Ndoni	112	1700	284,010	969	293	Omoku
Ogu/Bolo	39	1700	74,683	89	839	Ogu
Okrika	30	1650	222,026	222	1,000	Okrika
Omumma	33	1650	100,366	170	590	Eberi
Opobo/Nkoro	70	1850	151,511	130	1,165	Opobo Town
Oyigbo	30	1600	122,687	248	595	Afam
Port Harcourt	-	1500	541,115	109	4,964	Port Harcourt
Tai	43	1650	117,797	159	741	Sakpenina

Source: Author Field Work (ii) National Population Commission

Table 3.20: **Summary of Results: (Regression Models)**

S/No	Analysis	Dep. Var.	Indep. Var.	Type of Model	Results of Experiment					Inferences	
					Regression Equation	R^2 (%)	F_{tab}	F_{cal}	P_{value}	Strength of Relationship	Remarks
1	Regression of LGAs on land	Mean price of Cement	Distance from PH(Land)	Linear	y = 1599.403 + 1.113(x)	0.341	9.302	4.38	0.007	Weak Positive Relationship	Not Statistically Significant
2	Regression of LGAs on land	Mean price of Cement	Population of LGA(Land)	Linear	y = 1701.730 + 0.000(x)	0.209	4.767	4.38	0.042	Weak Positive Relationship	Statistically Significant
3	Regression of LGAs on land	Mean price of Cement	Area of LGA(Land)	Linear	y = 1615.918 + 0.076(x)	0.304	7.845	4.38	0.012	Weak Positive Relationship	Not Statistically Significant
4	Regression of LGAs at sea	Mean price of Cement	Distance from PH(Sea)	Linear	y = 2070.613 – 6.616(x)	0.924	12.083	161.4	0.178	Strong Positive Relationship	Not Statistically Significant
5	Regression of LGAs at sea	Mean price of Cement	Population of LGA(Sea)	Linear	y = 1719.854 + 0.001(x)	0.170	0.205	161.4	0.729	Weak Positive Relationship	Not Statistically Significant
6	Regression of LGAs at sea	Mean price of Cement	Area of LGA(Sea)	Linear	y = 1776.843 + 0.186(x)	0.882	7.465	161.4	0.223	Strong Positive Relationship	Not Statistically Significant

Descriptive Analysis of Data:

The descriptive charts show the pattern and trends between variables, and mean price of cement and population for LGA(s) accessible by land. Port Harcourt, which has the highest population is less than (550,000) recorded the least mean price. Akuku, with the highest mean price of cement, has a population less than (160,000). Ogu/Bolo, though with the population, has a mean price of N1,700.

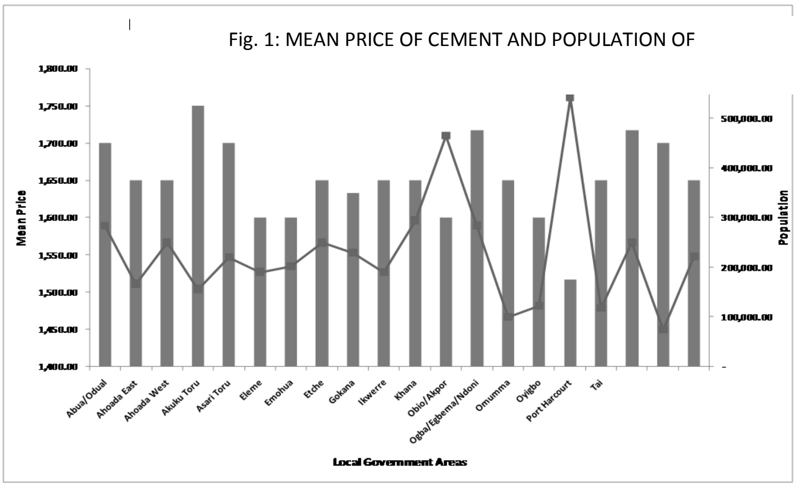


Fig. 1: MEAN PRICE OF CEMENT AND POPULATION OF

The Chart, for mean price of cement and the geographical areas, indicate that Akuku LGA with the highest mean price also has the largest area. Generally the mean prices of cement do not show, a progressive increase according to the geographical areas of the local government areas. Prices of cement, are not reflective of geographical seizes of LGAs.Ogu/Bolo, though has the least geographical area (less than 160km^2) records mean price value of N1,700, which is at per with Asara, Abua/Odual having geographical areas of (113)km^2 and 704km^2 respectively.

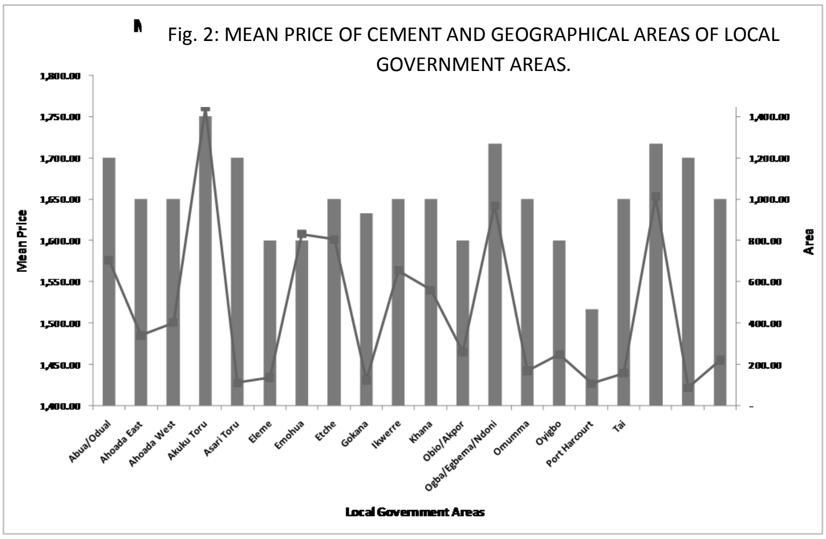


Fig. 2: MEAN PRICE OF CEMENT AND GEOGRAPHICAL AREAS OF LOCAL GOVERNMENT AREAS.

DISCUSSION OF RESULTS

Research findings establish as follows

A weak positive relationship that indicates significance between the distance from Port Harcourt (using land) and the mean price of cement. The model, is y = 1599.403 + 1.113 (x), R^2 value = 34.10%, Fcal (4.38), Ftab (9.302), P value = (0.007). The statistics of the analysis between the parameters of the mean values of cement prices and distance show that both variables increase in same direction (a positive relationship). The correlation between both variables is a weak one establishing an R^2 of 34.10%. The outcome of the Fcal and P values led to the acceptance of the Null hypothesis. There is no significant relationship between the variables of distance and price of cement (for local government accessible on land).

There is a significant relationship (though) a weak positive one, between the population of LGA(s) accessible through land and the mean price of cement. The model, is of the form, y = 1701.730 + 0.000 (x), ^{R2} value = 20.9%, Fcal (4.38), Ftab (4.767), P value = (0.042). The statistics of the analysis between the parameters of population of LGA(s) and the mean values of cement prices show that both variables increase in the same direction (a positive relationship). The correlation, extent of relationship is a weak one, with an R^2 value of 20.9%. The outcome of the Fcal, Ftab and P value statistics, led to the acceptance of the alternative hypothesis. There is a significant relationship between the variables of population and price of cement (for local government areas accessible on land).

There is no significant relationship, between the geographical (Area of LGA(s)) accessible through land and the mean price of cement. The model, is of the form, y = 1615.98 + 0.076 (x), R^2 value = 30.4%, Fcal (4.38), Ftab (7.84), P value = (0.012). The statistics of the analysis between the parameters of the mean values of cement prices and geographical areas of LGA(s) show that both variables increase in the same direction (a positive relationship). The degree of relationship is weak, establishing an R^2 value of 30.4%. The outcome of the Fcal, Ftab and P value statistics led to the acceptance of the null hypothesis. There is no significant relationship between the variables of geographical areas of LGA(s) and the mean values of cement prices (for LGA(s) accessible through land).

There is no significant relationship between distance from Port Harcourt (using sea) and the mean price of cement. The model, is of the form, y = 2070.613 – 6.616 (x), R^2 value = 92.4%, Fcal (161.40), Ftab (12.08), P value = (0.178). The analysis between the parameters of the mean values of cement prices and distance from Port Harcourt (using sea) show that both variables increase in he opposite directions (a negative relationship). The correlation between the variables is a strong one, establishing an R^2 value of 92.4%. The outcome of the Fcal, Ftab and P value led to the acceptance of the null hypothesis. There is no statistically significant relationship between the variables of distance and price of cement (for LGA(s) accessible through sea).

There is no significant relationship between population of LGA(s) accessible (by sea) and the mean price of cement. The model, is of the form, y = 1719.854 + 0.001 (x), R^2 value = 17.0%, Fcal (161.40), Ftab (0.205), P value = (0.729). The analysis between the parameters of population of LGA(s) accessible (by sea) and the mean values of cement prices show that both variables increase in the same direction. The correlation between both variables is a weak one, establishing an R^2 value of 17.0%. the outcome of the Fcal, Ftab and values led to the acceptance of null hypothesis. There is no statistically significant relationship between the variables of population and the prices of cement (for LGA(s) accessible (by sea).

There is no significant relationship between the geographical size (areas) of LGA (using sea) and the mean price of cement. The model, is of the form, y = 1776.843 + 0.186 (x), R^2 value = 88.2%, Fcal (161.40), Ftab (7.465), P value = (0.233). The analysis between the parameters of the mean values of cement prices and the geographical size (areas) of LGA(s) show that both variables increase in the same direction (a positive relationship). The correlation between both variables is a strong one, establishing R^2 value of 88.2%. The outcome of the Fcal, Ftab and P value led to the acceptance of the Null hypothesis. There is no statistically significant relationship between the variables (cement and geographical areas) for LGA(s) accessible through sea.

IMPLICATIONS OF RESULTS OUTCOME

The outcome of the analysis between distance from Port Harcourt to the local government headquarters either accessible by land and sea, is indicative that the impact of distance on price of cement is infinistimal. Variations in the price of cement are explainable by other factors – the state of roads, ready availability and transportation means used. (2) The outcome of the analysis between population of LGA(s) and the mean price of cement, shows that though population as an economic variable has a propensity to influence the price of cement, the matrices of the population structure, disposal income of the target group, amidst the volume of economic activities should not be isolated. (3) Outcome of analysis between geographical (areas) of LGA(s) and the mean prices of cement shows that the demographic variable of size cannot unilaterally influence price rather variables like volume of economic activities, economic population and the state of terrain and difficulties encountered within and between areas are potent sources.

CONCLUSION

Cement, is a predominant material used in concrete and construction works generally in Nigeria. Variables of spatial disparity can influence the dynamics of its transportation and distribution from location to location; peculiarities of regions (topography, terrain, economic climatic and conditions) can influence its price within localities. Research findings conclude as follows: (1) The price of cement is not influenced by Distance from the state capital for both LGA(s) accessible by land or sea. (2) the population of locations accessible by sea. (3) The geographical size (areas) of LGA(s) accessible by land and sea. (4) The price is however influenced by population of LGA(s) accessible land. The research findings therefore imply that values of the Dependent (cement prices) cannot be adequately predicted from the values of Independent variables of (Distance, Geographical size and Population) for LGA(s) accessible by both land and sea. Population of LGA(s) accessible by land can however attempt to predict the price of cement, though the strength of the outcome is likely to be weak. Locations of Iso costs from cement price contour, show that those LGA(s) headquarters are not equ-distance from Port Harcourt, yet they have same price of cement.

The study recommends as follows:

Construction cost analyst – Quantity surveyors and other professionals in the built environment as well as policy makers, during the pricing and synthesis of bills of quantities for construction works procurement should discard the impct of the variables of (i) distance (ii) population, geographical size (areas) for both LGA(s) accessible both by land and sea. However some weighting could inputed for the impact of population for LGA(s) accessible through land. They should give due cognizance to the impact of terrain, typography, other environmental as well as economic factors outside the tested variables (for instance the prevalent macro-economic variables, the volume of construction activities). Weighted factors should be inputed for their impact.

Recommendation for further studies:

It recommends similar studies to investigate the impact of distance on some other building materials and constituents of concrete (sand, chippings). (ii) Investigate the impact of distance on price of cement from the local headquarters (as supply centres) to other towns within the local government areas.

REFERENCES

Adegboro, T. A. (1992): Construction industry in Nigeria paper in “The Nigerian Quantity Surveyor Vol. 14 (April)” Journal of the Nigerian Institute of Quantity Surveyor’ Lagos, Nigeria p(10).

Adeniyi, E. O. (1987): Transport planning and development in Nigeria. “Construction in Nigeria” journal of the Federation of building and civil Engineering Contractors in Nigeria. Vol. 14. No. 3 pp(52)

Ajanlekoko, J. O. (1987): Controlling Cost in the Construction Industry: The text of an article “the Lagos Q. S. Digest”. Journal of the Nigerian Institute of Quantity Surveyors, Lagos State chapter. (p5)

Ataev, S. S. Zolotnitsky, N. D, Bondarik L. N., Gromov, L. N., Ovchinnikon, E. V. and Tamkovich, A. T. (1980): Construction Technology” MIR publishers. Moscow pp(29-30).

Avery, D. W (1982a): Problems of Locality in Construction Cost forecasting and control in (Ed) P. S. Brandon: Building Cost Techniques: New Editions. E and F. N. Spon Ltd. London, New York. Pp (159-160).

Avery, D. W (1982b): Problems of Locality in Construction Cost forecasting and control in (Ed) P. S. Brandon: Building Cost Techniques: New Editions. E and F. N. Spon Ltd. London, New York. Pp (160-161).

Avery, D. W (1982c): Problems of Locality in Construction Cost forecasting and control in (Ed) P. S. Brandon: Building Cost Techniques: New Editions. E and F. N. Spon Ltd. London, New York. Pp (163-164).

Bala, A (1976): Public Transportation in Kaduna state unpublished PhD Thesis. National Institute of Transport Technology, Zaria.

Begg D, Fischer, S and Dornbusch, R (1991): “Economics Third edition”. McGraw-Hill Book company London, New York pp (60-61).

Bello Sheriff (1997): Transport and cost of selected construction materials. (A case study of Kaduna State). Unpublished Research dissertation. Department of Quantity Surveying. Federal University of Technology, Minna (unpublished) pp55-56

Caparetis, T, Levy, H and Wolden, T (1991): Sub-Suharan Transport Program, Road maintenance initiative, Building capacity for policy Reform Vol. 1. Report on the policy seminars, EDI Seminar series Washington D. C. World Bank.

Dayyabu, A. U (1994): Review of Block work and Concrete Work in Nigerian Housing Construction. Study of cost and construction. Unpublished Research project dissertation. Department of Quantity Surveying. Federal University of Technology, Minna, Nigeria. Pp(6 and 23).

Harris, F and Mc Caffer (1983): Modern Construction Management third edition. Black well Scientific Publications. Oxford, London Edingburgh p(119)

Holmes, Roy (1995): “Introduction to Civil Engineering Construction third edition” College Estate Management, Reading. Pp(34-35).

Holyes, B (1988): Transport and Development in the Tropical Africa, John Murray publisher Ltd, London. Pp(44-45)

Jagboro, G. O. (1992): The role of Professionals in the choice, and utilization of local building materials. Paper in the "Nigerian Quantity Surveyor" Vol. 14 Journal of the Nigeria Institute of Quantity Surveyings, Lagos, Nigeria. P (23).

Kawu, A. M (1994): "Construction cost price book" "Newproquants Consult" Kano Nigeria p(vi)

Kutin, T. E. (1995): Transport and Communication Systems Planning, Reconstruction and Development in Nigeria. In (Ed): Ayida, A. A. and Onitan H. M. A. reconstruction and Development Nigeria. Proceedings of a National Conference Ibadan. Niser and Oxford Univeristy press. Pp(489-520).

Lipsey, R. G (1983): "An Introduction to Positive Economy: Sixth edition" English Language Book Society. London pp (81, 85-86)

Mac-Barango D. O. (2006): Locational Variations in the elemental cost of bungalows due to climatic and environmental influences in Nigeria. Paper in "The Quantity Surveyor". Journal of the Nigerian Institute of Quantity Surveyor". Vol. 54 P(33).

Martin J. (2000): How to produce the best early cost advice to clients. "Chartered Quantity Surveyor" London 32-33

Mc Quillen (1996): Reforms of Road Sector Management and Financing, Federal Ministry of Works and Housing Road Vision 2000: Workshop papers. P (3).

Mogbo (2002a): The effect of distance on the Regional Variations in the prices of imported building materials in Nigeria: paper in "The Quantity Surveyor" Journal of the Nigerian Institute of Quantity, Surveyor, Lagos, Nigeria. Vol. 38 Pp(14 and 15)

Mogbo (2002b): The effect of distance on the Regional Variations in the prices of imported building materials in Nigeria: paper in "The Quantity Surveyor" Journal of the Nigerian Institute of Quantity, Surveyor, Lagos, Nigeria. Vol. 38 Pp(14)

Nwoji, C. (1995): Deplorable state of Roads, Daily Champion Newspaper Friday September 22. P(9)

Olateju, S.O. (2000): The analysis of the effect of price of selected building materials in Kaduna State. Unpublished Research dissertation. Department of Quantity Surveying. FUT, Minna (unpublished). P(55)

Onukwube, H. N. (2000): Project Evaluation Techniques, the text of article in "The Quantity Surveyor". Journal of the Nigerian Institute of Quantity Surveyors. Jun/Sept. Vol. 32. (page 24)

Powell, R (1989a) "Economics for Professional and Business Studies" . Dp publications, London. Pp (13-14).

Powell, R (1989b) "Economics for Professional and Business Studies" . Dp publications, London. Pp (288 and 290).

Ratcliffe, J. (1981): An Introduction to Town and Country Planning. London. Hutchinson & Co. Publishers. Pp (63-69).

Salter, R. J (1977): Highway Traffic Analysis and Design. London Heinman Education Books. P(128).

Seeley I. H. (1983): Building Economics third edition. Macmillan publishers Ltd. London & Basingstoke. Pp(61 and 161.

Sharp, A. M and Register, C. A (1988a) "Economics of Social issues. Eighth edition" Longman Group. England pp (29 and 30).

Sharp, A. M and Register, C. A (1988b) "Economics of Social issues. Eighth edition" Longman Group. England p (334).

Shutt, R. C (1988a) "Economics for the Construction Industry: second edition. Longman Group. England pp (60 and 73).

Shutt, R. C (1988b) "Economics for the Construction Industry: second edition. Longman Group. England pp (191-197, 199).

Udo, R. K. (1980): Geographical Region of Nigeria. Heinemann Education books. London. P (95)

Uliman, E (1957): "American commodity flow Seattle". University of Washington press.

Wheeler, J. O. and Muller, P. O. (1986). "Economic Geography" second edition. Wiley Publishers

Yusuf, S. M (2004): Cost Profile of Ground and First Floor of a Four Flat Two Bedroom Residential (Concrete Work). Unpublished Research Dissertation. Department of Quantity Surveying. Federal University of Technology, Minna, Nigeria. Pp(1 and 79).

Zubair, S. A (2005a) Factor influencing project cost in Niger Delta. Paper in the Niger Delta Q. S. Port Harcourt. P(5 and 6).

AN OVERVIEW OF HUMAN SETTLEMENT IN NIGERIA: A RAY OF HOPE FOR THE SLUM DWELLERS?

Clinton Aigbavboa[1] and Wellington Thwala[2]

School of Civil Engineering and the Built Environment, University of Johannesburg, Doornfontein Campus, Johannesburg, 2028, South Africa

Provision of affordable housing to its citizens has remained the principal focus of every successive government in Nigeria. This is because of the pivotal role played by housing in national development, advancement and growth on one hand and its being a necessity in the life of the people, on the other. The Nigeria housing problem basically relates to quantitative and qualitative inadequacies regardless of the various government policies that have been formulated in the past towards overcoming the huge shortage through several Housing Reform Programmes. Despite these past efforts, adequate housing provision continues to be an illusion to ordinary Nigerian. This paper reviews housing in Nigeria; the policies and agencies supporting housing delivery in Nigeria, such as the Government, private sector and others. Slum upgrading and other issues helping the delivery of affordable and adequate housing in Nigeria is also discussed. Based on the above, the success achieved to date is compared with the support received and the lessons learnt to date are also presented. The paper is mainly a literature review/survey. Finally, the paper closes with some recommendations for the future.

Keywords: housing, Government policy, Nigeria, slum, slum upgrading.

INTRODUCTION

Provision of affordable and adequate housing for its citizens has remained the principal focus of every successive government in Nigeria. This is because of the vital role played by housing in national development and growth on one hand and its being a necessity in the life of the people, on the other. At a primary level Van Vliet (1998) says that housing is shelter where people live and on the secondary level it is a critical component in social and economic establishment. According to Novick (1990) housing is the environment, which exerts the greatest and most immediate influence on the lives of the people, their health, well-being and satisfaction towards life. Thus, habitable and decent housing in a serene environment that would protect the populace from unwanted diseases, injury and discomfort and guarantee safety remains the concern of every individual, corporate bodies and the government in Nigeria (Jolaoso *et al.,* 2008).

Housing is recognized world-wide as one of the basic necessities of life and a pre-requisite to the survival of man (Onibokun, 1983; United Nations, 1992; Salau, 1990). It is a priority for the attainment of living standard and it is important to both rural and urban areas. A house also affords the physical structure in which human, social,

[1] aigclinton@gmail.com
[2] didibhulut@uj.ac.za

Aigbavboa, C. and Thwala, W. (2011) An overview of human settlement in Nigeria: A ray of hope for the slum dwellers? *In:* Laryea, S., Leiringer, R. and Hughes, W. (Eds) *Procs West Africa Built Environment Research (WABER) Conference,* 19-21 July 2011, Accra, Ghana, 167-179.

economic, and cultural resources are realized, enriched, and integrated (Ademiluyi, 2010). Ademiluyi further informs that in the traditional African setting and in most developing nations, housing is one of the greatly cherished material properties. This is because of the other functions that a house performs in the traditional society which includes the protection of family cohesion and values, taking care of the aged through the extended family system, and the protection of the ancestral values, among others. In developing nations, a home of one's own represents a precious refuge. Indeed, the literature on housing in developing countries often show that housing ranks above education and health services as a priority (Ferguson, 2001). Thus, households in developing countries value homeownership more than households in advanced industrialized countries. In fact, in most developing nations when a family does not have a house they can call their own, that family is regarded as the poorest of the poor. Thus, the importance of providing adequate housing (housing that meets the needs and expectations of the people, ranging from the supplied quantity to the quality, thus assuring the quality of life of the people) in any country cannot be over-emphasized, much less a country like Nigeria with a GDP- per capita income of $2, 400.

However, acquiring access to a house and to the components that comprise housing and housing policy—land and property rights, building materials, basic services, regulations, subsidies, and credit—are extraordinarily difficult for most households in developing countries (Angel, 2000). Housing has an intense effect on the health, social behaviour, satisfaction and the quality of life of a community (Nubi, 2008). According to the Human Rights Resources Centre (2008) housing is essential for normal healthy living as it fulfils deep-seated psychological needs for privacy and personal space; physical needs for security and protection from inclement weather and social needs for basic gathering points where important relationships are forged and nurtured. In many societies, a house also serves an important function as an economic centre where essential commercial activities are performed.

Despite the fundamental role of housing in the life of every individual and the nation, and in spite of the United Nations' recognition of the need to globally attain affordable shelter for all, inclusive of the Millennium Development Goal (MDG) of meaningfully making a significant impact in the lives of at least 100 million urban poor, the housing crisis remains one of the problems and a grave and rising challenge facing both urban and rural residents, particularly in the developing countries. According to the United Nations World Population projections (2004) an estimated 68 – 80 million houses is needed annually to house the annual increase in world population growth. Also, the United Nations Population Fund (2003) informs that the world population passed 6.8 billion in 2009 and is expected to reach between 7.9 and 10.9 billion by 2050. Over 90% of the growth during the next two decades is forecasted to occur in the developing countries. According to Mthembi-Mahanyele (2002), it is in the developing nations of the world, that the fundamental challenge of housing provision for the future lies. According to Ademiluyi (2010) the "situation even becomes more serious and worrisome when one realizes the fact that despite a number of political, social, and religious initiatives taken in the past in some of these developing countries, a large proportion of their population still lives in sub-standard and poor housing and in deplorable and unsanitary residential environments". This is the situation of Nigeria today, where housing provision by the government commenced before political independence in 1960 and where, despite numerous government involvements and huge investments in housing provision, the problem still remains impossible to solve as many rural and urban populations in Nigeria do not have free access to safe and affordable housing. This, according to Onibokun (1990) is as a result of the government not able to set up systems that enable the citizens to access housing effectively, and even when they are set-up, the systems are hijacked by the political parties to foster their mandate amongst the people and the rich and middle class not needing them become beneficiaries while the poor is left with nothing.

Nigeria being the 8th largest nations in the world will not be spared from the challenges ahead, as more and more Nigerians make towns and cities their homes, which will result in a social, economic, environmental and political challenge for the time to come. Without the proper formulation of policies and likewise their implementation, housing will be a mirage to the ordinary citizens who cannot independently access housing. It is against this backdrop that the paper attempts a review of housing in Nigeria to date. The paper is structured into four parts. Following this introduction, section two focuses on the policies and agencies supporting housing delivering in Nigeria, section three will give a review on slum upgrading in Nigeria and other issues relating to government programmes supporting slum upgrading and how they are financed, which are generally the issues helping the delivery of affordable housing from the prevailing slum condition in the cities of Nigeria. Based on the above, the success achieved to date is compared with the support received and the lessons learnt to date are also present. Finally, the paper closes with some recommendations for the future.

POLICIES SUPPORTING HOUSING DELIVERING IN NIGERIA

The Federal Government of Nigeria adopted its first housing Policy in 1991, in response to the Agenda 21 of Global Shelter Strategy, aimed at achieving sustainable human settlement development. This was in response to the exploding population and urban growth rate and also an acceptance, for the first time, that government alone was incapable of addressing the alarming gap in the housing needs of all Nigerians. The current housing policy is the main document supporting housing delivery in Nigeria with reference to past policies. A review of past housing policies and programmes of both the public sectors as contained in the National Housing Policy (2006) reveals that effective implementation of housing policies and programmes are yet to be made and that most of the policies and programmes do not satisfy the quest of the average Nigerian.

The adopted 1991 policy was reviewed in 2004 with the ultimate goal to ensure that all Nigerians own or have access to decent, safe and healthy housing accommodation at affordable cost (National Housing Policy, 2006). The most significant differences between the new policy and the previous ones is that housing is now seen in context of the overall National Development in contrast to when housing was regard as a social service and a natural fall-out of the national economic development. Secondly, the policy has identified the fact that different people both within and between income groups tend to have different demands for housing, moving away from the one-size-fit all syndrome. This is evident from the ultimate goal of the Housing Policy which is, “to ensure that all Nigerians own or have access to decent housing accommodation at affordable cost”. Thirdly, the current focus is on removing all barriers to the supply of housing and to providing of incentives to all parties involved in the housing delivery system.

The previous policies from the past until now has always been formulated with good intentions, but the formulators of the policies do not spell out the direction, neither do they take into consideration the amount of involvement required from the would-be beneficiaries. A typical short coming of the previous ones usually has the slogan of "housing for all Nigerians". This statement ordinarily assumed that all families in Nigeria would be provided with adequate housing regardless of who needed one and with no contribution or participation being expected from the beneficiaries (Ajanlekoko, 2001). For instance, accessing land in most states for the execution of the intended programmes are not readily available and most land accessed is too far from existing infrastructures like roads, water and electricity.

In Nigeria, the major policy steps taken, so far, towards solving the housing crisis in the country can be summarise below:

Policies to date	Reason for policy formation
Formation of the Lagos Executive Development Board (LEDB) - 1928	The Board was authorized to carry out slum clearance, land reclamation, and the development of residential and industrial estates.
The setting up of Nigerian Building Society (NBS) - 1956	Provision of housing loans to both civil servants and the Nigerian public.
Establishment of housing corporations – 1964	The regional housing corporations were mandated to develop estates and at the same time provide mortgage for the people to build houses and pay back over many years.
Establishment of the Federal Housing Authority, established under Decree No. 40 of 1973 and amended by CAP 136 LFN of 1990 – 1973	Its roles was to make proposals to the government for housing and ancillary infrastructural services and implementing those approved by government.
The creation of the National Site and Services Scheme - 1986	Formed to provide land for government housing with essential infrastructural facilities for housing developments in well-planned environments. Also, to provide well laid-out serviced plots in each of the 36 state capitals of the federation, including FCT Abuja.
The formation of the National Prototype Housing Program by the Federal Ministry of Works and Housing	To complement the objectives of the National Site and Services Scheme. The project was embarked upon to demonstrate the feasibility of constructing functional, effective, and affordable housing units through imaginative designs, judicious specification of materials, and efficient management of construction.
The setting up of the State Housing Corporation	To provide housing to the populace at affordable prices;
The creation of the Federal Mortgage Bank of Nigeria - 1977	To finance housing loans to prospective housing developers at minimal interest rates.
The setting up of the National Housing Program (NHP) in 1991 and the National Housing Fund (NHF) scheme by Decree No 3 of 1992	To provide self-loans to potential housing developers and also monitor developments in the housing sector.
The deconsolidation of the Federal Mortgage Bank of Nigeria (FMBN) through the establishment of the Federal Mortgage Finance Limited (FMFL)	To take over retail mortgage portfolios previously handled by the bank and also to facilitate effective management of the National Housing Fund (NHF) Scheme.
The setting up of a Housing Policy Council (HPC)	To monitor development in the housing sector and also to set up the machinery for the review of the 1978 Land Use Decree (LUD) in order to make more land available for large scale land developers.
The creation of the ministry of Housing and Urban Development in June 2003	Charged with the responsibility of ensuring adequate and sustainable housing delivery and maintenance of a conducive living environment that meets the needs and aspirations of Nigerians.
The review of the mandate given to the Federal Housing Authority to include provisions of the National Social Housing as part of the strategy towards meeting the Millennium Development Goal.	The authority also plans to facilitate the provision of two million housing units before 2015, which is not a realistic goal with the way housing issues are still be treated in the country.

Others are the formulation of the National Housing Policy (NHP) in 1984, the establishment of the Infrastructural Development Fund (IDF) in 1985, and the Urban Development Bank (UDB) in 1992 (Federal Republic of Nigeria, 1997).

In addition to the above, all the introduced National Development Plans (NDPs) from 1962-1985 and the National Rolling Plans (NRPs) from 1990 to date plainly recognize the importance of providing affordable housing in the country as a tool for stimulating the national economy (Ademiluyi, 2010; Gbolagade, 2005), but little has been done to bring about an actualization of the policy intentions.

There are several challenges facing the provision of housing in Nigeria, with particular emphasis to the low-income group; unlike the case of South Africa where government provide houses free of charge to the low-income group or disadvantage poor, through the South Africa National Housing Subsidy schemes; to make a start into economic independence and freedom. Shu'aibu (2007) posits that the problems associated with the attainment of affordable housing in Nigeria include compromises during implementation, lack of political sensitivity, corruption, amongst others. Any compromises made during implementation that sought to alter basic policy goals are normally detrimental to the successful execution of any housing policy. Though policy implementation is a tedious process that requires a great deal of analysis before starting it, but the reality of basic housing can only be realised if there is proper implementation of policies. Furthermore, lack of adequate data relating to the magnitude of the problem, which is as a result of the absence of a national data bank for housing; inconsistency in policies and programs, including regular changes of policies with changes of government without proper assessment of the existing ones; lack of efficient and sustainable credit delivery to the housing sector; incomes level of those needing houses, this is relatively low in comparison with house market prices, resulting in an affordability problem; high cost of building materials; the rapid annual growth rate of the Nigerian population, which was estimated at 3.3% on the basis of annual birth rate of 49.3 per 1,000. All these coupled with the rapid population growth/urbanization a problem of an increasing poverty level among the citizenry, which has risen from 65% in 1996 to about 70% in 2009, according to UNDP and World Bank estimates confirming UN-habitat (2009) statement that 70% of the urban dwellers in Nigeria live in slums; lack of effective coordination among Housing Agencies. While all the three tiers of the government are involved in one way or the other in housing matters, their activities are hardly coordinated.

SLUM IN NIGERIA

According to Kim (2008) slums, informal settlements, shantytowns, favela, ghettos: are words which describe an urban typology that has become the focus of intense interest for architects, urbanists, social-economists, and scholars such as Rem Koolhaus, Robert Neuwirth, Jeffrey D. Sachs and Mike Davis to mention a few. Despite the phenomena not new, this urban typology of squalid, overly-dense communities has flourished over the last decade to over 1 billion people. Today, almost half of the world's urban population are said to be living in slums.

However, Gilbert (2007) informs that 'slum' is nowadays employed to describe 'bad' shelter. The word slum is used at a varying scale in that a house or a large settlement can be tagged slum provided it is perceived to be substandard and is occupied by the poor. Nevertheless, Gilbert (2007) further informs that "every urban area in the world tend to define slums differently, even though efforts have been made for years to establish objectives measures with which to demarcate the major problem areas. Furthermore, the UN-HABITAT report (2003) on "The Challenge of Slums", defines "slum" as a "household or group of individuals living under the same roof that lack one or more of the following conditions: access to sale water; access to sanitation; secure tenure; durability of housing; and sufficient living area." This working definition, officially adopted at a UN meeting in Nairobi on October 2002, is "restricted to the physical and legal characteristics of the settlement," and according to Kim (2008) this definition shies away from the more difficult-to-measure social dimensions associated with slum. However, in most cases, it is equally related to both the economic and social circumstances of the individual or community (UN-Habitat, 2003). The literature informs that two types of slum exist in Nigerian cities. There are the traditional slums arising in towns from the decay of existing structures and the spontaneous slums created by squatters on illegally acquired lands (Agbola, 1998). The latter pattern represents the majority of the slums existing in the urban areas in Nigeria. In a study on urban decay in 40 Nigerian cities, Abumere (1987) states that the cities closely identified with the phenomenon of overcrowding are large cities like Lagos, Kano, Ibadan, Benin, Onitsha, and these cities are generally deemed to be ancient (all except Onitsha). This study of almost three decades is more than true as these cities have become a shadow of themselves with numerous slums springing up daily as a result of urbanisation caused by population growth. Laurent (2002) further argues that urban decay connected with overcrowding is almost entirely an urban problem in Nigeria and is the major cause of the growing slum environment. Laurent also informs that about 68.2% of the slums in Nigerian cities are found within a radius of one km from the city centre; of which, if there are no resources for urban renewal, the city centre, which is the oldest by definition, turns into a slum in time. However, slums on the outskirts of the city can also be found, normally in the largest Nigerian cities. In the large cities, such as Enugu, Kano, Ibadan and Lagos, a considerable proportion of slums occur on the city outskirts, more than five km from the centre. The reason being that accommodation in many of these cities has been over-priced beyond what most citizens can afford. Many low-income workers, who cannot afford the high price, therefore live in low-cost shanties or slums on the outskirts of the city. The situation has not improved in the major cities with the money that reportedly has been spent on slum upgrading and eradication in Nigeria (Laurent, 2002).

Slum upgrading approaches differ from city to city. In its simplest form, the approach that deals with the main deficiencies determined in the slum definition of the UN-Habitat in Section 2.1.2 is normally adopted in Nigeria. Slum upgrading is a package that improves the basic services such as clean water supply, sanitation, sewage disposal, garbage collection, electricity, amongst others, up to a satisfactory standard (Camilo, 2008). Usually it does not involve the construction of new houses, because it is assumed that the residents can do this by themselves. Others include legalization and regularization of property rights or providing security of tenure. Security of tenure is considered to be one of the essential actions of upgrading since it opens up possibilities of raising credit for livelihood related activities (UN-HABITAT, 2003). However, it is also known to be among the most difficult since it requires changes or flexibility in governmental mechanisms and legislation. At neighbourhood level, upgrading includes actions such as improvement of footpaths, roads and public spaces. In some cases actions go beyond the physical aspects and health issues are addressed by providing clinics and health education programs; school facilities and training programs are also implemented to attack the lack of basic education and courses offered to increase income earning opportunities and the general economic health of the community (Camilo, 2008). Further action includes the removal of environmental hazards and providing incentives for community management and maintenance or investment in capacity building. The responsibility of the public sector is to provide basic infrastructure, while housing is a matter of enabling people to improve their own conditions (Tannerfeldt & Ljung, 2006). Besides, it has been confirmed that after the provision of services and infrastructures and guaranteeing security of tenure, slum dwellers have been motivated to invest up to four times the amount of funds that the governments invest in the infrastructure improvements of the area (World Bank, 2000). Nevertheless, it is important to mention once more that the ways of implementing and applying this approach can vary from city to city and not always are all these actions put into practice. This is because in a country like South Africa, slums dwellers are not only provided security of tenure, but also, already constructed houses are given to them to make a start into the socio-economic environment. In some other situations in-situ upgrading of the slums are done where relocation is practically impossible. Also, illegal evictions of slums dwellers were rampantly used during the Military regime without an alternative solution for the poor.

The Nigerian development agenda concerning slum upgrading is particularly geared towards achieving the MDGs. Sibeudu (2007) informs that the comprehensive political, economic and social reforms taking place in Nigeria today emphasis poverty reduction, slum upgrading, integrated planning and the sustainability principle (Sibeudu, 2007). But this has only resulted in a little percentage of improvement in the quality of life for it citizens. The National Framework for poverty reduction strategy, which is the National Economic Empowerment and Development Strategy (NEEDS), specifically focuses on poverty reduction, employment generation, wealth creation, gender mainstreaming, overall social development and value reorientation, without an agenda to affordable housing and slum upgrading in its formative years. However, in 2007, NEEDS was expanded to cover housing, slum upgrading, social housing, regional development and other urbanisation issues. Current policy measures in operation include a revised National Housing Policy, Urban Development Policy and Environmental Sanitation Policy amongst others to achieve the goals of the MDGs (Sibeudu, 2007). NEEDS has put in place a modernized land registration and information system and the establishment of a National Housing Data Bank, as well as preparation of Strategic Regional Development Plans to correct national disparities.

To date, Nigeria has witnessed a rapid rate of urbanization in the last two decades, because of the developmental neglect of the rural areas. It is estimated that over 40% of the Nigerian population live in urban areas. The rapid rate of urbanization has brought with it significant problems including a shortage of housing, overcrowding, traffic congestion, environmental degradation, inadequate infrastructure and services, slum creation, amongst others. In recognition of these problems, the National Rolling Plans have factored in the new National Housing Policy instruments for implementing the National Housing Programme that will enable the provision of affordable housing for the poor. Furthermore, the National Housing Fund an Infrastructural Development Fund has been put in place to facilitate the attainment of the goals of Sustainable Human Settlement in the country (UN-Habitat, 2008).

Numerous policies have been adopted by government to improve Urban Management as discussed above. For instance, the National Urban Development Policy was formulated in 1992 to provide guidelines for urban development and management. In addition, a National Construction Policy was promulgated in 1994 to ensure and enhance the following: the use of indigenous building materials and industries; adoption of standards and regulatory measures for increased use of energy-efficient designs; and use of labour intensive construction and maintenance technologies for the generation of employment (UN-Habitat, 2008).

Other strategies being employed include a mortgage system to facilitate home ownership among all segments of the population, a National Contributory Pension Scheme to ensure the availability of long-term savings for residential estate development and a robust secondary mortgage system. If all these must be realised, the present administration must complete as efficiently as possible abandoned programmes by past government and its agencies and target those who can always benefit from them, which are the poor. As contained in the new National Housing

Policy, 2006, government should make available 40% of the National Housing Trust Fund (NHTF) for low income and rural housing, support and encourage the inclusion of community Urban Upgrading Programmes and support through Housing co-operatives and housing association in the provision and maintenance of low income housing in decent, safe and healthy environment (UN-Habitat, 2008).

PROGRAMMES SUPPORTING SLUM UPGRADING

Nigeria's efforts towards sustainable development since 1986 are marked by policy formulation and the establishment of agencies for implementation. One of such 'efforts' is the establishment of the Family Support Programme (FSP) initiated by the then First Lady of the Federal Republic of Nigeria, Her Excellency, Mrs. Maryam Babaginda. The FSP recognizes that one of the most important needs for the survival of any family and healthy family living is the provision of decent and affordable housing, as most low income families in cities do not own houses because they cannot afford them. In this regard, the FSP sets out, amongst others, the above objectives to ensure affordable housing for the less privileged in the society.

The Federal Government through the Federal Housing Authority (FHA) started the National Housing Programme in 1994. The objective was to produce 121,000 housing units for low, medium, and high income earners. Records show that about 5% of the target has been achieved as at 2010. Further efforts on direct construction of houses continue to be made through the National Prototype Housing Programme aimed at demonstrating the feasibility of constructing functional, cost effective and affordable housing units. Currently, the Nigerian Urban Renewal Programme is directed at improving existing slums in the core of cities. The programme has been implemented in 18 cities across the nation. The Federal Government has also provided through the National Sites and Services Programme over 15,000 plots at subsidized rates to the public; and over N250 million have been committed to the programme in the last six years as reported by the UN-Habitat (2008).

Further to the achievement of the goal of improving urban management, the country is now participating in the Sustainable Cities Programme (SCP) under the urban management programme (UMP) of the United Nations Centre for Human Settlement (UNCHS) / World Bank/United Nations Development Programme (UNDP). Under the programme, the Sustainable Ibadan Project (SIP) is being implemented. Also, through this initiative, Local Governments, NGOs, Community Based Organizations, and private individuals are encouraged to participate and contribute to urban improvement and management. Presently, the process of replicating the sustainable city programme in other cities has already begun. Two other cities, Kano and Enugu have commenced their projectsThe SCP emphasizes a two-way relationship between development and environment, which promotes better awareness and understanding of the priority issues to be addressed in urban environment and development, better considerate of modern urban and environmental management methods, and the most effective and lasting impact (UN-Habitat, 2008).

The Nigerian Government is currently working on developing future programmes aimed at improving the human settlement development and management sectors. These sectors include: poverty alleviation programmes in collaboration with the World Bank and UNDP; a programme support document for Governance in collaboration with UNDP; a National strategy for the replication of the Sustainable City Programme in other Nigerian cities; and replication of the Urban Basic Services Programme in collaboration with the United Nations Children's Fund. The government intends to concentrate efforts in the near future on: capacity building for improved management; institutional and policy reforms; social reorientation; increased participation of NGOs and the private sector; and promotion of appropriate technologies (UN- Habitat, 2008). These future plans are aimed at achieving a state of environmentally sound human settlements, free of slum conditions, in which every disadvantaged and poor Nigerian will have access to adequate and affordable shelter.

FINANCING OF SLUM UPGRADING PROGRAMMES IN NIGERIA

Slum upgrading in Nigeria is mostly funded by the Federal Government. Slum upgrading, according to the Nigerian Minister for housing in 2007, is to embark on re-planning of already existing plans, which have not been properly planned to invariably improve lives of the slum dwellers across the country. It should be known that slum upgrading is not just about this alone, because some of the cities centres that are now in slum condition are planned. But because of the lack of a maintenance culture and lack of infrastructure and other amenities, they have become slum centres. Although, the later was the reason while in 2007 the ministry of housing allocated, N500 million for an intervention fund for three slums locations to be upgraded. The projects executed in these areas included rehabilitation and upgrading of township roads and drains including water drainages; rehabilitation and provision of water to household connections, provision and upgrading of electricity supply in slum neighbourhoods; household connection and others (UN-Habitat, 2008).

Currently, the Nigeria Urban Basic Services Programme (UBS) is being financed with a $3 million grant from UNICEF with a matching grant from the Federal Government. The targeted communities to benefit from the programme were identified in the cities of Lagos and Ibadan, which have some of the oldest slums in the country. Through financial assistance from the World Bank (US$ 180 million), the Infrastructure Development Fund has been able to finance urban development projects in 15 States of the Federation. The initial loan from the World Bank was matched with local funds. The projects carried out covers storm drainage, sanitation, urban road rehabilitation, water and solid waste management, market development, water rehabilitation, motor part development, river channelization, and street lighting according a report of UN-Habitat (2008).

Under the various programmes for the upgrading and eradication of informal settlements, the government in collaboration with agencies such as the World Bank, UNDP, the United Nations Environment Programme (UNEP), the International Labour Organisation (ILO), UNICEF, and UNCHS have sponsored foreign and local training programmes to acquaint operators of this sector with contemporary ideas, strategies, and tools for human resources development and a better approach to slum upgrading in the selected sites. Also, technical assistance for human resource development has been received to enhance the management capacity of agencies responsible for urban development.

SUCCESS ACHIEVED TO DATE COMPARED WITH THE SUPPORT RECEIVED

Further to the foregoing, the Nigeria government in collaboration with other international agencies have made a lot of commitment to the upgrading of slum condition in the country. This commitment thus gives a ray of hope to the slum dwellers which is seen as a worthy commitment to changing the slum condition plaguing the urban areas. These thus contradict the World Bank research findings that African countries do not see housing and slum upgrading as a funding priority (Shea, 2008). But when a critical review of what is achieved to date is compared with the investment/support, one can conclude that the success achieved is not commensurate with the support received. Although a significant impact has not really been made in reality that can adequately compensate for the support received, however, we can still say that the urban poor's right to adequate housing and other problem issues that are associated with slum conditions are being given attention. However, it should be noted that one major obstacle to the short comings of the success received to date is a lack of transparency and corruption in the part of the policy implementers and the country's law makers.

This is because, if the financial assistance from the World Bank (such as - US$ 180 million) and other agencies, said to have been used for urban development projects in 15 States can be adequately accounted for, the majority of the slum dwellers would have had a roof over their heads, free supply of drinkable water, good sanitary system amongst others even though it is not up to the standard that can called "adequate in terms of the quality received". Also, there should be an integrated approach to informal settlements upgrading, and also the project should build capacity in order to improve the lives of slum dwellers. Because even though the sponsored trainings have indeed foster a capacity building within those that were trained, in the acquisition of contemporary ideas, strategies, and tools for human resources development and giving of a better approach to slum upgrading in the selected sites; there should be the involvement of volunteers within the community to be upgraded so that they can contribute meaningfully and give suggestions based on the pressing need of the other community members. Also, technical assistance for human resource development should not only be to those agencies responsible for urban development, but also to the locals; because for the slum upgrading process to be sustainable, the locals must have a first oversight of the development so that they can be responsible to their communities when the agencies are gone from the slum upgrading sites. Moreover, in making a significant contribution in the lives of the urban poor, economic empowerment should be sought, because in this lies the true and only way out of slum conditions, because when the slums of today are upgraded without the socio-economic empowerment of the poor, the slums being upgraded today will again become slums to be upgrade tomorrow.

LESSONS LEARNT TO DATE ON NIGERIA SLUM UPGRADING EFFORT

From the reviewed literature, the lessons learnt to date from the Nigeria slum upgrading include:

1. the success of slum upgrading depend on ensuring full support and engagement of local actors and the beneficiaries, which the new housing policy have fully recognised;
2. the Government initiative towards upgrading of slum is more of a borrowed initiative from the MDGs, and until the Nigeria government set its own goals and develop its own approach that will align with the Cities Without Slums goals and others, the quick reality of Nigeria cities without slum will not be achieved;
3. also, slum dwellers confuse slum upgrading to mean construction of housing, and this myth is hard to erase from their minds;

4. the buy-in of the slum dwellers into the project has been difficult because no one wants to work for free, however, the government should encourage the locals to be involved so that they can be empowered for economic opportunities;
5. Government must promote alternative strategies for housing construction, such as provision of service sites with basic infrastructure before making them available for sale to individuals who need them.

CONCLUSIONS AND RECOMMENDATIONS

The study revealed that the Nigerian government has embarked on the provision of housing for its citizens with a revised Housing Policy Framework to fight the current slum condition associated with the city capitals in the country. However, the problem with management and implementation of housing policy by the agencies given the responsibility has made these laudable policies ineffective. It should be appreciated that it is the operational effectiveness of these public agencies that will help in the achievement of the revised objectives of the National Housing policies. The present housing difficulty in Nigeria results from the absence of effective administrative machinery to mobilize and organise the country’s natural resources, human, industrial, amongst others; for housing and urban development. Thus, the problem of poor co-ordination and ineffectiveness of some public housing agencies in Nigeria is in most cases responsible for the failure of certain laudable housing policies and programmes. However, to date, there is no known government housing subsidy programme in place to help provide houses for the low income group. Therefore, the following recommendations are therefore made:

- the government must shift attention from direct housing construction to that of providing empowering environment for the sector. This is because individuals and private agencies are known to be more effective in housing construction. Therefore, given the same amount of money that is reported to have been spent, individuals and private agencies are likely to build more and better houses than the government or quasi-government agencies, especially in a country like Nigeria where there is a high level of corruption;
- also, Nigeria being a politically diverse nation, the government need to master the necessary political will and make more concerted efforts to address and solve for the majority of its citizens living in slum conditions, the twin problem of shelter and better living conditions.

REFERENCES

Abumere, S. (1987) Urbanisation and Urban Design in Nigeria. IN Onibokun, A. C. & OLOKESUSI, ET AL (Eds.) Urban Renewal In Nigeria.

Ademiluyi, I. A. (2010) Public housing delivery strategies in Nigeria: a historical perspective of policies and programmes Journal of Sustainable Development in Africa, 12, 153-161.

Agbola, T. (1998) The Housing of Nigerian: A review of policy development and implementation. Research Report No.14.

Ajanlekoko, J. S. (2001) Sustainable Housing Development in Nigeria - The financial and infrastructural Implication. International Conference on Spatial Information for Sustainable Development. Nairobi, Kenya.

Angel, S. (2000) Housing Policy Matters, Oxford University Press.

Bret, T. J. D. (2002) The Human Right to Adequate Housing: Tool for promoting and Protecting Individual and Community Health. Am J Public Health. American Journal of Public Health, 92, 712–715. .

Camilo, A. C. A. (2008) Learning from Slum Upgrading and Participation. A case study of participatory slum upgrading in the emergence of new governance in the city of Medellín–Colombia. KTH, Department of Urban Planning and Environment Division of Environmental Strategies Research fms. Kungliga Tekniska Högskolan.

Federal Republic of Nigeria. (2006) National Housing Policy. Chebychev Ventures Ltd.

Ferguson, B. (2001) Process, Policy, and Public-Private Partnerships in Housing in Developing Countries: What Can the United States Learn?, London.

Gbolagade, M. O. (2005) An Appraisal of Maintenance of Privately Owned and Publicly Owned Multi-Tenanted Estate in Lagos Metropolis. (An Unpublished Work of the Department of Urban and Regional Planning). Ibadan, Nigeria, University of Ibadan.

Gilbert, A. (2007) The return of the Slum: Does Language Matter? International Journal of urban and Regional Research. Volume 31.4, pp. 697-713

Jolaoso, et al. (2008) Self-help Contribution: a Viable Source of Financing Low-income Housing. The 3rd Built Environment conference. Cape Town, South Africa.

Kim, L. (2008) The kijijikit: a strategy for slum upgrading in Nairobi. Water loo, Ontario: Canada, University of Water loo

Laurent, F. (2002) Urban Slums Reports: The case of Ibadan, Nigeria. Institut Francais de Recherche en Afrique (IFRA). University of Ibadan, Oyo State, Nigeria.

Mthembi-Mahanyele, S. (2002) Keynote address to the Round Table on Sustainable African Cities. WSSD: Crowne Plaza.

Novick, R. E. (1990) The Poor die young. Housing and Health in The Third World cities. London: Earth scan Publication Ltd.

Nubi, O. T. (2008) Affordable Housing Delivery in Nigeria. The South Africa Foundation International conference and exhibition. Cape Town, October, pp. 1-8

Onibokun, A. G. (1983) Housing Needs and Responses: A planner’s view. Journal of the Nigerian Institute of Town Planners, 11.

Onibokun, P. (1990) Urban Housing in Nigeria, Ibadan: NISER.

Salau, A. T. (1990) The Environmental context of urban housing-public services and infrastructural facilities in Nigerian urban centres. IN P., O. (Ed.) Urban Housing in Nigeria. Ibadan: NISER.

Shu'aibu, M. U. (2007) Housing policy implementation problems in Nigeria. Daily Triumph newspaper. Nigeria.

Sibeudu, A. (2007) Planning Sustainable Urban Growth in Nigeria: Challenges and Strategies. Planning Sustainable Urban Growth and Sustainable Architecture. ECOSOC Chambers, United Nations Headquarters, New York.

Tannerfeldt, G. & Ljung, P. (2006) More Urban Less Poor - An introduction to Urban Development and Management, London, UK: Earthscan Publications Ltd.

United Nations Centre for Human Settlements. (2009) Habitat Backgrounder: Facts and Figures. Available at: ww2.unhabitat.org/istanbul+5/back11.doc. [Accessed on: 02 March 2009].

United Nations Human Settlements Programme (UN-HABITAT). (2003) The Challenge of Slums: Global Report on Human Settlements. London, United Kingdom: Earthscan.

United Nations Human Settlements Programme (UN-HABITAT). (2006/2007) State of the World's Cities: The Millennium Development Goals and Urban Sustainability. London, United Kingdom: Earthscan.

United Nations Human Settlements Programme (2008) Un-habitat and the Kenya slum upgrading programme Strategy document. May 2008 HS: 1010/08E.

Van VLIET, W. (1998) The Encyclopedia of Housing, Sage Publications.

World Bank. (2000) Cities Without Slums - Moving Slum Upgrading to Scale. Urban Notes - Upgrading Experiences (2).

ASSESSING THE IMPACT OF THE NATIONAL BUILDING REGULATION, 1996, L.I.1630 IN GHANA

John Dadzie[1] and David Coles[2]

[1]*Kumasi Polytechnic, Ghana*

[2]*University College of London (UCL), UK*

The development of the National Building Regulation was based on the ideas and objectives of a new national policy. It is a complicated document with far reaching consequences. The Regulation has been in existence for well over ten years now yet, it is within this same period that the nation (Ghana) has witnessed high level of collapse of structures, flooding and fire outbreaks. This research paper, therefore, looks at the impact of the National Building Regulation ever since its passage into law and what can be done to reverse the current trend. Pertinent areas such as; location of buildings, structural stability, structural fire precaution and obstructions and hazards in means of escape as stipulated in the Regulation were considered. After analysing data and testing of scientific hypothesis, the results establish that the National Building Regulation has not made the needed impact due to poor adherence. The results further establish that poor construction practices leading to collapse of structures, fire outbreaks and flooding are as a result of non-adherence to the National Building Regulation.

Keywords: flooding, Ghana, National Building Regulation.

[1]ghanaian6@yahoo.com

Dadzie, J. and Coles, D. (2011) Assessing the impact of the National Building Regulation, 1996, L.I.1630 in Ghana *In:* Laryea, S., Leiringer, R. and Hughes, W. (Eds) *Procs West Africa Built Environment Research (WABER) Conference,* 19-21 July 2011, Accra, Ghana, 181-181.

ASSESSMENT OF PATRONAGE OF NATURAL HISTORY MUSEUM, OBAFEMI AWOLOWO UNIVERSITY, ILE-IFE, NIGERIA

Emmanuel Olufemi Omisore[1]

Department of Urban and Regional Planning, Obafemi Awolowo University, Ile-Ife, Nigeria

This study examined the extent to which tourism sites on Obafemi Awolowo University Campus particularly Natural History Museum have attracted patronage and its contribution to the development of the built environment of the University Campus. Data for this study were sourced through primary and secondary sources. From the physical survey, tourist sites were identified on the Campus and these formed the sample frame of the eight study. However, a detailed survey was carried out on the Natural History Museum which formed the sample size. The survey was carried out through physical survey and questionnaire administration in order to assess its patronage pattern over a period of twelve weeks. 320 questionnaires were administered to collect the primary data from tourists that visited the Natural History Museum during the working days only. From the questionnaire administered the purpose of patronage, frequency of visit and time spent at the museum were determined through data analysis. Analysis showed that 25.6% patrons came to the museum for sightseeing, 24.4% for personal relaxation and 35.4% visit for educational and research purposes. The secondary data obtained from the register of attendance showed a decline from a total number of 13,747 patrons in 1998 to 8,444 in 2005. It was observed that the exploitation of the identified tourism potentials on the University campus would attract more patrons, even of varying age, educational and occupational distributions for the overall development of the Campus. The study suggested ways by which the potentials of tourism could be achieved through proper exploitation, investment and management to enhance the development of the University community and her built environment.

Keywords: environment, Ile-Ife, museum, tourism, tourist site, tourist.

INTRODUCTION

The built environment of Obafemi Awolowo University campus is endowed with several man-made and natural sites with tourism potential. These tourist sites are places of significant events. They are areas or places containing properties and monuments commemorating diverse socio cultural- events (Omisore and Akande, 2009). Access sites reveal natural and artificial structures of significance and provide insight into how past generations lived, worked and worshiped. In addition, the level of patronage of these sites depends on accessibility and the ability of facilities on these sites to meet the taste of the tourist. Accessibility is the ease with which an activity or a service can be reached or used (Social Exclusion Unit, 2003). Today, tourism is one of the fast growing industries in the world particularly in terms of its social and economic benefits (UNESCO, 2005 and Foan and Franco, 2008). One of the most valuable characteristics of the tourism industry is that while it has grown in number, it

[1] femsor@yahoo.com

Omisore, O.E. (2011) Assessment of patronage of Natural History Museum, Obafemi Awolowo University, Ile-Ife, Nigeria *In:* Laryea, S., Leiringer, R. and Hughes, W. (Eds) *Procs West Africa Built Environment Research (WABER) Conference,* 19-21 July 2011, Accra, Ghana, 183-192.

has also grown in variety of destinations. There has been a continued geographical spread of tourism to all parts of the world. This may be the reason why many countries, especially developing countries, have shifted to the development of tourism as a viable engine for their socio-economic development (FRN, 2006).

As a human activity, tourism deals with the movement of people in search of holiday or business (United Nation Economic and Social Council, 2005). It is a driver of economy at the local, national and international levels. It is a rapidly growing phenomenon and has become one of the largest industries in the world (Shah and Gupta, 2000, Kreag, 2001, UNESCO, 2005). The impact of tourism is extremely varied. On one hand, it plays an important and certainly positive role in the socio-economic and political development in destination countries by, (for instance), offering new employment opportunities. In addition, it may contribute to a broader cultural understanding by creating awareness, respecting the diversity of cultures and ways of life (United Nations Commission on Sustainable Development, 1999, United Nations, 2003).

In another perspective, tourism contributes, to a greater degree than most activities, in the provision of encouragement of the wide range of infrastructural services - airports, air navigation, roads, railheads and ports, as well as basic infrastructural services required by hotels, restaurants, shops, and recreation facilities (for instance telecommunications and utilities). As such, it can be said that tourism is able to contribute to development, which is economically, ecologically and socially sustainable. This is because it has less impact on natural resources and the environment than most other industries. It is based on enjoyment and appreciation of local culture, built heritage, and natural environment. The industry has a direct and powerful motivation to protect these assets; it can play a positive part in increasing consumer commitment to sustainable development principles through its unparalleled consumer distribution channels; and it provides an economic incentive to conserve natural environment and habitats which might otherwise be allocated to more environmentally damaging land uses, thereby, helping to maintain bio-diversity (United Nations Commission on Sustainable Development}, 1999, UNESCO, 2005).

The impact of patronage of tourists' site on the built environment in Nigerian towns and cities whether for tourism or any other purposes need to be critically examined. This paper focused on the examination of the extent to which the patronage of the Natural History Museum located within the built environment of Obafemi Awolowo University has contributed to the development of the University Campus.

LITERATURE REVIEW

Francis Perroux postulated growth pole theory in 1955. He argued that a growth pole is a place of passage of forces. It attracts people and objects to itself and repulses them. He further claims that it is a center from which centrifugal and centripetal forces operates. In the context of spatial development, a regional growth pole according to Hermansen (1981) is a set of expanding industries located in an urban area and including further development of economic and social activities throughout its zone of influence.

Kuklinski (1972) extended the theory of growth pole to include, more comprehensively the geographical dimension. He however based his observation and consequent recognition of the facts that development does not appear everywhere all at once. It appears at point of development pole with variable intensities: it spreads along diverse channels and has varying terminal effects for the whole of the economy. Perroux's interests were economic activities, that is, industries and commercial enterprises were used as his main element of attraction for creating the pole. The concern which has lead to rather ready acceptance of the growth pole as a basis for policy making are the problems generated by the rapid metropolitan growth. Over concentration of economic activities and social services in one or few large metropolitan centers has stimulated effort to decentralize industries and government employment in relation to country population and natural resources location for even economic development. In contribution to industrial theory, Myrdal (1957) believes that a growth pole result in a circular and cumulative causation. He states that once a particular region has the virtue of the location of a large industry, new increment of activities and growth will concentrate in the region because of the derived advantage.Once growth has begun in a place, spatial flow of labour, capital and commodities develop spontaneously to support it. There are trickledown effects or spread even to other parts of the region with respect to this development. A backwash effect is also set in the surrounding region since the region loses their younger, more skilled and able bodied workers to the growth centres. Fredmann (1966) in the theory and strategy of development discussed the need for concentration of the development and impulse in some centers. They believed that in the long run development will trickle down from these growth centers into the hinterland as well as the periphery.

Tourism sites are referred to as development impulses of growth poles from which development can trickle down into other parts of the host environment. Once growth has begun in a place of tourism site, spatial flow of labour, capital and commodities develop spontaneously to support it. This study postulates that the development of the existing tourism sites has potentials to stimulate socio-economic development of the host communities with significant multiplier effects. It is on his theoretical concept that this study is based

THE STUDY AREA

Obafemi Awolowo University is situated in Nigeria as a Federal government-owned and operated Nigerian University. It situated in the South Western part of Nigeria and lies between Latitude 7^{o}15'N, 7^{o}31'N and Longitude 4^{o}43'E, 4^{o}45'E at a distance of 288 and 671 kilometres from Lagos and Abuja respectively. See Figure 1. The Campus is situated in Osun State precisely within the Ife-Central Local Government Area. (See Figure 2 and 3).

It is situated in a tropical zone and therefore, tropical temperature and rainfall prevail there. In the dry season, the temperature can be as high as 29^{o}C (90^{o}F) and in raining season, the temperature can be as low as 23^{o}C (70^{o}F). The University formed the northern part of the ancient city of Ile-Ife, and lies between the tropical rain forest belts of Nigeria. Its vegetation is characterised by high evergreen forest. The University was founded in 1962 as the University of Ife by the regional government of Western Nigeria led by late chief Samuel Ladoke Akintola and was renamed Obafemi Awolowo University on May 12, 1987 in honour of Chief Obafemi Awolowo (1909–1987), the first Nigerian premier of the Western Region of Nigeria.

The University is endowed with beautiful architecture and an eye-catching landscape built on about 5,000 acres (20 km^2) out of a total of 11,560 acres of the land owned by the University. (See Figure 4). It is however by no means "Africa's most beautiful campus" as students and staff are always wont to claim. Some of these endowments include: Natural History Museum, Opa Dam, Zoological Garden, Botanical Garden, Hills, Bat Colony, Sculptural Park and Architectural Buildings such as Oduduwa Hall, the Spider House, and Senate Building among others. These features (natural and manmade) could contribute to the local economic development of the University's Built Environment. Pictures of some of these features are shown below. However, in this paper, emphasis and analysis will be on Natural History Museum.

Figure 1: Map of Nigeria showing Osun State

Figure 2: Map of Osun State indicating Ife Central LGA

Figure 3: Ife Central LGA indicating Obafemi Awolowo University Campus

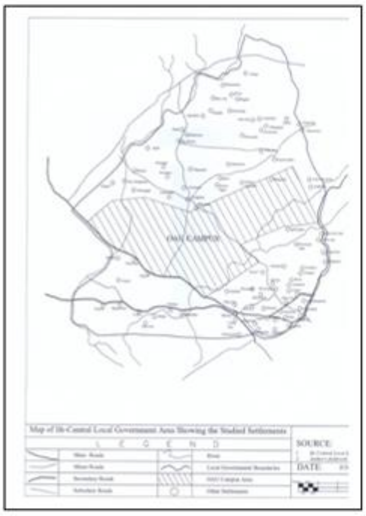


Figure 4: Obafemi Awolowo University Campus Plan

Natural History Museum

The Natural History Museum was established in 1971 as a sub-unit under the Department of Biological Sciences. In 1990, the Department of Archeology in the University was merged with the Museum, thus expanding the scope of activities to include Archeology and Cultural Anthropology (Faborode, 2011). The Museum was housed temporarily on the top floor in one of the buildings of the Faculty of Agriculture for more than 30 years.

The roles of the Natural History Museum in the life of a nation with particular reference to the Museum at Obafemi Awolowo University, Ile-Ife have been published (Ige, 2010). Other objectives of setting up the Museum include

To conduct research into the vast natural and cultural history of Nigeria;

To serve as a repository of natural and cultural objects in Nigeria;

To create scientific awareness on natural and cultural resources of Nigeria through annotated exhibitions for public enlightenment in display of galleries;

To prepare database on natural history and cultural resources in Nigeria to facilitate an information retrieval system on them for use by the public and the scientific community as a basis for sustainable development

To provide identification services on natural history and cultural objectives to user groups especially pest control workers in Archaeology, Agriculture, Veterinary and Human medicine.

According to Ige (2011), the Museum is currently organized into six scientific sections comprising of Botany, Entomology, Zoology, Earth Sciences, Paleontology and Archaeology/Anthropology. A hole unit of the museum is devoted to Illustration, Graphics, Taxidermy and Publication.

METHOD

Data for this study were collected through primary and secondary sources. The primary source of data includes both physical survey and questionnaire administration. The physical survey involved the reconnaissance of the University Campus to identify potential tourism sites. An inventory of the study area revealed some potential tourist sites, which formed the sample frame and these are represented in the Table 1 below.

TABLE 1: Tourism Sites in Obafemi Awolowo University, Ile-Ife

S/N	TOURISM SITES
1	Zoological Garden
2	Botanical Garden
3	Opa Dam
4	Natural History Museum
5	Aladura Mountain or Messiah Hills
6	Bat Colony
7	Architectural Buildings(e.g. Spider House, Architecture Department, Senate Building, Heziekiah Oluwasanmi Library, Music Department and so on.
8	Sculptural Park

Source: Author's fieldwork (2010)

Data for this study were collected through field surveys using a propulsive method of sampling over a period of 12 weeks. The questions in the questionnaire sought information from patrons of Natural History Museum on such variables as age, sex, marital status, education, place of origin, occupation, family size, car ownership, religious affiliation, purpose of patronage, mode of patronage, gate fees, frequency of patronage, duration or hours of patronage and quality of services given at this site.

Secondary sources include record of attendance, Dissertation, Theses and Journals. The study revealed that most of these sites had no record except Natural History Museum. This informed the selection of National History Museum as the sample size. Data analysis was carried out using simple frequencies and cross-tabulation of variables.

DATA ANALYSIS

This study was conducted using the natural history museum as one of the tourism sites on the campus. A survey was carried out through questionnaire administration in order to assess its patronage over a period of twelve weeks (Monday to Friday). The questionnaire were administered on 320 patrons who were selected propulsively.

Analysis of the socio-economic characteristics of the 320 respondents revealed that most of the respondents (75.3%) were male while the remaining (24.7%) are female. The age distribution of the respondents also revealed that majority of the respondents were less than 20 years of age (39.4%) and between 20 and 30 years (35.0%). This confirmed the information from the attendants in the museum that most of the patrons of the museum were students of the university and others from primary and secondary schools from within and outside the University community.

Likewise, the educational qualification of the respondents showed that some of them had secondary education (25.9%) and higher education (57.2%) respectively. The occupational distribution of respondents revealed that majority were students (65.6%) while others were civil servants (9.37%), traders (18.7%) and company or private workers (6.3%). All these indicate that the respondents were mainly students within the University environment and those that were coming for excursion on the campus. Therefore, with these categories of patrons to museum, it could be deduced that the patrons may be more satisfied to have variety in having different areas of interest to visit. It can then be said that the utilization of the identified tourism potentials on the University campus would attract more patrons, even of varying age, educational and occupational classes.

TABLE 2: Purpose of the Patronage of the Museum

Purpose	Frequency	Percentage
Sightseeing	82	25.6
Personal Relaxation	78	24.4
Religious/Spiritual	8	2.5
Picnic	22	6.8
Educational/Research	113	35.4
Convalescence	17	5.3
TOTAL	320	100.0

Source: Author's Survey, 2010

Table 2 above revealed that, patrons come to the museum for various purposes. The table showed that patrons come to the museum mainly for sightseeing (25.6%), personal relaxation (24.4%) and educational and research purposes (35.4%). It could be said from this analysis that people visit mainly for recreation and learning (85.4%). Therefore, the availability of the tourism potentials on the University campus, if maximized could enhance learning and improve recreational activities within the campus.

TABLE 3: Frequency of Visit to Tourist Centre

Visiting Period	Frequency	Percentage
Weekly	51	15.9
Monthly	76	23.8
Occasionally	193	60.3
TOTAL	320	100.0

Source: Author's Survey, 2010

Table 3 above gave insight that most people visit the museum occasionally (60.3%) and other patrons come weekly or monthly. The reason that can be adduced for this was that the weekly and monthly regular patrons might be University students that patronize the museum for academic purposes. Nevertheless, the occasional patrons to the museum were students from other educational institutions which include secondary and primary schools that are coming for excursion, sightseeing and relaxation. It could then be said that the occasional visits to the museum and the purpose of patronage (sightseeing and relaxation) indicate that the museums have tourism potential that could be maximized.

TABLE 4: Time Spent at the Museum

Time	Frequency	Percentage
Less than 1 hour	189	59.1
1 – 3 hours	131	40.9
Whole day	-	-
More than a day	-	-
Total	320	100.0

Source: Author's Survey, 2010

Table 4 revealed that 189 patrons (59.1%) spend less than an hour while 131 patrons (40.9%) spend one to three hours in the museum. However, no respondents spend a day or more in the museum. This might be because of the nature of operation of the museum that does not allow visits after working hours. This is an indication that the museum was having less economic impact as it was established in the literature that such short trips have less economic impact. Analysis of the respondents revealed that they spend between 1-3 hours while 59.1% spent less than one hour.

TABLE 5: Patronage to the Museum (1998 – 2006)*

Months	1998	1999	2000	2001	2002	2004	2005	2006
January	914	1171	1341	1467	1089	-	175	347
February	919	1365	1060	1069	1203	-	568	612
March	769	834	-	1057	2283	-	646	330
April	964	526	-	819	1844	-	775	491
May	1631	574	119	394	902	479	813	904
June	757	1320	172	973	660	816	1216	1026
July	637	1089	823	660	1027	517	933	-
August	1181	1552	1616	1448	1125	726	1057	-
September	1962	1150	1479	1267	731	799	603	-
October	1535	635	575	1637	520	440	456	-
November	1428	752	1291	1803	1310	328	410	-
December	1050	1809	1543	1352	843	510	792	-
TOTAL	13747	12777	10037	13946	13537	4615	8444	3710

* Data for some months (2000, 2004 and 2006) and year 2003 are not available.
Source: Natural History Museum, OAU, Ile-Ife, (2010)

From Table 5 above, it can be deduced that there was a downward trend in the rate of patronage of the museum. The decline from a total number of 13, 747 patrons in 1998 to 8,444 in 2005 was an indication that the patronage of the museum might not have effective economic impact on the economic development of the University and Ife communities. This might be because the museum was primarily established for education and research purposes. However, it can be financially sustained and better managed if there is a focus on its tourism potential, which could generate revenue to the local economy while the primary focus of education and research are also sustained.

The above not withstanding, the Director of the museum revealed during interview that visitors to the museum were charged ^5.00 as entry fee. This was the amount charged across the board since the inception of operation of the museum regardless of age, gender or social status.

However, the fee has been increased to ^50.00 since the completion and opening of the new ultra modern architectural complex in March 2011.

Table 6: Computed Gate Fees (1998 -2006)

Months	1998(^)	1999	2000	2001	2002	2004	2005	2006
January	4570	5855	6705	7335	5445		875	1735
February	4595	6825	5300	5345	6015		2840	3060
March	3845	4170	-	5285	11415		3230	1650
April	4820	2630	-	4025	9220		3875	2455
May	8155	2870	595	1970	4510	2395	4065	4520
June	3785	6600	860	4865	3300	4080	6080	5130
July	3185	5445	4115	3300	5135	2585	4665	
August	5905	7760	8080	7240	5625	3630	5285	
September	9810	5750	7375	6335	3655	3995	3015	
October	7675	3175	2875	8185	2600	2200	2050	
November	7140	3760	6455	9015	6550	1640	2050	
December	5250	9045	7715	6760	4215	2550	3960	
TOTAL	68,735	63,885	50,095	69,730	67,685	23,075	42,220	18,550

Source: Author's Fieldwork (2010)

The amount of money that had been collected as gate fees at ^5 per person are since 1998 on yearly basis are calculated and shown on table 6.The table showed that the months of August to November of every year had more revenue than other periods. This period seem to coincide with the beginning of session when students are less busy. It is also the period when fresh students come on campus.

SUMMARY OF FINDINGS, CONCLUSION AND RECOMMENDATIONS

Summary of Findings

The paper revealed that the University has many natural resources that could be developed for tourism purposes. The study reveals that many of these potentials are not optimally utilized. The study conducted on a tourism facility on the campus (the Natural History Museum) revealed that its use is not maximized. Analysis of the socio-economic characteristics of the 320 respondents revealed that most of the respondents (75.3%) were male while the remaining (24.7%) were female. Further analysis showed that patrons come to the museum mainly for sightseeing personal relaxation and educational research purposes with 25.6%, 24.4% and 35.4% respectively. The summary of frequency of visit showed that 60.3% people visit the museum occasionally and other patrons come weekly or monthly and that 189 patrons (59.1%) spend less than an hour while 131 patrons (40.9%) spend one to three hours in the museum. Findings also revealed that the museum would have been more functional if there had been a better focus on its tourism potentials (including its ability to generate revenue). This has made the patronage of the museum to be characterized by a downward trend leading to lesser income and thereby sapping the University revenue rather than generating income to improve the internally generated revenue of the University. There is substantial evidence to show that the small amount of gate fee collected had generated substantial sum over years. This money could be used to improve the services provided at the museum also make the organization self sustaining. This paper has also revealed that the University and Ile-Ife communities can benefit immensely if all the identified tourism potentials are developed and maximized.

CONCLUSION

Tourism is widely considered to be one of the sectors that provide the built environment opportunity to meet economic targets by generating revenue and promoting socio-economic development. In addition, it is evident that a well-developed tourist sites will boost the volume of patronage and consequently, the socio-economic developments of the host environment. Directing tourism growth toward local needs, interests, and limits can greatly enhance the value of tourism to the community and help create a sustainable built environment. Obafemi Awolowo University have the skills and resources for successful tourism development. Creating a local tourism development for international and national patronage is not a daunting task, but making tourism really fit in the community requires work.

RECOMMENDATIONS

*The university should have a policy on the utilization of the tourism sites to be self-sustaining by ensuring their continuous and effective maintenance.

*Partnership with private investors should be encouraged in order to allow external influx of money into the development and maintenance of these tourism sites.

*The University management should create awareness of the existence of these tourism sites on the University campus.

*There should be an upward review of the entrance fees to the Natural History Museum so as to ensure fund generation thereby improving the internally generated revenue of the University.

*The management of the university should as a matter of urgency address the development of the other tourist sites within the campus. This will create such multiplier effects in the areas of creating employment, boosting the internally generated revenue of the University and promoting the global image of the University and the city of Ile-Ife.

REFERENCES

Faborode, M.O. (2011) Speech Delivered by the Vice Chancellor,Obafemi Awolowo University, Ile-Ife at the Opening Ceremony of the New Building of the National History Museum, Ile-Ife.

Federal Republic of Nigeria (FRN) (2006) Nigeria Tourism Development Master Plan. Institutional Capacity Strengthening to the Tourism Sector in Nigeria. Final Report Executive Summary, January 2006

Friedmann, J. (1966). Regional Development Policy. Case Study of Venezuela. Cambridge Mass. M.I.T. Press.

Foan, L. and Franco, R. (2008) Measuring the Local Economic Impact of Tourism. In *Local Tourism in Guatemala, Honduras, and Nicaragua.* Washington D. C.: The SEEP Network

Hermansen, T.(1981). Development Poles and Development Centres in National and Regional Development. Element of theoretical framework in UNRISD Concepts and Theories of Growth Poles and Growth Centers.

Ige, Akin. (2011) Speech by the Director of National History Museum during the Commissioning of the New Building at OAU, Ile-ife.

Kreag. G. (2001). The Impacts of Tourism. University of Minnesota Publication

Kuklinshink, A. (1972). Growth Poles and Growth Centres in Regional Planning Morton, New York. Pp3

Myerscough, J. (1988). *The Economic Importance of the Arts in Britain*. London: Policy Studies Institute.

Myrad, P.G (1957). Economic Theory and Underdeveloped Regions, Methuen and Co. Ltd, London, pp 66-67

Omisore, E.O. and Akande, C.G. (2009). Accessibility Constraints of Patronage of Tourist Sites in Ondo and Ekiti, States, Nigeria. Ethiopian Journal of Environmental Studies and Management Vol.2 No.1.

Shah, K. and Gupta, V, (2000) Tourism, the Poor and other Stakeholders: Asian Experience. London: ODI Fair Trade in Tourism Paper.

Social Exclusion Unit Report (2003): Office of the Deputy Prime Minister, Eland House, London. www.socialexclusion.gov.uk

UNESCO (2005). Major issues in tourism development in the Asian and pacific Region: enhancing the role of tourism in socio-economic Development and poverty reduction. Bali, Indonesia.

(UNCSD {United Nations Commission on Sustainable Development}, 1999) Global Importance of Tourism. Commission on Sustainable Development Seventh Session 19- 30 April 1999, New York.

BIOCLIMATIC AND DESIGN STRATEGIES ANALYSIS TOWARDS THE IMPROVEMENT OF COMFORT IN SEMI-DETACHED HOUSES IN GHANA

David Nyame-Tawiah[1], Christian Koranteng[2] and Adeline Mawupemor Woyome[3]

1,3Research Centre for Building Performance and Design, Kumasi, Ghana

2Department of Architecture, Kwame Nkrumah University of Science and Technology, Kumasi, Ghana

A 10 month period of monitoring temperature and relative humidity values in semi-detached houses on the campus of the Kwame Nkrumah University of Science and Technology in Kumasi was studied. The thermal conditions prevailing in the spaces were analysed using recommended design strategies to achieve comfort, as well as the Bioclimatic Chart, modified for warm countries. The main purpose was to find out which of the sustainable design strategies (thermal mass, night ventilation, comfort ventilation, evaporative cooling, etc) and air velocity would have a commensurate effect on thermal comfort in Ghanaian semi-detached houses. The results showed that the most effective design strategy would be comfort ventilation. Further, the plots on the Bioclimatic Charts resulted in the use of an air velocity of $0.5 m.s^{-1}$ to attain comfort. This outcome implied that designers ought to enforce passive design recommendations in the orientation, placing of building elements and the use of efficient systems.

Keywords: bioclimatic, psychrometric, thermal comfort, ventilation.

INTRODUCTION

Thermal comfort is generally defined as a state of mind which displays satisfaction with the thermal environment. The main factors are temperature, humidity, air-movement and radiation. Over the years, researchers have attempted to provide a range of acceptable comfort indices which are normally referred to as the comfort zone. Previous studies have in-part concentrated on some of the factors of comfort (for instance, temperature in relation to activity, etc). According to Szokolay (2004), Olgyay introduced a chart in 1963 (the Bioclimatic Chart) with temperature and relative humidity on its axes. The chart has an aerofoil comfort zone in the middle, with the possibility of extension by air-movement and by radiation at high temperatures and low temperatures (Fig. 1).

The effect of $0.5 m.s^{-1}$ air-movement on thermal comfort has been reported by Gut and Ackerknect (1993) to have a cooling effect of 1 to 1.7 °C at a corresponding ambient temperature of 25 to 30°C.

[1] nyametawiahdavid@yahoo.co.uk

[2] rcbpd.ghana@yaho.com

[3] woyomeadeline@yahoo.com

Nyame-Tawiah, D., Koranteng, C. and Woyome, A.M. (2011) Bioclimatic and design strategies analysis towards the improvement of comfort in semi-detached houses in Ghana *In:* Laryea, S., Leiringer, R. and Hughes, W. (Eds) *Procs West Africa Built Environment Research (WABER) Conference*, 19-21 July 2011, Accra, Ghana, 193-202.

The most recent comfort indices used are the effective temperature and its standardised versions. These indices take activity and clothing into consideration (thus, at higher activity level, clothing is reduced). Further, slopes bordering recommended comfort zones on psychrometric charts (Fig. 2) are characterised by temperature tolerance (at higher humidities, temperature acceptance is reduced (Szokolay, 2004)).

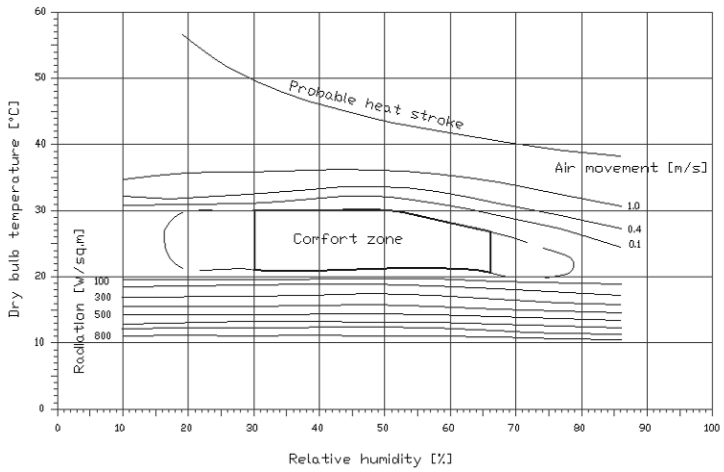


Fig.1: Olgyay's Bioclimatic Chart (Szokolay, 2004)

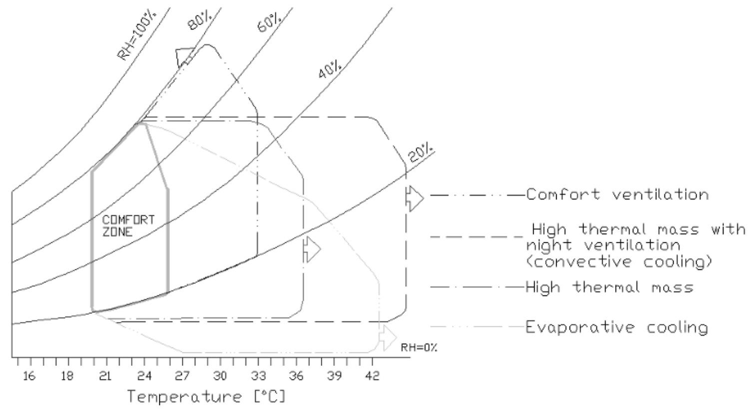


Fig.2: Comfort zone with recommended design strategies by Givoni and Murray (Lechner, 2001)

For tropical countries, a temperature range of 22 to 29°C as the comfort zone has been suggested by international and local researchers (Olgyay, 1963; Koenigsberger *et al.*, 1974; Ferstl, 2005; and Koranteng and Mahdavi, 2010).

Studies on design strategies on climatic zones, conditions and recommendations have been cited by Lechner (2001). Zones of design strategies to be implemented have been plotted on psychrometric charts (Fig. 2). The main zones recommended are comfort ventilation, the use of thermal mass, night ventilation and evaporative cooling.

The positive potential of thermal mass (depending on outdoor environmental conditions) and natural ventilation have been the focus of recent studies (Koranteng and Mahdavi, 2010 and, Mahdavi and Orehounig, 2009). The studies which were based on building performance simulations concluded that thermal mass and night ventilation could improve the thermal conditions of indoor spaces. This approach is however only efficient in regions with a high diurnal temperature difference of more than 10°C (Szokolay, 2004). With thermal mass, the building envelope and floors are used to store cool air during periods when the temperature outdoors is lower than indoors. The stored cool air is then released into the internal space whenever there is a temperature imbalance. Night ventilation is the use of outdoor air to cool building fabrics in the night whereas comfort ventilation can be used during the day. Comfort ventilation depends on air-movement and has been found to be appreciable at wind speeds of 0.2 to 1.0m.s^{-1} (Szokolay, 2004). Furthermore, comfort ventilation assists the evaporative cooling potential of the human skin.

Ghana is characterised by high temperatures and humid conditions. These conditions, in part, contribute to thermal discomfort in semi-detached houses. Most of the time, the outdoor air velocity is low and this is coupled with low diurnal ranges culminating in the inefficient use of thermal mass and comfort ventilation. Furthermore, sustainable design principles of orientation, shading, window sizes and positioning, efficient building materials, etc, are not exploited. Neither are scientific methods and low power consuming equipment (for instance, fans are capable of improving the thermal sensation of a space by 2-3°C (Hyde, 2000)) used to support design recommendations towards indoor comfort. Against the background of prevailing characteristics of the climate and practices in Ghanaian construction, it is imperative to find out which design strategies and air velocities work efficiently in Ghanaian houses. The solutions would help contribute to the few studies on thermal comfort in Ghana and narrow down the existing knowledge gap.

This paper analyses the thermal performance of semi-detached houses in warm and humid Ghana. The study is based on the bioclimatic chart modified for warm countries (see Szokolay, 2004) and design strategies recommended by Givoni and Murray in Lechner (2001).

RESEARCH METHOD

The study uses recommended charts and design strategies (see Szokolay, 2004 and Lechner, 2001) to analyse the thermal performance of semi-detached houses in Kumasi, capital of the Ashanti Region in Ghana. The twelve buildings under the study are situated on the campus of the Kwame Nkrumah University of Science and Technology (KNUST) and are called the "Four Star Estate" housing (Fig. 3). The thermal performance of the 4-star rated buildings is worth studying, since they are the only star-rated residential facilities on the campus of KNUST and are representatives of semi-detached dwellings in the region.

Fig.3: View of a semi-detached building, KNUST

Each detached unit has an area of ca. 90m² and contains a gracious entrance with the living area and kitchen oriented towards the north. Two bedrooms and a bathroom are situated at the rear (southern orientation) of the house, which are separated by a corridor to the northern oriented spaces. All the active spaces are cross ventilated and the corridors have windows on the eastern and western sides. The form aspect ratio of

1:1.80 per block is ideal for rectangular buildings with north-south orientations (Koranteng and Abaitey, 2010).

To analyse the thermal performance of the buildings, indoor sensors that measured the temperature and relative humidity values were mounted in the spaces (living area, kitchen, corridor and bedrooms). The monitored variables were limited to temperature and humidity because financial constraints prevented us from mounting sensors capable of observing occupancy patterns, light switching on and off activities, frequency of equipment usage, etc. The outdoor environmental conditions were also monitored. The observation period was 10 months, from September 2008 until June 2009. However, the data for the months of November and December was lost due to a malfunction of the loggers. The data loggers are capable of measuring temperature and relative humidity values from -20 to 70°C and from 5 to 95% with an error of ± 0.4 oC and ± 3% respectively.

To a large extent, the data gathered was processed with MS Excel, because of its high compatibility with a number of other applications. Other software applications used in the study were Greenline and Hoboware pro. Greenline was used to launch and download the files from the data loggers. The downloaded temperature and relative humidity values were screened in Hoboware pro software, after which the data points were exported to an MS Excel file. In MS Excel, the text files were imported, screened, and built together in monthly tables. Since the data was recorded in minute intervals, formulae sheets were generated to produce mean hourly values, and the output values were graphed in charts and analysed. Two charts were used for the graphs: a psychrometric chart with recommended design strategies and a bioclimatic chart which shows that different air-movement values should be employed to attain thermal comfort.

RESULTS

The mean monthly values tabulated and plotted in the charts show points of minimum and maximum temperature in relation to the prevailing relative humidity values. The points were joined with lines which indicate the monthly thermal behaviour of the respective spaces. Fig. 4 shows the mean monthly outdoor temperature and relative humidity values in relation to the comfort zone and the recommended design strategies. The mean outdoor values plotted in the modified bioclimatic chart for warm countries are illustrated in Fig. 5. The thermal behaviour prevailing in the bedroom is demonstrated in Fig. 6 and Fig. 7. Further, Figs. 8, 10 and 12 show the mean temperature and relative humidity values of the corridor, kitchen and living areas in relation to the comfort zone and design strategies. Demonstrations of the thermal conditions on the bioclimatic chart of the corridor, kitchen and living areas are shown in Figs. 9, 11 and 13.

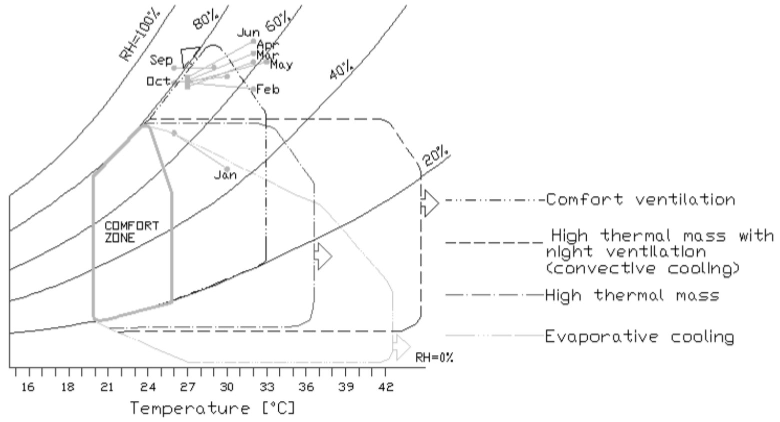


Fig.4: Mean monthly outdoor temperature and relative humidity values in relation to the comfort zone and design strategies

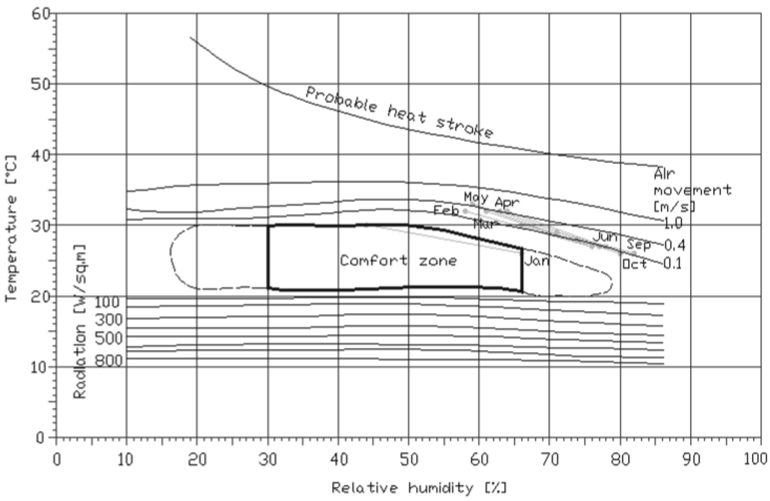


Fig.5: Mean monthly outdoor temperature and relative humidity values in relation to the comfort zone and air-movement

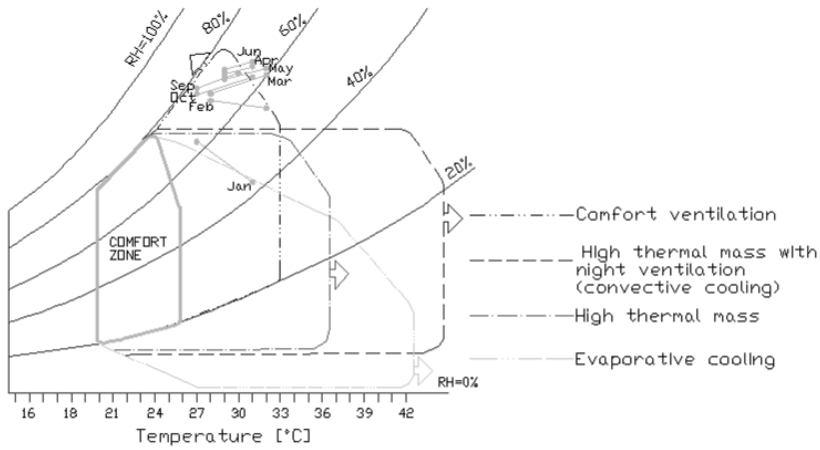


Fig.6: Mean monthly bedroom temperature and relative humidity values in relation to the comfort zone and design strategies

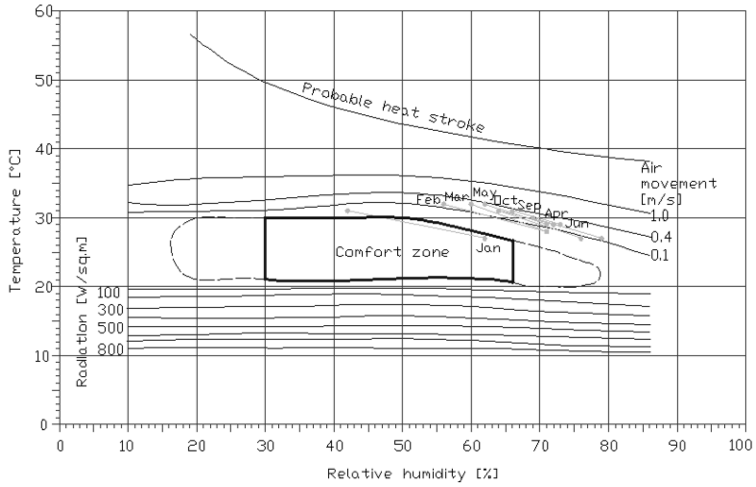


Fig.7: Mean monthly bedroom temperature and relative humidity values in relation to the comfort zone and air-movement

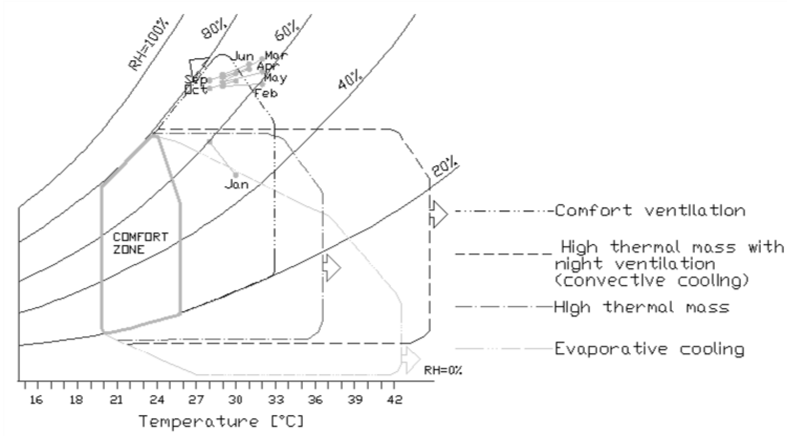


Fig.8: Mean monthly corridor temperature and relative humidity values in relation to the comfort zone and design strategies

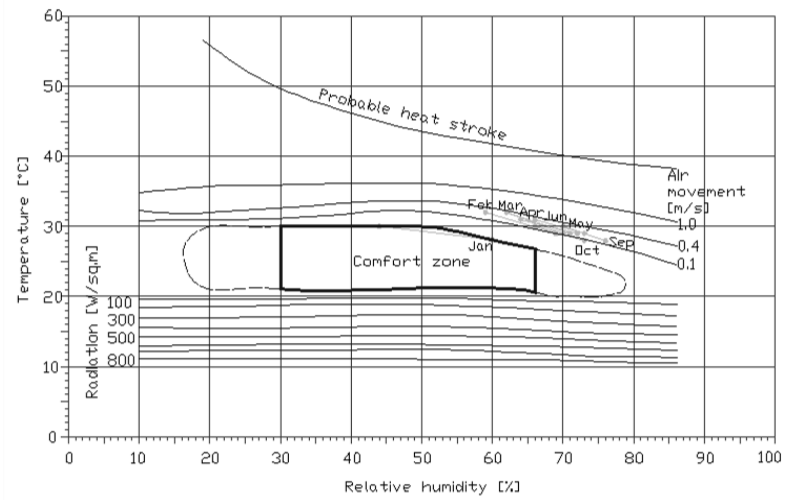


Fig.9: Mean monthly corridor temperature and relative humidity values in relation to the comfort zone and air-movement

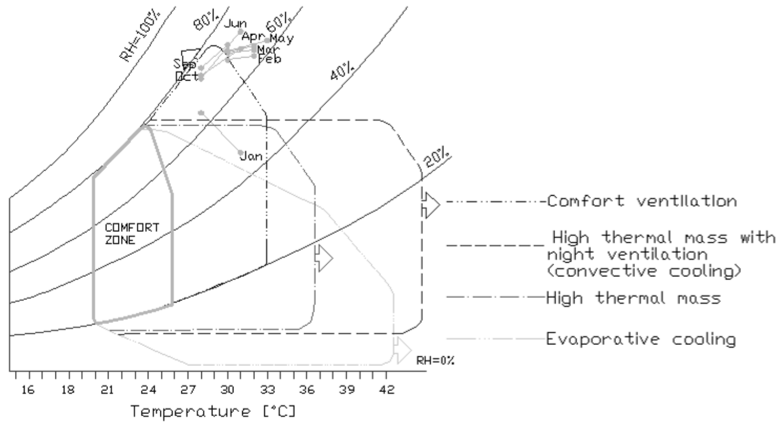


Fig.10: Mean monthly kitchen temperature and relative humidity values in relation to the comfort zone and design strategies

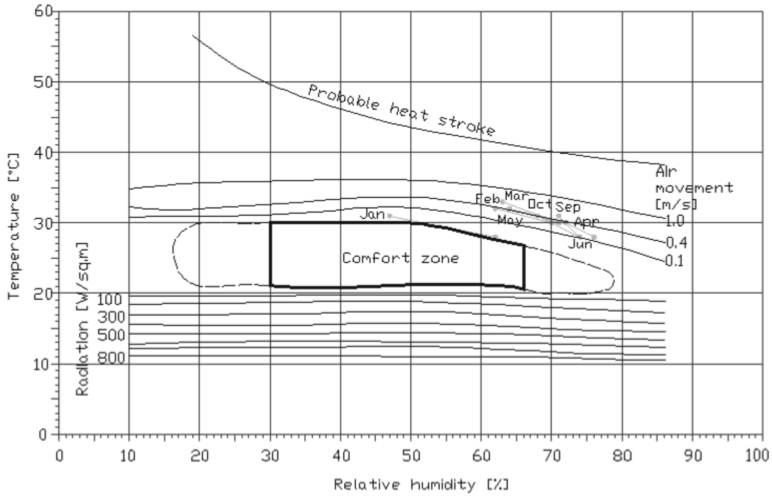


Fig.11: Mean monthly kitchen temperature and relative humidity values in relation to the comfort zone and air-movement

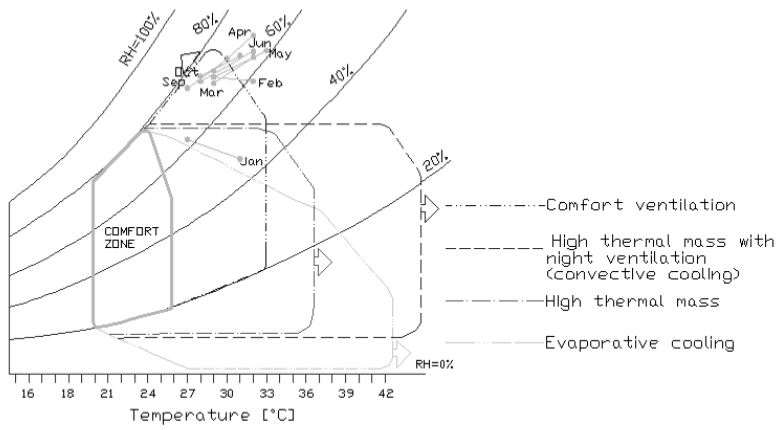


Fig.12: Mean monthly living room temperature and relative humidity values in relation to the comfort zone and design strategies

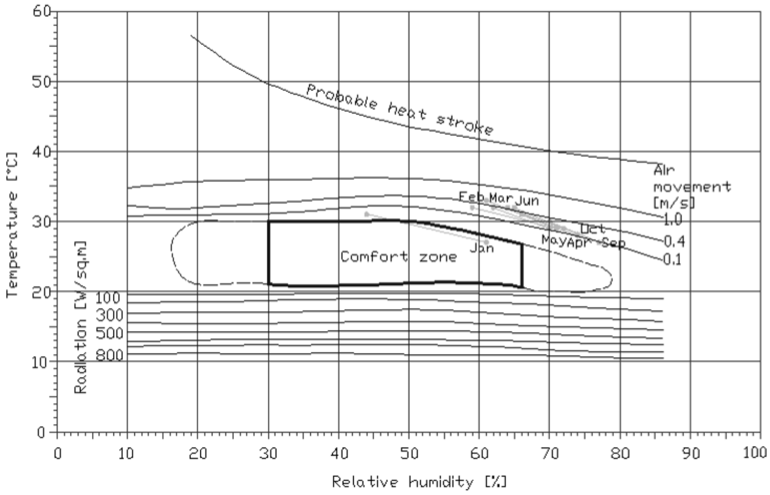


Fig.13: Mean monthly living room temperature and relative humidity values in relation to the comfort zone and air-movement

DISCUSSION

The mean outdoor temperature and relative humidity values plotted on the design strategies chart show that all monthly values are outside the comfort zone (Fig. 4). Furthermore, the design strategy to be employed in attaining thermal satisfaction is comfort ventilation. Thermal mass with night ventilation, high thermal mass and evaporative cooling characterize the month of January. Monthly points outside the comfort ventilation zone imply the use of conventional air-conditioning to achieve comfort. According to Fig. 5, the month of January is comfortable whilst during all other months, air-movement of about 0.5m.s-1 would be required for thermal comfort.

The thermal performance of the bedrooms oriented towards the south shows uncomfortable conditions. All the months are outside the general comfort recommendations (Fig. 6). Comfort ventilation and high thermal mass could be used as a design strategy for the month of January. However, the application of thermal mass as a design strategy would not be economical for the other months of the year. The only strategy that could prove efficient is comfort ventilation. In Fig. 7, the bioclimatic chart modified for warm countries shows most of the month of January to be comfortable. An extension of the comfort zone to 0.4m.s-1 air-movement would result in all months within the zone. The reason for the performance of the southern oriented spaces could be the inadequate overhang of the building in shading the building envelope. Even though the windows have been recessed and the spaces cross ventilated with an orientation towards 45° east of the prevailing wind direction, the effect of direct and reflected solar radiation could have contributed to the performance of the spaces (Lauber, 2005 and Heerwagen, 2004).

The thermal situation of the corridor was similar to that of the bedroom spaces. The plotted values in Fig. 8 show representations outside the general comfort zone. High thermal mass could improve the thermal performance of the space in January (Koranteng, 2010). However, the most effective approach towards thermal relief is comfort ventilation. An air velocity of 0.4m.s-1 would guarantee thermal comfort (Fig. 9).

The northern oriented kitchen space had temperature values of 28 to 34 °C and relative humidity values between 60 and 80% (Fig. 10). The relative humidity values fall within the recommended range for comfort (Ferstl, 2005). Conversely, most of the temperature values are above the maximum recommended value of 29 °C (Koranteng and Mahdavi, 2010). The frequent addition of latent and sensible heat from cooking in the kitchen space makes the room vulnerable to poor thermal performance. This is the main reason why cooking areas have to be placed in prevailing wind directions and if possible, separated from living areas. To attain comfort, the installation and use of fans (Hyde, 2000) with a velocity of 0.5m.s-1 would contribute to improving the performance of the space (Fig. 11). Furthermore, a comfortable and clean indoor environment can be achieved by the adoption of an effective ventilation system, both in terms of providing thermal comfort and removing contaminated air (Alamdari, 1994).

In Figs. 12 and 13, comfort ventilation and an air velocity of 0.4m.s-1 could provide comfort in the living room. Even though the space is oriented towards the cool northern side, it has poor indoor thermal conditions. The possible reasons for the behaviour of the space are the bedrooms and corridor spaces blocking air from the prevailing wind direction, direct and reflected solar radiation and conductive sensible loads from the attic space of the roof (Koranteng, 2010). The pressure difference created by temperature variations makes the size and position of windows in naturally ventilated buildings an important criterion in sustainable and passive building designs (Walker, 2010). Fans ought to be used in the building, since their effect would be a thermal sensation reduction of air temperature values of 2 – 3°C (Hyde, 2000). Late afternoon discomfort could be alleviated by using dehumidifiers; however, their energy consumption needs to be considered. The most imperative strategy would be the use of sustainable design principles of orientation, shading, ventilation, planting, insulation and efficient building materials (Dubois, 2008). In addition, buildings should be able to respond to changes in climate by rejection of solar heat, and have the thermal integrity to maintain internal comfort, despite the influence of climatic forces acting on the building envelope (Salmon, 1999).

CONCLUSION

To effectively study the thermal performance of semi-detached houses towards the improvement of comfort, staff bungalows at KNUST were thermally monitored over a period of 10 months. The main objective was to find out which sustainable design strategies and air velocities work efficiently in Ghanaian houses. The thermal values plotted on comfort and design strategies graphs showed conditions of discomfort in the building. These were due to the mean room temperature of above 30°C and relative humidity values of above 80% represented outside the comfort zone boundaries in the charts employed. The most effective design strategy to attain thermal satisfaction was found to be comfort ventilation. Further, an air velocity of $0.5m.s^{-1}$ was capable of achieving comfort in the buildings. The use of sustainable design principles of orientation, shading, and efficient building elements can contribute to thermal comfort sensation in houses and as such, these measures have to be employed by designers.

REFERENCES

Alamdari, F. (1994) “Applications of CFD in the Built Environment”, Microclimate Centre, BSRIA, Bracknell, England.

Dubois, P. (2008) Shaping Buildings for the Humid Tropics, (available at www.earthbagbuilding.com/pdf/shapingbuildings1.pdf).

Ferstl, K. (2005) "Fundamentals of Climatically Appropriate Building and Relevant Design Principles", In: Tropical Architecture by Lauber W., First Edition, Prestel Verlag, Munich, Germany.

Gut, P. and Ackerknecht, D. (1993) "Climate Responsive Building", First Edition, SKAT – Swiss Centre for Development and Cooperation in Technology and Management, Switzerland.

Heerwagen, D. (2004) Passive and Active Environmental Controls: Informing the Schematic Designing of Buildings, First Edition, McGraw Hill, New York, USA.

Hyde, R. (2000) Climate Responsive Design, First Edition, E and FN Spon, United Kingdom.

Koenigsberger, O. H., Ingersoll, T. G., Mayhew A. and Szokolay S.V. (1974). Manual of Tropical Housing and Building: part one, Climatic Design, First Edition, Longman Inc., New York, USA.

Koranteng, C. (2010) "The Energy Performance of Office Buildings in Ghana", Journal of Science and Technology, Ghana.

Koranteng, C. and Abaitey, G. E. (2010) "The Effects of Form and Orientation on Energy Performance of Residential Buildings in Ghana", Journal of Science and Technology, Ghana.

Koranteng, C. and Mahdavi, A. (2010) "An Inquiry into the Thermal Performance of Five Office Buildings in Ghana", 10th Rehva World Congress, Sustainable Energy Use in Buildings, CLIMA 2010, Antalya, Turkey, May 9 – 12, 2010.

Lauber, W. (2005) Tropical Architecture, First Edition, Prestel Verlag, Munich.

Lechner, N. (2001) Heating, Cooling, Lighting: Design Methods for Architects, Second Edition, John Wiley and Sons, Inc., New York, USA.

Mahdavi, A. and Orehounig, K. (2009) "Building Energy Use Via Intelligent Passive Cooling", 6te Internationale Energiewirtschaft, TU Wien, IEWT 2009.

Olgyay, V. (1963) Design with Climate: Bioclimatic Approach to Architectural Regionalism, First Edition, Princeton University Press, New Jersey, USA.

Salmon, C. (1999) Architectural Design for Tropical Regions, First Edition, John Wiley and Sons, Inc., New York.

Szokolay, S. (2004) Introduction to Architectural Science: The Basis of Sustainable Design, First Edition, Architectural Press, Oxford, UK.

Walker, A. (2010) Natural Ventilation, (available at www.wbdg.org/resources/naturalventilation.php).

BUILT ENVIRONMENT EDUCATION AND RESEARCH IN WEST AFRICA

Samuel Laryea[1]
School of Construction Management and Engineering, University of Reading, P.O. Box 219, Reading, RG6 6AW, UK

Built environment programmes in West African universities; and research contributions from West Africa in six leading international journals and proceedings of the WABER conference are explored. At least 20 universities in the region offer degree programmes in Architecture (86% out of 23 universities); Building (57%); Civil Engineering (67%); Estate Management (52%); Quantity Surveying (52%); Surveying and Geoinformatics (55%); Urban and Regional Planning (67%). The lecturer-student ratio on programmes is around 1:25 compared to the 1:10 benchmark for excellence. Academics who teach on the programmes are clearly research active with some having published papers in leading international journals. There is, however, plenty of scope for improvement particularly at the highest international level. Out of more than 5000 papers published in six leading international peer-reviewed journals since each of them was established, only 23 of the papers have come from West Africa. The 23 papers are published by 28 academics based in 13 universities. Although some academics may publish their work in the plethora of journals that have proliferated in recent years, new generation researchers are encouraged to publish in more established journals. The analyses of 187 publications in the WABER conference proceedings revealed 18 research-active universities. Factors like quality of teaching, research and lecturer-student ratio, etc count in the ranking of universities. The findings lay bare some of the areas that should be addressed to improve the landscape of higher education in West Africa.

Keywords: built environment, education, research, university, West Africa.

INTRODUCTION

The aim of the paper is to explore the built environment programmes offered in West African universities; and research contributions from West Africa at an international and regional level. The specific objectives are:

- To identify major universities in West Africa (WA) that offer programmes and research contributions in the built environment;
- To examine the range of the built environment programmes offered in different universities and the nature of the programmes; and
- To explore research contributions from West Africa published in leading international peer-reviewed journals and proceedings of the West Africa Built Environment Research (WABER) Conference (2009-11).

The rationale of the paper is not to provide a ranking of schools in the region; the purpose is merely to offer some insights on universities in the region that are playing a

[1] s.laryea@reading.ac.uk; salaryea@yahoo.com

Laryea (2011) Built environment education and research in West Africa *In:* Laryea, S., Leiringer, R. and Hughes, W. (Eds) *Procs West Africa Built Environment Research (WABER) Conference,* 19-21 July 2011, Accra, Ghana, 203-214.

leading role in the provision of academic programmes and research contributions in the built environment.

METHOD

Three main tasks were necessary. The first objective involved searching the websites of Education Ministries of all 16 WA countries to obtain a list of accredited universities. This was followed with a detailed searching of the websites of universities to identify the ones that offer built environment programmes such as architecture, building, engineering, quantity surveying, urban and regional planning, etc. Author addresses found in research publications in journals and database of the WABER conference also helped to identify some of the built environment departments. The second objective was achieved through analyses of data from websites of universities and firsthand information from academics. The papers by Vorster (2011), Abudayyeh *et al*. (2000) and Oglesby (1990) provided some of the theoretical context for construction education in universities. The third objective involved analysing research publications of academics teaching on the built environment programmes. This involved analyses at both international and regional level. The online databases of six leading built environment-related journals were searched to identify papers originating from WA. The journals chosen were based on a paper by Chau (1997) on the ranking of construction management journals. Bibliometric information available in Journal Citation Reports; Scopus; Journal Impact Factors; Thomson Reuters Web of Knowledge; and journal ratings of the Excellence in Research for Australia initiative also gave an indication of leading journals in the field. 187 publications in the proceedings of the WABER conference were also examined and analysed to trace the institutions and countries of authors. By bringing together all of this data for the first time, it has been possible to obtain some insights into the higher education landscape in WA the built environment programmes in universities, and the research contributions of academics in WA universities.

COUNTRIES AND UNIVERSITIES IN WEST AFRICA

The 16 countries in WA are developing countries that are pushing for socio-economic development (UN, 2010). Their average GDP is $1,397 (IMF, 2010).

Table 1: Universities in West African countries

Country	**Population (million)**	**Year of Independence**	**Official language**	**Number of universities**
Benin	9	1960	French	3
Burkina Faso	16	1960	French	1
Cameroon	19	1960 (France) 1961 (Britain)	French and English	13
Cape Verde	0.5	1975	Portuguese	10
Côte d'Ivoire	21	1960	French	6
Gambia	2	1965	English	1
Ghana	24	1957	English	59
Guinea	10	1958	French	6
Guinea-Bissau	1.6	1973	Portuguese	4
Liberia	4	1847	English	9
Mali	15	1960	French	10
Mauritania	3.5	1960	Arabic	9
Niger	15.5	1960	French	1
Nigeria	152	1960	English	195
Senegal	14	1960	French	6
Sierra Leone	6.5	1961	English	2
Togo	7	1960	French	1
Total	320.6			336

There are at least 336 universities across WA for a total population of 320.6 million people (see Table 1). From its establishment in 1962, Ahmadu Bello University based in Zaria, Nigeria is the largest university in Sub-Saharan Africa. The University of Monrovia, opened as Liberia College in 1862, is the oldest degree-awarding institution in WA. The universities in WA offer a wide range of degree programmes in the arts, education, engineering, medicine, social sciences, law, physical sciences, built environment, etc. The interest of this paper lies in built environment programmes. As a simple way to define 'built environment', it encompasses buildings and infrastructure, in their planning, design, management, operation, maintenance and disposal stages (Hughes, 2010). The analysis of universities from this point forward focuses mainly on universities in Ghana and Nigeria. The two countries have the largest number of universities (76%) in the region (Table 1). However, less than 50 percent are public universities funded by the state. The majority of universities are private-owned 'smaller' institutions with most affiliated to public universities.

BUILT ENVIRONMENT PROGRAMMES IN UNIVERSITIES

Tables 2 and 4 show some universities in West Africa that offer undergraduate and postgraduate programmes relating to the built environment.

Table 2: Built environment undergraduate programmes in some West African universities

University	*Country*	*Year established*	*Architecture / Design*	*Building / Building Technology*	*Civil / Env. Engineering*	*Estate/land Management*	*Quantity Surveying / Construction Economics*	*Urban and Regional Planning*
Abubakar Tafawa Balewa University	Nigeria	1980	●	●	●			
Ahmadu Bello University	Nigeria	1962	●	●			●	●
Anambra State University	Nigeria	2000	●					
Covenant University	Nigeria	2002	●	●	●	●		
Enugu State Uni. of Science and Tech.	Nigeria	1979	●	●	●	●	●	●
Federal University of Tech., Akure	Nigeria	1981	●		●	●	●	●
Federal University of Tech., Minna	Nigeria	1982	●	●	●	●	●	●
Federal University of Tech., Owerri	Nigeria	1980	●					
Federal University of Technology, Yola	Nigeria	1983	●	●	●		●	●
Kwame Nkrumah University of Science and Technology, Kumasi	Ghana	1961	●	●	●	●	●	●
Nnamdi Azikiwe University	Nigeria	1991	●	●	●	●	●	
Obafemi Awolowo University	Nigeria	1962	●	●	●	●	●	●
Olabisi Onabanjo University	Nigeria	1982	●					●
Osun State University	Nigeria	2006			●			●
Rivers State Uni. of Science and Tech.	Nigeria	1979	●	●	●	●	●	●
University of Benin	Nigeria	1970			●			●
University of Ibadan	Nigeria	1948			●			
University of Ilorin	Nigeria	1975	●		●			
University of Jos	Nigeria	1975	●	●		●	●	●
University of Lagos	Nigeria	1962	●	●	●	●	●	●
University of Nigeria, Enugu	Nigeria	1960	●			●		●
University of Nigeria, Nsukka	Nigeria	1960	●			●		●
University of Uyo	Nigeria	1991	●	●	●	●	●	●
			86%	57%	67%	52%	52%	67%

Notes: Programmes may not have the exact titles in universities. Other programmes include Project Management, Real Estate, Surveying, etc. The data here is a combination of information taken from university websites and firsthand information obtained from built environment academics in the region.

Undergraduate programmes

Table 2 shows some universities in WA and their built environment programmes. BSc programmes include Architecture, Building, Civil Engineering, Development Planning, Estate Management, Geoinformatics, Land Economy, Planning, Quantity Surveying and Construction Economics, Real Estate, Surveying and Urban and Regional Planning. Some universities also offer a combination of technical and vocational education programmes. The duration of BSc programmes in Ghana is four years. However, the duration of programmes in Nigeria is five years. For architecture, the duration tends to be for four years in the first instance plus one or two additional years for the Post Graduate diploma or MSc in Architecture. Much of the programme contents examined reflects little change over the years, but educational programmes should develop based on research into the phenomena we observe (Hughes, 2010), current trends and future directions. An approximation of lecturer-student ratios on built environment programmes in some universities is presented in Tables 3-7. The lecturer-student ratio gives a measure of the staffing level; this is often a criterion considered when ranking institutions. In the UK, staff-student ratio in institutions is calculated by the Higher Education Statistics Agency (HESA). A ratio of 1:10 is often considered as the benchmark for excellence.

Table 3: Built environment programmes at Obafemi Awolowo University

Programmes /Departments	No. of Lecturers	No. of Students	Lecturer/Student ratio
Architecture	20	235	1:12
Building	16	333	1:21
Estate Management	13	538	1:41
Quantity Surveying	09	272	1:30
Urban and Regional Planning	13	323	1:25
Total	71	1701	

Table 4: Built environment programmes at Federal University of Technology, Minna

Programmes /Departments	No. of Lecturers	No. of Students	Lecturer/Student ratio
Architecture	25	401	1:16
Building	14	383	1:27
Estate Management	20	660	1:33
Quantity Surveying	16	479	1:29
Surveying and Geoinformatics	11	320	1:29
Urban and Regional Planning	24	585	1:24
Total	110	2828	

Table 5: Built environment programmes at Kwame Nkrumah University of Science and Technology

Programmes /Departments	No. of Lecturers	No. of Students	Lecturer/Student ratio
Architecture	15	281	1:19
Building Technology	17	474	1:28
Land economy	11	457	1:20
Planning	17	528	1:31
Total	60	1740	

Table 6: Built environment programmes at Enugu State University of Science and Technology

Programmes /Departments	No. of Lecturers	No. of Students	Lecturer/Student ratio
Architecture	14	326	1:23
Building technology	7	411	1:59
Estate Management	13	428	1:33
Quantity Surveying	6	198	1:33
Surveying and Geoinformatics	7	143	1:20
Urban and Regional Planning	8	184	1:23
Total	55	1690	

Table 7: Built environment programmes at Federal University of Technology, Akure

Programmes /Departments	No. of Lecturers	No. of Students	Lecturer/Student ratio
Architecture	21	454	1:22
Estate Management	13	476	1:37
Industrial Design	11	324	1:29
Quantity Surveying	16	469	1:29
Surveying and Geoinformatics	2	13	1:7
Urban and Regional Planning	16	427	1:27
Total	79	2163	

The analyses in Tables 3-7 show that the average lecturer-student ratio on built environment programmes in selected WA universities is around 1:25. A lower lecturer-student ratio is often better in tertiary education context. A lecturer-student ratio of 1:25 may seem reasonable. However, a clear need for improvement becomes evident when the 1:25 statistic is compared to that of institutions where academics achieve prolific research publications. At the School of Construction Management and Engineering at University of Reading, for example, the lecturer-student ratio is 1:14. Improvements in lecturer-student ratio can enable staff and students to engage more effectively; reduce students' demand on staff time; and enhance time spent by staff on teaching preparation, personal development and research work if appropriate support is available. The findings by Aregbeyen (2010) on students' perceptions of effective teaching and effective lecturer characteristics in Nigeria should be addressed. Generally, many lecturers are not 'trained teachers' per se, although most have a PhD or equivalent qualification. To improve quality of teaching on programmes, the concept of teaching training for lecturers can be introduced by higher education councils and universities. Thus will provide opportunity for lecturers to acquire and develop teaching skills and techniques. In the US, training requirements for lecturers teaching civil engineering in universities are explored by Quadrato *et al*. (2005). In the UK, a postgraduate teaching qualification accredited by the Higher Education Academy (HEA) is almost compulsory for new university lecturers.

Postgraduate programmes

Most universities in Table 2 offer MSc and PhD programmes. The postgraduate (PG) programmes offered in some universities are shown in Table 8.

Table 8: Built environment postgraduate programmes in some WA universities

University	MSc/MPhil programmes	PhD programmes
Ahmadu Bello University, Nigeria	Building Services, Construction Management, Construction Technology, Building, Facilities Management, Landscape Architecture, Urban Design	Building Services, Construction Management, Construction Tech., Building, Facilities Management
Kwame Nkrumah University of Science and Technology, Ghana	Architecture, Construction Management, Development Planning and Management, Development Policy and Planning, Land Economy	Architecture, Development Studies; Planning, Building Technology
Obafemi Awolowo University, Nigeria	Architecture, Building, Civil Engineering, Estate Management, Quantity Surveying, Urban and Regional Planning	Architecture, Building, Civil Engineering, Estate Management, Planning
University of Lagos, Nigeria	Environmental Design, Landscape Architecture, Architecture, Construction Management, Construction Technology, Project Management, Estate Management, Urban and Regional Planning, Urban Design, Environmental Management, Environmental Design, Building Services, Facilities Management	Architecture, Building, Estate Management, Urban And Regional Planning

The duration of MSc programmes is officially two years and PhD is three years. Table 8 gives an idea of the range of academic programmes and staff expertise available at the postgraduate level.

RESEARCH CONTRIBUTION OF UNIVERSITIES IN LEADING JOURNALS AND WABER CONFERENCE PROCEEDINGS

Table 9: Research contribution from West Africa in six leading international journals

Author(s) institution	**Journal**	**Year**	**Research focus**
Kwame Nkrumah University of Science and Technology, Kumasi, Department of Building Technology, Ghana	IJPM	2011	Effect of integration on project delivery team effectiveness
University of Benin, Faculty of Engineering, Benin City, Nigeria	JME	2009	Unethical practices in Nigerian firms
Kwame Nkrumah University of Science and Technology, Kumasi, Centre for Settlements Studies, Ghana	ECAM	2009	Project management competencies
Ahmadu Bello University, Department of Quantity Surveying, Nigeria	ECAM	2009	Finance for healthcare facilities
Federal University of Technology, Akure, Department of Quantity Surveying, Nigeria Obafemi Awolowo University, Department of Quantity Surveying, Nigeria	CME	2006	Time-cost model
Kwame Nkrumah University of Science and Technology, Kumasi, Department of Building Technology, Ghana	CME	2005	Strategic planning by construction firms in Ghana
Osun State College of Technology, Department of Building, Nigeria Obafemi Awolowo University, Department of Building, Nigeria	CME	2004	Non-financial incentives
University of Lagos, Department of Building, Nigeria	IJPM	2002	Project leadership, team composition, performance
Obafemi Awolowo University, Department of Quantity Surveying, Nigeria	IJPM	2002	Effect of delay on project delivery
University of Lagos, Department of Building, Nigeria	JME	2002	Project leadership skills
Federal University of Technology, Owerri, Department of Project Management Technology, Nigeria	JCEM	2001	Methodology for determining price variation in project execution
Abubakar Tafawa Balewa University, Engineering and Quantity Surveying programme, Nigeria	JCEM	2001	Time-overrun factors in Nigeria
Ahmadu Bello University, Department of Civil Engineering, Zaria, Nigeria	BRI	1997	Solid soilcrete blocks for low-cost buildings
University of Benin, Department of Civil Engineering, Nigeria	JCEM	1995	Causes of high costs of construction in Nigeria
University of Benin, Department of Civil Engineering, Nigeria	CME	1995	Business environment of construction
Abubakar Tafawa Balewa University, Department of Civil Engineering., Nigeria	JCEM	1993	Construction cost factors in Nigeria
Obafemi Awolowo University, Faculty of Env. Design and Management, Nigeria	CME	1992	Cost information management
University of Jos, Department of Building, Nigeria	CME	1991	Evaluation and selection of projects
University of Ilorin, Department of Management Sciences, Nigeria	JCEM	1990	New approach to construction management
Obafemi Awolowo University, Department of Building, Nigeria	CME	1989	Production outputs in building trades
Obafemi Awolowo University, Department of Building, Nigeria	CME	1989	Operative productivity
University of Benin, Department of Civil Engineering, Nigeria	CME	1987	Contract arrangements
University of lfe, Building Department, Nigeria	BRI	1985	Pipe-Type Solar Water Heater

Notes: BRI = Building Research and Information; CME = Construction Management and Economics; ECAM = Engineering, Construction and Architectural Management; IJPM = International Journal of Project Management; JCEM = Journal of Construction Engineering and Management; JME = Journal of Management in Engineering. 23 papers in all from West Africa. The criterion for including a paper is the author(s) affiliation. The full citation for the papers can be found in the list of references. Frequency: 1980-1990 (4); 1990-2000 (7); 2000-present (12).

The third objective of the study was to explore the research contribution of built environment academics teaching on the programmes from an international and regional perspective. At an international level, the journals examined for papers from West Africa are: Building Research and Information; Construction Management and Economics; Engineering, Construction and Architectural Management; International Journal of Project Management; Journal of Construction Engineering and Management; and Journal of Management in Engineering (see Tables 9 and 10).

Table 10: Frequency of research publications from Ghana and Nigeria

Journal	Contributions from Ghana	Contributions from Nigeria
Building Research and Information (1973-date)	0	2
Construction Management and Economics (1983-date)	1	8
Engineering, Construction and Architectural Management (1994-date)	1	1
International Journal of Project Management (1983-date)	1	2
Journal of Construction Engineering and Management* (1957-date)	0	5
Journal of Management in Engineering (1985-date)	0	2
Proceedings of the West Africa Built Environment Research (WABER) Conference (2009-date)	62	127
Total	65	147

*The *Journal of Construction Engineering and Management* has been published since the late 19th century i.e. for 137 years under different titles (see Pietroforte and Stefani, 2004: 441)

The basis for the journal selection is explained in the introductory section of the paper. This was based primarily on a journal paper by Chau (1997) on the ranking of construction management journals; bibliometric information on journals; and journal ratings in research quality assessment frameworks. All data was collected through a rigorous search of online databases of the six journals. The author address was a primary factor used to identify the location and institution of the paper author(s).

Table 11: Frequency of research publications from institutions

Institution	Publications in Journals	Publications in proceedings of the WABER conference
Abubakar Tafawa Balewa University, Nigeria	2	2009 (1)
Ahmadu Bello University, Nigeria	2	2009 (5); 2010 (17); 2011 (14)
Anambra State University, Nigeria	-	2011 (1)
Covenant University, Nigeria	-	2009 (5); 2010 (1); 2011 (3)
Federal University of Technology, Akure, Nigeria	1	2010 (7); 2011 (18)
Federal University of Technology, Minna, Nigeria	-	2009 (1); 2010 (4); 2011 (8)
Federal University of Technology, Owerri, Nigeria	1	-
Federal University of Technology, Yola, Nigeria	1	2011 (1)
Kwame Nkrumah University of Science and Technology, Kumasi, Ghana	3	2009 (2); 2010 (9); 2011 (5)
Obafemi Awolowo University, Nigeria	7	2010 (4); 2011 (7)
Olabisi Onabanjo University, Nigeria	-	2011 (1)
Osun State College of Technology, Nigeria	1	-
Osun State University, Nigeria	-	2010 (1)
Rivers State University of Technology	-	2011 (2)
University of Benin, Nigeria	4	2010 (3)
University of Ilorin, Nigeria	1	-
University of Jos, Nigeria	1	2009 (3); 2011 (2)
University of Lagos, Nigeria	2	2009 (7); 2010 (8); 2011 (17)
University of Nigeria, Enugu	-	2011 (1)
University of Uyo	-	2011 (1)
Total	25*	2009 (25); 2010 (57); 2011 (92)

*Notes: *Papers with authors from multiple universities were credited to each institution*

Table 9 shows an audit of papers of WA origin in the six leading international journals since each of them was established (see Table 11). From a regional perspective, publications in the proceedings of the WABER Conference (i.e. 2009-2011) were examined and analysed. This provided additional insights into the research contributions of built environment academics in WA. The data in Table 5 shows that the 23 papers in leading journals are published by 28 academics based in 13 West African universities in a period of 25 years (1985-2011). The data in Table 11 shows that Obafemi Awolowo University plays a leading role in terms of research contributions at an international level although not in the last five years. Some academics at Kwame Nkrumah University of Science and Technology, Kumasi, Ghana have made strong contributions in recent years. There has also been a strong contribution from some academics at University of Benin, Nigeria.

It should be emphasised that the construction management or built environment field is primarily a field of application (Hughes, 1999). The ARCOM book edited by Langford and Hughes (2009) gives an international overview of the development of the construction management discipline. Built environment researchers tend to use theories from mainstream academic disciplines (such as economics, mathematics, law, management, organisational science, geography, engineering, physics, chemistry, etc.) to analyse and interpret their observations and phenomena of what happens in construction. An even better publishing achievement will be to publish some of our research papers in leading journals of mainstream disciplines. Construction may be different from other industries because of the way a set of factors interact simultaneously to have influence on projects (as explained in a textbook on economic theory and the construction industry by Hillebrandt, 2000). However, the underlying scientific, economic, management, organisational theories governing construction work is not too different from theories governing work in other industries. Publishing in leading built environment journals can be a reasonable starting point. However, built environment researchers should also aspire to publish in mainstream journals. Current themes like sustainability, innovation, digital practices, etc. should provide an increased opportunity to contribute towards mainstream thinking and theory.

DISCUSSION OF FINDINGS

Four main points are discussed in connection with the research objectives and findings. First, the data on development of tertiary education institutions in WA is interesting. As demonstrated in Table 2, most universities in WA were established by the state in the post-independence era. From the start of the colonial period in 1850 to 1948 when the University of Ghana was founded as the University College of the Gold Coast, no higher education institution was established in West Africa in almost 400 years of colonial rule. This situation created a serious educational and development backwardness for people in the region. Between 1957 when Ghana became the first Sub-Saharan Africa country to gain independence, and now, more than 336 universities have been established in WA in the last 50 years alone. Most universities were traditionally established and funded by the state. Nowadays, the private sector is playing an increasingly greater role in the provision of access to higher education. Lagos City Polytechnic, established in 1990, is the first private tertiary education institution in Nigeria. In Ghana, the Central University College, established in 1998, is the first private tertiary education institution. Since the establishment of these pioneering institutions, several private tertiary institutions have proliferated in Ghana, Nigeria and other WA countries, and a significant number of them are owned by religious establishments. It is, however, important to mention that some of the new universities owned by the private sector are competing well with the public universities established long before them.

Second, there are several universities in WA that offer programmes and research contributions in the built environment (see Table 2). The dominant built environment programme areas are Architecture, Building, Civil Engineering, Estate Management, Land Management, Quantity Surveying, Surveying and Geoinformatics, and Urban and Regional Planning. With time, academic staff expertise and increasing specialising of practice in the construction sector, new and specialised undergraduate and postgraduate programmes are likely to emerge alongside the traditional degree programmes. A paper on construction education by Oglesby (1990) discusses some of the possible approaches for expanding university programme offerings in built environment studies. Universities like Ahmadu Bello University (Nigeria); Federal University of Technology, Akure (Nigeria); Kwame Nkrumah University of Science and Technology, Kumasi (Ghana); Obafemi Awolowo University (Nigeria); University of Benin (Nigeria) and University of Lagos (Nigeria) are the ones playing a leading role in the region when it comes to the provision of academic programmes and research contributions in the built environment. Unsurprisingly most of these universities are ranked among the top 100 universities in Africa (http://www.4icu.org/). On programme quality and relevance, it is important to update built environment programmes from time to time in line with changing national and global needs and trends (see paper by Abudayyeh *et al.*, 2000 which explores a wide array of issues on construction engineering and management undergraduate education). In the area of quantity surveying for example, a book by Cartlidge (2002) shows new aspects of quantity surveying practice arising from industry changes and new procurement methods in the UK.

Third, the data shows that built environment academics in WA are clearly research active. The dominant broad focus of the journal papers from West Africa has been on cost, time, project teams, contract arrangements, business environment of projects, productivity, incentives and business practices in firms (see Table 9). The frequency of publication of papers from WA in the six journals has proved to be increasing (see Table 9): 1980-1990 (4); 1990-2000 (7); 2000-present (12). However, this is a relatively small fraction compared to more than 5000 papers published in the six journals since each of them was established. Further details of regions where most journal papers originate from can be seen in a review paper by Abudayyeh et al. (2004). To increase research activity and contributions in journals and conferences will require greater collaboration with industry for research funding and access to data. Tables 10 and 11 show the frequency of publication of 212 papers from Ghana and Nigeria in journals (11%) and proceedings of the WABER conference (89%). For journal publications, the ratio of contributions from Ghana and Nigeria is 1:7. In interpreting the result, it is imperative to take the 1:7 population ratio of the countries into account including the 1:4 ratio of number of universities (see Table 1).

Fourth, the overall research statistics in Tables 10 and 11 shows a low level of high quality research output from the region. This conclusion has been earlier demonstrated in analyses of construction management research publications in papers by Abudayyeh et al. (2004); Pietroforte and Stefani (2004) and Pietroforte and Aboulezz (2005). Although academics in West African institutions may publish their work in the plethora of other journals that have proliferated in recent years, it would clearly be worthy for them to direct some of their high quality research output for publication in the more established journals as this can enhance their research profile. As articulated in a keynote paper by Hughes (2005) on the publication process for refereed journal papers, "The most important feature of an academic CV is the list of publications. It is not just the quantity that matters, but where they are published." It is fair to suggest that bibliometric information freely available in Journal Citation Reports; Scopus; Journal Impact Factors; Thomson Reuters Web of Knowledge; etc. should give researchers an indication of leading journals in the field and the best places to publish high quality work. Research quality counts in the ranking of universities and the academic environment in a university. Universities should support their academics to develop their research profile and output. Academics should also make a conscious effort to do and publish their research work in the best outlets. In institutions and environments where researchers may not have direct access or subscription to the literature in leading journals, collaborations with colleagues elsewhere can provide a useful means for overcoming the challenge.

CONCLUSIONS

The aim of the paper was to explore the built environment programmes offered in universities in West Africa; and some of the research contributions of academics teaching on the programmes. Academic programmes in 20+ universities were explored. The major programmes are Architecture, Building, Civil Engineering, Estate Management, Quantity Surveying, Surveying and Geoinformatics, and Urban and Regional Planning. Academics teaching on the programmes are clearly research active with some having published in leading international journals. However, the publication statistics of papers from West Africa shows that there is plenty of scope for improvement especially at the highest international level. Although some academics may publish their work in the plethora of journals that have proliferated, it would be worthy to publish high quality research output in more established journals. The analyses of 187 publications in the proceedings of the WABER conference, 2009-11, revealed 18 research-active universities.

The interpretation of the results flowing from this work requires careful consideration of its limitations. First, the analysis of research papers in journals was limited to six leading international journals. Another point is that the six journals examined here may not cover all areas of the built environment. There are a plethora of other journals that also provide an outlet for the dissemination of built environment research findings. Second, the conference papers examined and analysed were based on only papers published in the proceedings of WABER conference (2009-11). There may be other conferences that West African academics attend and get their papers published in the proceedings. Third, apart from information that was obtained directly from built environment academics in the region, some of the information examined in this paper was taken from the official websites of universities where there is a risk that some of the information might not have been updated to cover current information on programmes. Regardless of the study limitations, the need to refresh and improve built environment academic programmes in tune with current and future national and international trends and standards is clear. Participation in forums like the WABER conference can help. The WABER conference provides an ideal opportunity for built environment researchers in West Africa to interact, develop their research profile and disseminate their research work. The conference also provides an opportunity for researchers to develop new knowledge and collaborations with colleagues based elsewhere. Through these objectives, the WABER conference serves a major vehicle for developing built environment education and research in West Africa.

REFERENCES

Abejide, O. S. (1997) Solid soilcrete blocks for low-cost buildings: a Nigerian case study, *Building Research and Information*, 25(2), 115-119

Abudayyeh, O., Dibert-DeYoung, A., and Jaselskis, E. (2004) Analysis of trends in construction research: 1985:2002, *Journal of Construction Engineering and Management*, 130(3), 433–439.

Abudayyeh, O., Russell, J., Johnston, D. and Rowings, J. (2000) Construction engineering and management undergraduate education, Journal of construction engineering and management, 126(3), 169-175

Ahadzie, D.K., D.G. Proverbs, P.O. Olomolaiye, N.A. Ankrah, (2009) Competencies required by project managers for housing construction in Ghana: Implications for CPD agenda, *Engineering, Construction and Architectural Management*, 16(4), 353-375

Aibinu A. A. and Jagboro, G. O. (2002) The effects of construction delays on project delivery in Nigerian construction industry, *International Journal of Project Management*, 20(8), 593-599

Akintoye, A.S., Ajewoleb, O. Olomolaiye, P.O. (1992) Construction cost information management in Nigeria, *Construction Management and Economics*, 10(2), 107-116

Akpan, E. O. P. and Igwe, O. (2001) Methodology for determining price variation in project execution, *Journal of Construction Engineering and Management*, 127(5)367-373

Alutu, O. E. and M. L. Udhawuve (2009) Unethical Practices in Nigerian Engineering Industries: Complications for Project Management, *Journal of Management in Engineering*, 25(1), 40-44

Anaman, K. A. and Osei-Amponsah C. (2007), Analysis of the causality links between the growth of the construction industry and the growth of the macro-economy in Ghana, *Construction Management and Economics*, 25(9), 951-961

Aniekwu, A. (1995) The business environment of the construction industry in Nigeria, *Construction Management and Economics*, 13(6), 445-455

Aniekwu, A.N. and Okpala, D.C. (1987) The effect of systemic factors on contract services in Nigeria, *Construction Management and Economics*, 6(2), 171-182

Aregbeyen, O. (2010) Students perceptions of effective teaching and effective lecturer characteristics at the University of Ibadan, Nigeria, *Pakistan Journal of Social Sciences*, 7(2), 62-69

Cartlidge, D. (2002) New aspects of Quantity Surveying practice, Oxford: Butterworth-Heinemann

Chau, W. K. (1997) The ranking of construction management journals, *Construction Management and Economics*, 15(4), 387-398

Dansoh, A. (2005) Strategic planning practice of construction firms in Ghana, *Construction Management and Economics*, 23(2), 163-168

Elinwa, A.U.E. and Joshua, M. (2001) Time-overrun factors in Nigerian construction industry, *Journal of Construction Engineering and Management*, 127(5), 419-426

Elinwa, A. U. and Buba, S. A. (1995) Construction cost factors in Nigeria, *Journal of Construction Engineering and Management*, 121(3), 330

Elinwa, A. U. and Buba, S. A. (1993) Construction cost factors in Nigeria, *Journal of Construction Engineering and Management*, 119(4) 698-713

Fernie, S. and Leiringer, R. (2009) The construction management field: a bit of a dig. In proceedings of 5th Nordic Conference on Construction Economics and Organisation, vol. 1, Reykjavik, Iceland, June 10-12. pp. 110-120

Hillebrandt, P.M. (2000) Economic theory and the construction industry, 3ed. London: Macmillan

Hughes, W.P. (2010) Built environment education, research and practice: Integrating diverse interests to make an impact In: Laryea, S., Leiringer, R. and Hughes, W. (Eds) Procs West Africa Built Environment Research (WABER) Conference, 27-28 July 2010, Accra, Ghana, 1-8

Hughes, W. (2005) Keynote paper to The 2nd Scottish Conference for Postgraduate Researchers of the Built and Natural Environment (PRoBE), Glasgow Caledonian University, UK, 16-17 November 2005

Hughes, W.P. (1999) Construction research: a field of application. Australian Institute of Building Papers, 9, 51-58

Ibrahim, A.D., Price, A.D.F. and Dainty, A.R.J. (2009) Evaluation of key practices under the Local Improvement Finance Trust (LIFT) initiative for UK healthcare facilities, *Engineering, Construction and Architectural Management*, 16(5), 504-518

International Monetary Fund (2010) World GDP (PPP) and Country population, World Economic Outlook Database-October 2010, Accessed on 23 April 2011

Kalu, T.C.U. (1990) New approach to construction management, *Journal of Construction Engineering and Management*, 116(3), 494-514

Kennedy, D. (1997) Academic Duty, Boston: Harvard University Press

Langford, D. and Hughes, W. (2009) (Eds) Building a discipline: The story of construction management, Reading: Association of Researchers in Construction Management

Laryea, S., Leiringer, R. and Hughes, W. (Eds) (2010) *Proceedings of the West Africa Built Environment Research (WABER) Conference*, 27-28 July 2010, Accra, Ghana. pp. 670 ISBN 978-0-9566060-0-6

Ngoka, N. I. (1985) A Simple Pipe-Type Solar Water Heater, *Building Research and Information*, 13: 3, 166-169

Odia, L.O. and Omofonmwan S.I (2007) Educational system in Nigeria problems and prospects, *Journal of Social Sciences*, 14(1): 81-86

Odusami K. T. (2002) Perceptions of Construction Professionals Concerning Important Skills of Effective Project Leaders, *Journal of Management in Engineering*, 18(2) 61-68

Odusami, K.T., Iyagba, R.R.O. and Omirin, M.M. (2002) The relationship between project leadership, team composition and construction project performance in Nigeria, *International Journal of Project Management*, 21(7), 519-527

Oglesby, C.H. (1990) Dilemmas facing construction education and research in 1990s, *Journal of Construction Engineering and Management*, 116(1), 4-17

Ogunsemi, D. R. and Jagboro, G.O. (2006) Time-cost model for building projects in Nigeria, *Construction Management and Economics*, 24(3), 253-258

Okpala, D. C. (1991) Evaluation and selection of construction projects in Nigeria, *Construction Management and Economics*, 9(1), 51-61

Okpala, D.C. and Aniekwu, A. N. (1988) Causes of high costs of construction in Nigeria, *Journal of Construction Engineering and Management*, 114(2), 233-245

Olabosipo I. Fagbenlea, O.I., Aderemi Y. A., Adesanya, D.A. (2004) The impact of non-financial incentives on bricklayers' productivity in Nigeria, *Construction Management and Economics*, 22(9), 899 - 911

Olomolaiye, P. O. and Ogunlana, S. O. (1989) An evaluation of production outputs in key building trades in Nigeria, *Construction Management and Economics*, 7(1), 75-86

Olomolaiye, P. O. and Ogunlana, S. O. (1989) A system for monitoring and improving construction operative productivity in Nigeria, *Construction Management and Economics*, 7(2), 175-186

Pietroforte, R., and Stefani, T. P. (2004) ASCE Journal of Construction Engineering and Management: Review of the years 1983–2000, *Journal of Construction Engineering and Management*, 130(3), 440-448

Pietroforte, Roberto and Aboulezz, Mohamed (2005) ASCE Journal of Management in Engineering: Review of the years 1985-2002, Journal of Management in Engineering. 21(3), 125-130

Quadrato, C., Welch, R.W., and Albert, B.C. (2005) Training Faculty to teach Civil Engineering, Journal of Professional Issues in Engineering Education and Practice, 131, 111-117

Vorster, M.C. (2011) Teaching and learning: The critical balance in effective education, Journal of Const. Eng. and Mgt., doi:10.1061/(ASCE)CO.1943-7862.0000295.

CAPACITY-BUILDING IN CONTRACT ADMINISTRATION: KEY TO EFFECTIVE UTILIZATION OF DISTRICT ASSEMBLY COMMON FUND OF INFRASTRUCTURAL DEVELOPMENT

Michael A. Boadu[1], Joseph Eshun[2] and Emmanuel Opoku-Ware[3]
[1,2]*Human Resource Office, Takoradi Polytechnic, P. O. Box 256, Takoradi, Ghana*
[3]*Sunyani Polytechnic, Sunyani, Ghana*

The aim of the study is to examine the utilization of District Assembly Common Fund (DACF) under the capacity- building in contract administration to infrastructural developments. A capacity-building course in contract administration was organized for the staff of the Tender Boards of twelve District Assemblies in the Brong-Ahafo Region of Ghana. A self-reported instrument was used to measure participants' knowledge on contract administration. Sixty-nine per cent of the participant agreed that they had never attended any training in contract administration and 31per cent had no knowledge about contract administration. However, 99 per cent participants agreed that capacity building would help them to overcome the deficiencies in the administration of infrastructural projects in their District Assemblies. It is recommended that training seminars and workshops should be organized for all relevant contract administration staff in District Assemblies as a matter of government policy.

Keywords: contract administration, District Assembly, District Assembly Common Fund, Tender Board.

[1] micky15151@yahoo.com

Boadu, M.A., Eshun, J. and Opoku-Ware, E. (2011) Capacity-building in contract administration: key to effective utilization of District Assembly Common Fund of infrastructural development *In:* Laryea, S., Leiringer, R. and Hughes, W. (Eds) *Procs West Africa Built Environment Research (WABER) Conference*, 19-21 July 2011, Accra, Ghana, 215-215.

CASUAL WORKERS PREFERENCE OF OCCUPATIONAL HEALTH AND SAFETY ITEMS ON BUILDING CONSTRUCTION SITES IN GHANA; A KUMASI STUDY

Frederick Owusu Danso[1], Edward Badu[2] and Divine Kwaku Ahadzie[3]

1Department of Building Technology, Takoradi Polytechnic, Takoradi, Ghana

2College of Architecture and Planning, Kwame Nkrumah University of Science and Technology, Kumasi, Ghana

3Centres for Settlements Studies, Nkrumah University of Science and Technology, Kumasi, Ghana

The Ghanaian construction industry noted as a provider of employment and as a driver of economic growth is fraught with occupational health and safety issues. Employers of casual workers provide them substandard welfare facilities and safety materials. This paper aimed at the establishment of preference of casual workers to the provision of substandard welfare facilities and safety materials. Observations followed by a questionnaire survey were used to elicit from casual workers on their preference for occupational health and safety items involving their engagement. The items were grouped under two major thematic areas, namely welfare facilities and safety items, and the casual workers were asked to indicate their preference on 5-point rating scale. The findings reveal that, the casual workers preference for welfare facilities were in the order of safe drinking water (ranked 1st), suitable accommodation for resting (ranked 2nd), sanitary facilities (ranked 3rd), first-aid equipment (ranked 4th) and water for washing (ranked 5th), while for safety items the following emerged; safety boots (ranked 1st), safety signs (ranked 2nd), hard hats or helmet (ranked 3rd), training in safety (ranked 4th) and safety glasses (ranked 5th). One sample statistics supported the findings suggesting that the findings could have wider relevance in Ghana. Given that casual workers now account for about 70-90% of the construction labour workforce in Ghana. The findings have implications for both contractors' safety management strategies and also policy direction in future safety guidelines for improving health and safety practices on Ghanaian construction sites.

Keywords: casual worker, occupational health and safety.

INTRODUCTION

The construction industry plays an important role in any economy and its activities are also vital to the achievement of the socio-economic development goals of providing shelter, infrastructure and employment (Anaman and Osei Amponsah, 2007). In Ghana, just like many other developing countries the construction industry is playing a vital role in achieving socio-economic development goals, providing shelter, infrastructure and employment, and above all contributing significantly to the GDP of the country. For instance, since 2003 to 2008, the industry has consistently provided

[1] ofreddanso@yahoo.com
[2] edwardbadu@yahoo.com
[3] Divinedka10@yahoo.com

Danso, F.O., Badu, E. and Ahadzie, D.K. (2011) Casual workers preference of occupational health and safety items on building construction sites in Ghana; a Kumasi study *In:* Laryea, S., Leiringer, R. and Hughes, W. (Eds) *Procs West Africa Built Environment Research (WABER) Conference,* 19-21 July 2011, Accra, Ghana, 217-227.

an average GDP growth of 6.1% to the economy (ISSER 2005, Anaman and Osei Amponsah, 2007, IYF 2009, IMF 2009, DI 2009).

It is worth noting one of the main agenda of the Millennium Development Goals (MDGs) and The Ghana Poverty Reduction Strategy II (GPRSII), is to address human development issues of which, Cotton et al (2005) noted that the agenda is achievable by the provision of infrastructure for services and employment through the construction industry if health and safety on construction sites are improved to promote and sustain efficiency.

However, despite this strategic importance of the Ghanaian construction industry, it is fraught with occupational health and safety (OHS) issues. For example, it was reported that the construction industry, recorded 902 accident cases comprising 56 fatalities in 2000 and 846 non-fatal accidents (Danso, 2005). In that same report, Kumasi (the regional capital of Ashanti Region) alone recorded 124 construction fatalities from 1999 to 2004. In attempting to find the causes of this breach in Occupational Health and Safety issues, a number of factors are discussed and researched, among them the rise and the increasing use of casual labour on construction sites in Ghana.

Danso (2010) asserted the occupational health and safety issues of casual workers in the Ghanaian construction industry have been compromised in that 60% of Ghanaian contractors provide substandard welfare facilities and safety materials on construction sites. It is contended that with the increasing use of casual workers in many developing countries such as Ghana, there is the need for their perceptions of OHS to be fully understood towards building a collaborative framework for addressing the shortcomings arising from occupational health and safety issues. Thus the perceptions of casual workers on what should constitute the important Occupational Health and Safety items on site are sought and presented.

The paper starts by first putting into perspective the significant contribution that the Ghanaian Construction Industry is making to the economy in recent times. This is then followed by the situation of casual workers in the Ghanaian construction industry, making references to other developing countries. The next, is the discussions of the data collected and its analysis, having considered the framework that governs casualisation. The subsequent section discusses the findings of the study. The conclusion and recommendations follow after this section. Acknowledgement and the list of references are detailed at the end of the paper.

THE SIGNIFICANCE OF THE GHANAIAN BUILDING CONSTRUCTION INDUSTRY

As stated earlier on in the introduction, the construction industry plays an important role in the economy of Ghana (Anaman and Osei Amponsah 2007). Indeed, the interdependence between the construction sector and the Ghanaian economic has been addressed by various writers and in all cases, there is evidence indicating a direct link of the potential between investment in construction and economic growth (Anaman and Osei Amponsah, 2007; ISSER, 2005, IYF 2009, IMF 2009, DI 2009). Indeed in 2003 to 2008, the Ghanaian construction industry has consistently provided an average GDP growth of 6.1% to economy (see for instance Figure 1).

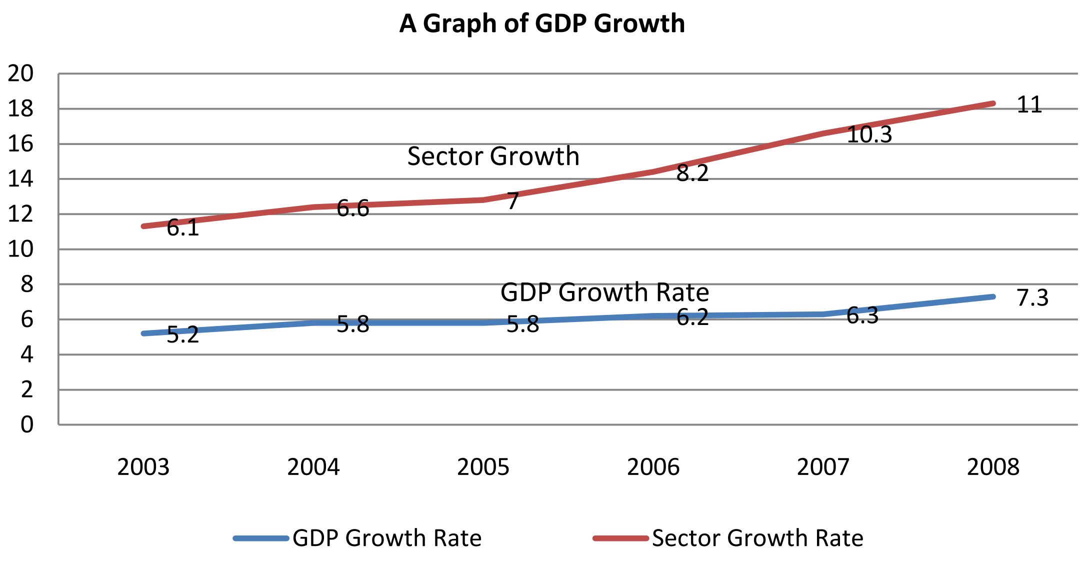


Figure 1: Contributions Construction Industry to GDP
Source: Anaman and Osei Amponsah, 2007; ISSER, 2005, IYF 2009, IMF 2009, DI 2009

Figure 1 indicates that, the construction industry in Ghana, as at 2003 had a GDP growth of 5.8% and experienced a constant GDP growth of about 5.8 % from 2004 to 2005. This remarkable consistent growth increased to 6.2 % in 2006. In 2007, it had picked up again from 6.2 % and peaked at 7.3% in 2008.Following the emergence of Ghana as an oil producing country, it is projected that the construction industry will grow stronger at an unprecedented rate of 13% (ISSER, 2008). It should be noted that concomitant with this projected growth is the increasing use of casualization with its attendant occupational health and safety challenges.

CASUAL WORKERS AND THE GHANAIAN CONSTRUCTION INDUSTRY

Rasell et al (1997) in their view defined casual work as a non-traditional employment in the absence of regular full-time work and it is characterised by non continuing work. Some writers have concluded that the services of these workers are temporal. They are required when the need arises, and are laid off when the assigned task (the task period is usually short) is over (Sheehan et al 2006; Brooks, 1985; Carter, 1990: Creighton el al, 1994; Dawkings et al, 1990). Buchanan (2004) defined casual worker as an individual who is hired on temporal basis, often for one day at a time. Mitullah et al (2003) further defined a causal worker to include all construction workers who are employed on a casual or temporal basis without any proper form of contract. Thus individual workers, either working alone or in groups, who undertake temporal work without any contract, are known as casual workers, labourers, temporary workers or day labourers.

Indeed, the fragmented nature of the construction industry, its transient nature and especially the fluctuating nature of jobs execution makes it unattractive for contractors to keep a lot of permanent workers, making construction firms rely enormously on the use of casual workers (Africa Development, 2007). The extent of employment of casual workers in the construction industry in developing countries has been documented by some researchers, and there is evidence to show that the practice has grown in recent years. For example in Sri Lanka, workers on building sites revealed 82% of the skilled workforce and 93% of the unskilled workforce were employed as casual workers (Jayawardane et al, 1998). Vaid (1999) also indicated that, an estimated 73% of construction workers in India were recruited on casual basis. Again, the proportion of casuals in Malaysia increased slightly from 71% in 1983 to 74% in 1998 (Abdul- Aziz, 2001). The trend is not different in Philippines, where construction companies continue to downsize their regular workforce. It is estimated that 85% of the 1.35 million wage and salaried workers in the construction industry in January 2000, were casual workers or project-based employees (Yuson, 2001). Mitullah et al, (2003) also indicated that there is a high level of casualization on all the construction sites in Tanzania. At least 70% of workers on each site were found to be employed on casual basis and on some sites the number is as high as 96%. In India, Wells (2007) reported that casual workers in the construction workforce increased in 10 years between 1983 and 1993. Wells (2007) further reported Mexico and Republic of Korea have about 64% and 77 % of casual workers on construction sites. In that same report Wells (2007) indicated, 90% of construction workforce in Egypt are hired on casual basis.

These characteristics of the industry are indeed very typical of the Ghanaian situation as well, with over 90% being artisans and also given that casual workers account for about 70-90% of the construction labour workforce in Ghana. However as noted by the International Labour Organisation (2001), the increasing use of casualisation (while it appears irresistible due to the unique nature of the industry) also has led to debilitating effect upon occupational health and safety issues.

DRIVERS OF CASUALISATION

As indicated, the ILO (2001) has indicated that, casualisation in the construction industry has led to debilitating effect upon occupational health and safety issues especially in developing countries. This led some writers to research in that area and that indeed in almost all cases, there were pieces of evidence indicating that the health and safety of casual workers had been compromised. For example, a base study conducted in Tanzania by Mitullah et al (2003) revealed that about 70% of casual workers were not provided with welfare related facilities and safety materials at most of the project sites resulting in accidents and sometimes fatal on construction sites. Writing in the same vein other writers such as Wachira (2003) and Buchanan (2004) also dealt with the situation of casual workers on construction sites to assert why contractors want to still engage casual workers on site and provide substandard safety materials and poor welfare facilities, and why casual workers want to continue to work in such unsafe conditions. Factors such as the ready availability of casual workers, casual workers being cheaper to employ, and as a means of saving on labour among others, are all plausible in the case of employers. Socio-economic conditions of the casual workers themselves have been suggested by some writers as one of the reasons why casual workers want to continue work in such unsafe conditions. For example during the ethnographical study by Buchanan (2004), the author found casual workers were unwilling to leave dangerous work situations because they recognised the turnover of workers and hence, worried that they would be replaced if they complained about safety hazards on construction site. Other writers are of the view that the lower level of education and the quest of casual workers to meet their basic needs such as food and shelter, among others, have contributed to their inability to refuse to work in unsafe conditions.

In view of the significant role casualisation plays in the construction industry, it is important to understand casual workers perception of Occupational Health and Safety

(OHS) issues to building a collaborative framework for addressing the defects emanating from these issues, which will further help to achieve some of the agenda of the Millennium Development Goals (MDGs) and The Ghana Poverty Reduction Strategy II (GPRSII).

THEORETICAL FRAMEWORK

As demonstrated, pieces of evidence indicate that indeed there has been a significant growth of casual workers in the construction industry. However, the ILO (2001) has indicated that the increasing number and the practice of casualisation have led to a debilitating effect upon occupational health and safety issues on construction sites. For example, in India, the on-site accommodation provided for casual workers is rudimentary, comprising simple shacks with no running water or decent sanitation, and poor ventilation (Vaid, 1999). The same can be said about Malaysia where it has been estimated that 82% of casual workers live on sites in buildings of poor quality, and this was their second major grievance after social security (Abdul-Aziz, 2001). Even China as an emerging developed nation, the trend is not different. The bulk of casual workers on construction sites, lack proper places to have their meals and they are often found eating outdoors, exposed to dust in the air, without dining tables or seats (Lu and Fox, 2001). Additionally, Jeemol et al (2002) indicated that casual workers have a problem of meeting their basic needs such as food and shelter. A base study conducted in Tanzania by ILO, (2005) revealed that casual workers were not provided with welfare facilities in most of the projects.

The Construction Industry is often seen as a driver of economic growth especially in the developing countries such as Ghana (Anaman et al, 2007). From 2001 to 2005, the annual economic growth rates of Ghana, has been between 5 to 6% (Anaman et al, 2007) and recently the Government of Ghana (GOG) has set a target of annual economic growth rate of 8% and above. This means that for the Government of Ghana (GOG) to achieve her target and beyond, one of the key sectors to consider is the construction sector. However, it appears that the policy makers in Ghana have different view about the industry. Anaman et al (2007) confirm that policy makers have not promoted this industry towards engendering the much needed growth of the economy. In Ghana, the main occupational health and safety policy frameworks are as listed below:

- National labour Act 651 of 2003;
- Factories, Offices and shop Act of 1970;
- Building Regulation; and
- Workmen compensation Act 1987

These documents obviously do provide some legal framework on casual labour practices in the Ghanaian construction industry. However indication from the blueprints available suggests some lack of understanding or inconsistencies on the real issues confronting casual workers in the construction industry. Moreover recent developments and challenges following the increasing use of casual labour have not been properly investigated to reflect modern occupational challenges.

Here, the ILO framework, the Ghanaian National labour Act 651 of 2003 in conjunction with the factory, offices and shop Act of 1970 was adopted as the main basis for theoretical framework (refer Fig 4.1).

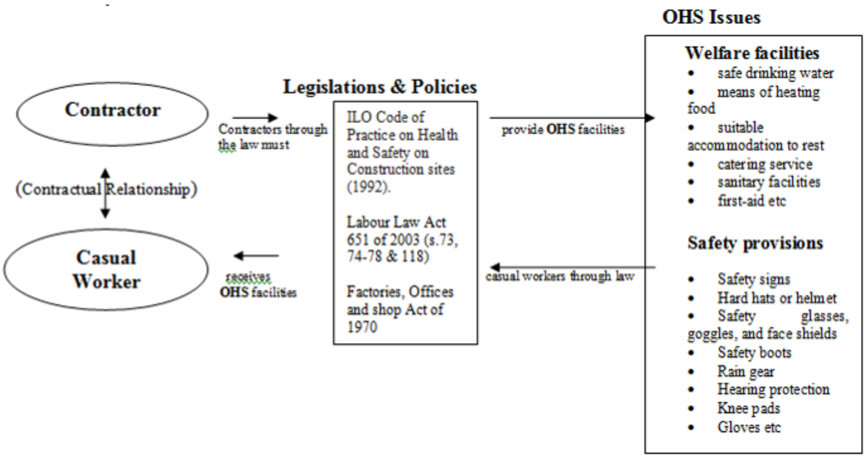


Figure 4.1: A framework of OHS provisions for casual workers

Within the legislation and policies in fig 4.1 lies the National Labour Act 651 of 2003 and Factories, Offices and shop Act of 1970 and the requirement of the law in the context of OHS is projected to form OHS issue (see fig 4.1). Section 73 under the legislation and policies in fig 4.1, deals with the right of employers to employ casual workers, whereas sections 74 and 78 deal with the conditions of employment of the casual worker, and the interpretation or the meaning of casual worker respectively. Section 118 of Act 651of 2003 explains how employers should manage the occupational health and safety of casual workers and the environment within which they work. From the legislation and policies, contractors are allowed to hire casual workers for short periods on terms that suit the operations of their firms. However contractors are to operate within the definition of engagement of a casual worker. Once the contractor employs a casual worker, by legislation, a verbal contractual relationship is established, where the casual worker have rights to minimum remuneration for each day worked, overtime and medical facilities. Further opportunity is provided by the legislation for the casual to access full remuneration when he or she attends work, for example whether the weather prevents him or her from carrying on his or her normal work. The legislation and policies further place the responsibility of provision of welfare facilities and safety materials for the casual worker on the main contractor on site. Portions of the Factories, Offices and shop Act of 1970 only re-echoes the health and safety provisions in sections 118 to 119 of the National labour Act 651. Portions of these legislation and policies were also adopted from blue print of the ILO Code of Practice on Health and Safety on Construction sites 1992. This legislation and policies as explained in the framework, becomes the base line for measuring what the Ghanaian contractor provides for the casual worker and what the casual worker receive from the contractor with regards to occupational health and safety measures. Indeed the framework seeks to confirm the provision of and receipt of standardised welfare and safety items

DATA COLLECTION AND ANALYSIS

Observations followed by a questionnaire survey of preference of casual workers for occupational health and safety items were carried out in Kumasi. The choice of Kumasi was based on the fact Kumasi is the second largest city in Ghana and has some of the highest concentration of construction activities in Ghana. Furthermore informal activities are very intense because of the largely traditional nature of the city (KPMG, 2008).

The questionnaire used a five-point Likert-type scale to measure a range of preference of welfare and safety items of opinions from “most preferred” to “least preferred” to determine the preference of welfare and safety items. The significant agreement or otherwise with the notion being tested was determined by adopting the mid-point value of the index (i.e. 3point or neutral) as the hypothesized mean (Coakes and Steed, 2001). This means that any result significantly different from this uncommitted or unsure value was assumed to be either most preferred or least preferred of welfare and safety items to the notion being tested (Pullin and Haidar, 2003).

Indications from Erbil et al (2010) are that purposive sampling allows the researchers to select the individual who have good knowledge on the subject in discussion. Here casual workers are known to be directly involved with the actual construction works and they know the problems they encounter with management in terms of provisions of welfare facilities and safety materials.

Using purposive sampling technique, 100 questionnaires were distributed to casual workers. Seventy-three were retrieved. Twenty three out of the seventy-three were not properly completed and were therefore discarded. This brought the responses effectively to fifty, representing a response rate of 50%. This response rate is considered adequate as, according to Oladapo (2005), Newman & Idrus (2002) and Ellhag and Boussabaine (1999), a response rate of 30% to 40.50% is good enough in construction studies. It is worth noting, those casual workers who could not read or write at the time of responding to the questionnaires were guided by the researcher to make their contributions.

Indications from Naoum, (2008) cited Creswell, (1994) is that any inquiry into a social or human problem which is based on a theory composed of variable, measured with number and analysed with statistical procedures is a quantitative research. Here the quantitative approach was used for basis of triangulating the results with previous findings, which were all based on quantitative analysis

ONE SAMPLE STATISTIC MEANS OF PREFERENCE

One sample statistics of preference was carried out to determine whether casual workers prefer the provision of substandard safety materials and welfare facilities or otherwise. While, the mean ranking establishes the preference of some of these issues, it also provides a clearer picture of the concerns raised by casual workers. The ranking of these variables (welfare facilities and safety issues), are determined by putting together the sample size, the sample mean, the standard deviations and the standard error of each of these variables of the welfare facilities and safety materials.

The sample mean, makes inferences about the population based on sample information (Saunders et al, 2007). Standard deviation according to Ahadzie (2007) is the statistical tool that measures the dispersion around the sample mean. High values of standard deviation (relative to the sample mean) suggest that the values of standard deviation are widely spread out from the sample mean. This means that that there is a lot of variability between means of the sample. Low values of standard deviations on the other hand, suggest that the values of standard deviation are more tightly clustered around the sample mean. This is an indication that most sample means are similar to the population mean and so the sample is likely to be an accurate reflection of the population (Ahadzie, 2007). The standard error indicates how tightly the sample mean are distributed around the population mean (Bbabbie, 2001). From this, the standard error appears to behave like standard deviation. To this, a number of researchers such as Bbabbie (2001), Ahadzie (2007) often referred the standard error as the standard deviation.

These characteristics of the above statistical tools, helped in ranking the variables of welfare facilities and safety issues. It is important to note that while ranking the variables of welfare facilities and safety materials using one sample statistic means of preference, when two or more variables have the same mean, the one with the lowest standard deviation is assigned the highest ranking. To this end, table 3 below shows the summary of results of ranking of welfare facilities and safety materials using one sample statistic means of preference on building construction sites.

Table 3: Summary of one sample statistic showing rankings of OHS issues from casual workers

	N	**Mean**	**Standard deviation**	**Standard error**	**Ranking**
Welfare facilities					
Safe drinking water	50	4.5686	1.00509	0.082	1st
Suitable accommodation to rest	50	4.1373	1.00039	0.127	2nd
Sanitary facilities (toilets, showers, changing rooms)	50	4.1373	1.13172	0.125	3rd
First-aid equipment	50	4.1373	1.42856	0.122	4th
Water for washing and cooking	50	4.0196	1.06752	0.138	5th
Catering service	50	3.8824	1.32132	0.136	6th
Means of heating food	50	3.6667	1.21106	0.118	7th
Accommodation to change and store clothing	50	3.5686	1.17055	0.144	8th
Safety Materials					
Safety boots	50	4.3725	1.01903	0.135	1st
Safety signs	50	4.1176	1.05161	0.106	2nd
Hard hats or helmet	50	4.0196	1.06752	0.130	3rd
Training in safety	50	4.0196	1.20814	0.128	4th
Safety glasses, goggles, and face shields	50	3.9412	1.12092	0.140	5th
Appointment of safety officer on site	50	3.9412	1.34777	0.143	6th
Rain gear	50	3.6078	1.32783	0.199	7th
Knee pads	50	3.1176	4.62881	0.095	8th
Gloves	50	3.0000	1.56205	0.100	9th
Hearing protection	50	2.8627	1.53648	0.177	10th
Safety nets	50	2.3333	1.46515	0.222	11th
Flashlights	50	2.2745	1.47076	0.268	12th
Ladder Scaffold platforms	50	2.2353	1.39411	0.292	13th
Hoisting equipment	50	2.0000	1.41421	0291	14th

FINDINGS

Welfare facilities

The following observations were made from table 3. Casual workers ranked safe drinking water first (1^{st}) as the most preferred welfare facility for addressing the health and safety issues concerning them, while suitable accommodation to rest, sanitary facilities, first-aid equipment and water for washing were ranked as second (2^{nd}),third (3^{rd}), fourth (4^{th}) and fifth (5^{th}) respectively as preferred facilities.

These welfare facilities are preferred by casual workers because it was observed that sanitary facilities such as toilets and urinals were virtually nonexistent and thereby casual workers have to depend on nearby bushes. With first aid kits, some sites have them alright, but they do not contain drugs or clinical items. Further, there is no arrangement for catering services for casual workers. Food is sold by women vendors who come around and there is no proper place for dining; they have their meals is outdoors, exposed to dust and without dining tables or seats in an unhygienic environment. Drinking water is not provided to casual workers at some construction sites. They have to carry their drinking water from home, otherwise they have to request or buy from these women sellers. Sites that are provided with water are stored in unhygienic concrete or poly tanks and this is usually infested by spirogyra and other organisms. All these and others have created poor and dangerous conditions for casual workers to work unsafely. To be able to work effectively and efficiently means that certain basic human needs are needed, and clearly the casual workers have demonstrated that by indicating that safe drinking water, sanitary facilities, suitable accommodation to rest, first-aid equipment and water for washing are the most preferable welfare facility for addressing the health and safety issues concerning them. It appears the choices of casual workers confirm Abraham Maslow's hierarchy of human needs at the Physiological stage.

Safety materials

Casual workers also ranked safety boots first (1^{st}) as the most preferred safety material for addressing the health and safety issues concerning them, while safety signs, hard hats or helmet , training in safety and safety glasses were ranked as second (2^{nd}), third (3^{rd}), fourth (4^{th}) and fifth (5^{th}) respectively as preferred safety materials. The preference of safety boots, safety signs, hard hats or helmet, training in safety norms and safety glasses on sites, are the unknowingly thought of casual workers on proactive measures on construction sites. Proactive measures, in the context of Occupational Health and Safety (OHS) issues, on construction sites means taking steps necessary to prevent accidents and control of loss and damage of materials on construction sites. To react proactively, casual workers are of the view that wearing of safety boots and helmet coupled with training in safety norms is the best option and this is an indication to the fact that they are directly involved in the actual construction work.

CONCLUSION AND RECOMMENDATIONS

As earlier indicated, the Ghanaian construction industry is fraught with occupational health and safety issues. This study has shown that casual workers who constitute about 70-90% of the construction labour workforce in Ghana, have their occupational health and safety issues compromised, and if given the opportunity they would have preferred safe drinking water, sanitary facilities, suitable accommodation to rest, first-aid equipment and water for washing for addressing their welfare issues on construction site. Additionally safety boots, safety signs, hard hats or helmet, training in safety, and safety glasses were their first choice of safety materials for addressing their provision of safety materials. This outcome of casual workers preferences was based on one sample statistic, which apart from the fact that it determined the preferences of items, it also provided a clearer picture of the concerns raised by the casual workers. In the light of this and given the results obtained from the studies, it is recommended that contractors, consultants of construction sector and construction clients should allocate more resources to improve the preferred welfare facilities and safety materials on site. Government ministries, agencies and department of labour should liaise with the Ministry of Water Resources, Works and Housing and in conjunction with the Association of Civil Engineering and Building Contractors, produce a comprehensive policy document to cover standardised preferred welfare facilities and safety materials on site in order to build a more sustainable construction industry in Ghana.

ACKNOWLEDGEMENTS

The authors are grateful to **Mr. Augustine Owusu Danso** for his enormous contribution.

REFERENCES

Ahadzie, D.K. (2007), Model for Predicting the Performance Of Project Managers At The Construction Phase Of Mass House Building Projects, http://wlv.openrepository.com/wlv/bitstream/2436/15393/2/Ahadzie_PhD%20thesis.pdf**,** Accessed on 12th November 2009

Anaman, K. A. & Osei-Amponsah C.,(2007), Analysis Of Causality Links Between The Growth Of The Construction Industry And Growth Of The Macro-Economy In Ghana, *Construction Management & Economics*, Vol 25, pp. 951-961.

Buchanan, S. (2004), Day Labor And Occupational Health: Time To Take A Closer Look, *Baywood, Publishing Co. Inc*., USA, pp 253 – 260.

Cotton A.P., Sohail, M. & Scott, R.E. (2005), Towards improved labour standards for construction of minor works in low income countries, *Engineering, Construction and Architectural Management*, Vol. 12 No. 6, pp. 617-632

Danso, F. O. (2005), Improving Safety on Building Construction Site on KNUST Campus in Kumasi Ghana, Unpublished BSc Thesis, Faculty of Architecture and Building Technology, KNUST, Kumasi, Ghana

Danso, F.O. (2010), Occupational Health and Safety Issues Involving Casual Workers on Building Construction Sites In Ghana, A Kumasi Study, Unpublished BSc Thesis, Faculty Of Architecture And Building Technology, KNUST, Kumasi, Ghana

Earl Babbie. (2001), The practice of social Research, Eve Howard, United States of America

Erbil, Y. & Akıncıtürk, N. (2010), An Exploratory Study Of Innovation Diffusion In Architecture Firms, *Scientific Research And Essays,* Vol. 5(11), Pp. 1392-1401

ILO. (2005a), Prevention: A Global Strategy. Promoting Safety and Health at Work The ILO Report For World Day For Safety And Health At Work International Labour Organisation, Geneva, Switzerland. Accessed On 15th September 2009 from Http://Www.Ilo.Org.Pk/Informationfiles/Prevention%20A%20Global%20Strategy.Pdf

ILO. (2005b), Global Estimates Of Fatal Work Related Diseases And Occupational Accidents, World Bank Regions. International Labour Organisation, Geneva. Programme On Safety And Health At Work And Environment (Safework), Accessed On 15th September 2009 From; Http://Www.Ilo.Org/Public/English/Protection/Safework/Accidis/Globest_2005/Index.Htm

ILO. (2007), The Decent Work Agenda In Africa: 2007-2015. In: Eleventh African Regional Meeting, Held At Addis Ababa, Ethiopia. Report Of The Director General– International

Jayawardane, A.K.W. & Gunawardena, N.D. (1998), Construction Workers In Developing Countries: A Case Study Of Sri Lanka, *Construction Management And Economics*, London, E & FN Spon, Vol.16, Pp. 521-530.

Kheni, N.A. Dainty, A, R. & Gibb A. (2008), Health and Safety Management in Developing Countries: A Study of Construction SMES in Ghana, *Construction Management and Economics,* Vol. 26, pp. 1159-1169

KPMG (2008), Potential Opportunity for Investors Kumasi, Ghana, pp. 1-15.

Lopes, J. (1998), The Construction Industry And Macroeconomy In Sub-Saharan Africa Post 1970, *Construction Management And Economics*, Vol 16, pp 637-649.

Mitullah, W. V. And Wachira, I. N. (2003), Informal Labour In The Construction Industry In Kenya: A Case Study Of Nairob, Sectoral Activities Programme Working Paper 204, International Labour Organisation, Geneva.

Naoum, S. (2008), dissertation Research and writing for Construction Student, Oxford: Butterworth-Heinemann.

National Labour ACT 651 (2003), Section 74 – 118.

Neuman W., (2007), *Social Research: Quantitative and Qualitative Approaches, Pearson Education*, Inc., USA.

Oladapo, A. A. (2005), An Investigation Into The Use Of Ict In The Nigerian Construction Industry, from Http://Www.Itcon.Org/Data/Works/Att/2007_18.Content.02391.Pdf, Assessed On 30 November 2009

Resell, E. & Applebaum, E. (1997), Nonstand Work Arrangement: A Challenge For Worker And Labour Unions, *Social Policy*, Vol. 28 No 2 Pp31-6.

Vaid, K.N. (1999), The Construction Industry In Nepal - The Challenges Of Manpower Development, National Institute Of Construction Management And Research (NICMAR), Walchand Center, Mumbai

Wells, J. (2007), Informality In The Construction Sector In Developing Countries, *Construction Management And Economics*, Vol. 25, Pp 87-93.

CAUSES OF VARIATIONS ON BUILDING PROJECTS IN NIGERIA

J.A. Babalola[1] and A.F. Idehen
Department of Building, University of Lagos, Akoka, Yaba, Lagos, Nigeria

Variations are inevitable reality of every construction project. Variations in construction projects can cause substantial adjustment to the construction project duration, cost and quality. The aim of this study is to examine causes and possible control measures of variations in the Nigerian construction industry. Data on recently completed projects were collected from clients, consultants and contractors in the construction industry in Nigeria. A total number of seventy five (75) questionnaires were distributed out of which sixty five (65) were returned for analysis. The data collected were analyzed using descriptive statistics. Change of plan or scope of work by owner, change of specification by owner, unforeseen problems, change in economic conditions and differing site conditions were identified as the major causes of variations. While involvement of professionals at initial stages of project, clear and thorough project brief, thorough detailing of design, team effort by the owner, consultant and contractor, also comprehensive site investigation are major possible control measures of variations in the Nigerian construction industry. In conclusion, to minimize variations, client and consultants must be actively involved in the planning stage of construction project and the collaborative effort of the construction professionals should be encouraged with site investigation carried out during the pre-contract stage.

Keywords: cost overrun, Nigeria, time overrun, variations.

INTRODUCTION

Construction projects are complex endeavours majorly because they involve many human and non human factors and variables (Arain and Pheng, 2007). Construction projects are unique, one off task that last for a defined period. Another important fact about project is that no two projects are entirely the same. Furthermore, a project involves different stages ranging from initial stage, feasibility analysis, design stage, procurement, construction, turnover to the disposal of the facility. Thus, the need to make changes in a construction project is a matter of practical reality. Even the most thoughtfully planned project may necessitate changes due to the above factors and more (O'Brien, 1998).

The problem of delays in construction is a global phenomenon as pointed out by various researchers (Sambasivan and Soon, 2006; Arain and Pheng, 2006; Mohammed, 2001) and variations constitute one of the major causes of construction delays. Thus, variations in construction projects are a global phenomenon. Variations are inevitable in any construction project because needs of the owner may change in the course of design or construction, market conditions may impose changes to the project, and technological developments may alter the design and the choice of the

[1] adewumi_babs@yahoo.com

Babalola, J.A. and Idehen, A.F. (2011) Causes of variations on building projects in Nigeria *In:* Laryea, S., Leiringer, R. and Hughes, W. (Eds) *Procs West Africa Built Environment Research (WABER) Conference*, 19-21 July 2011, Accra, Ghana, 229-236.

engineers. The engineer's view of the design may bring about changes to improve or optimize the design and hence the operations of the project (Arain and Pheng, 2006).

Variations affect project cost, time, and quality of projects in so many ways. Variation can lead to contractual disputes, compromised quality of construction products and frustration of all parties involved in the construction project (Akinsola, 1996). Change orders could be disruptive, beneficial or neutral (Motawa et al; 2007). Early identification and analysis of potential causes of variations and there consequential effect on a project can enhance the management of projects. In O'Brien (1998) clear and thorough project brief is an important control for variations in construction projects, as it helps in clarifying the objectives to all participants. According to Mokhtar et.al. (2000) clarification of variation order procedures is an integral part of effective management of variation orders.

However, some of the studies carried out on the causes of variations were outside Nigeria. The few in Nigeria did not do much justice on the possible control measures of variations on construction projects. The significant importance of this study will be to have a clearer understanding of the causes and to assist the project team to make more informed decisions, to minimize the effects of unavoidable variations and to prepare adequately for unforeseen and or unaffordable variations.

LITERATURE REVIEW

Various researchers have described variations in various ways but generally, variations refer to change in the requirement of the original contract signed by the parties, or a "variance from what was originally stated in the contract documents (Kassim and Boong, 2002; Ssegawa et al, 2002; Ibrahim, 2006). It is a common saying that the only constant thing in life is change. The same applies to construction projects, there is hardly any construction project void of alterations, omissions, substitutions and the like. In the construction industry, these changes are referred to as "variations" and they are initiated by a written instruction issued by the architect who stands as the client's representatives, these instructions are known as "variation order" or "change order".

Major variations include increase and decrease in the quantity of work, modification of the quality of materials to be used, change in the dimensions of any parts of the work, omissions, changes which cause limitation to site access, working space or hours, removal from sites of materials or for inspection of any work covered up and replacement of any person employed in connection with the contract (Ssegawa et al, 2002). To Arain and Pheng (2008) causes of variations can be grouped under the following headings:

- Owner related variations, e. g change of plans or scope by owner, change of schedule by owner, owner's financial problems and inadequate project objectives etc.
- Consultant related variations, e. g change in design by consultants, errors and omissions in design, conflicts between contract documents, inadequate scope of work for contractor etc.
- Contractor related variations, e. g lack of contractor's involvement in design, unavailability of equipment, unavailability of skills and contractor's financial difficulties etc.
- Other variations, e. g weather condition, safety considerations, change in government regulations and change in economic conditions etc.

However, on the way forward opinions of some researchers were reviewed on the possible control measures of variations. To the Construction Industry Institute (1994) contract documents are the main source of information for any project. Comprehensive and balanced variation clauses would help in improving co-ordination and communication quality. According to Arain et al. (2004) involvement of the professionals in design may assist in developing better designs by accommodating their creative and practical ideas. This practice would assist in developing a comprehensive design with minimum discrepancies (O'Brien, 1998). Clarity of variation order procedures would help in reducing the processing time and other mishandling issues (Ibbs et .al 2001). To Chan and Yeong (1995) and Fisk (1997) a structured and thorough prequalification system for awarding projects would act as a filter to select only the capable parties for project bids. However, the lack of such pre-qualification system may allow incapable parties to bid. This may eventually lead to numerous problems in the later stages of a construction project.

RESEARCH METHOD

The population of this study includes building projects in Lagos State. The samples selected for this study includes some selected new building projects in the Lagos State area of Nigeria.

A sample size of seventy five (75) construction projects in Lagos State was selected using non-probabilistic sampling technique. Both primary data and secondary data were used in carrying out the research study. The sources of primary data were structured questionnaires administered to consultants, contractors and clients on new building projects. The questionnaire contained questions aimed at answering the research questions. The 5 points Likert rating scale was adopted to elicit information from the respondents. The ratings used are as follows: for agreement ratings 5 – strongly agree, 4 – agree, 3 – uncertain, 2-disagree and 1 – strongly disagree. In addition personal interviews and in–depth discussions with the professionals concerned were carried out.

In analyzing the data, the mean item scores of the variables were calculated using the formula below;

$$MIS = \left(5 - \frac{\sum(f \times s)}{N} \right) (1 \leq MIS \leq 5)$$

Where MIS is the mean item scores, f is the frequency of responses to each rating (1-5), s is the score given to each variables by the respondents (ranging from 1 to 5), and N is the total number of responses concerning that variable. SPSS was used to arrived at the analysis of the data by coding and data entry. The information collated from the respondents were presented in tables. These table were interpreted according to information obtained and conclusions and recommendations were deduced from the results of the analysis.

DATA ANALYSES AND RESULTS

This section of work presents the result and the analysis of the data obtained from the questionnaires distributed.

Table 1: Respondents characteristics

Characteristics of Respondents		Frequency	Percentage	Cumulative
	Client	1	1.50	1.50
Professionals:	Quantity surveyor	26	38.80	40.30
	Architect	21	31.30	71.60
	Services Engineer	3	4.50	76.10
	Structural Engineer	8	11.90	88.10
	Contractors	8	11.90	100.00
	1 -5 years	35	52.20	52.20
Years of	6 – 10 years	19	28.40	80.60
experience	11-15 years	8	11.90	92.50
	16 – 20 years	3	4.50	97.00
	Over 20 years	2	3.0	100.00
Qualification:	Ordinary Diploma ND	1	1.50	1.5
	Higher National	7	10.40	11.90
	Diploma HND	28	41.80	53.70
	B.SC	31	46.30	100
	PGD/M.SC			

Table 1 shown that the respondents have adequate understanding of the professional practice and the activities of the construction industry and that the questionnaires are representative of the activities in the construction industry.

Table 2 Causes of Variation

Causes	MIS	Standard deviation	Rank
Change in plan or scope by owner	4.57	0.722	1
Change in specification by owner	4.31	0.925	2
Unforeseen problems	3.97	1.114	3
Change in economic conditions	3.75	1.210	4
Differing site conditions	3.63	1.139	5
Change in design by consultant	3.52	1.352	6
Rigid nature of owner/owner’s interference	3.49	1.341	7
Owner’s financial difficulties	3.49	1.295	8
Change in government regulations	3.49	1.341	9
Lack of communication	3.45	1.105	10
Poor procurement process	3.45	1.222	11
Lack of strategic planning	3.45	1.363	12
Weather conditions	3.37	1.166	13
Errors and omissions in design	3.36	1.484	14
Inadequate working drawings details	3.25	1.429	15
Contractor’s lack of judgement and experience	3.24	1.338	16
Inadequate shop drawing details	3.24	1.349	17
Lack of co-ordination	3.12	1.285	18
Socio-cultural factors	3.10	1.061	19
Conflicts between contract documents	3.10	1.316	20
Design complexity	3.10	1.304	21
Non compliance of design with government regulation	3.03	1.21	22
Lack of specialized contraction manager	3.03	1.359	23
Shortage of skilled manpower	3.00	2.780	24
Unfamiliarity with local conditions	2.93	1.235	25
Fast track construction	2.90	1.116	26
Lack of contractors involvement in design	2.90	1.220	27
Technology change	2.84	1.423	28
Contractor’s mismanagement of funds	2.70	1.423	29
Consultant’s lack of judgement and experience	2.73	1.309	30
Unavailability of equipment	2.73	1.098	31.

Table 3: Possible control measures for variations

Control measures	Mean	Standard deviation	Rank
Involvement of professionals at initial sages of project.	4.63	0.850	1
Clear and thorough project brief	4.58	0.838	2
Thorough detailing of design	4.52	0.804	3
Team effort by owner, consultant and contractor.	4.49	0.894	4
Comprehensive site investigation	4.30	0.954	5
Continuous coordination and direct communication.	4.28	0.982	6
Value engineering at conceptual phase	4.25	1.106	7
Knowledge base of previous similar projects	4.24	0.923	8
Prompt approval procedures	4.22	0.867	9
Owner's involvement at planning and design phase	4.22	1.204	10
Use of collected and organized project data complied by owner, consultant and contractor.	4.19	0.973	11
Ability to negotiate variation	4.13	1.028	12
Clarity of variation order procedures	4.10	1.017	13
Control the potential for variation orders to arise through contractual clauses.	4.09	0.965	14
Review of contract documents	4.09	1.203	15
Comprehensive documentation of variation order	3.94	1.179	16
Variation order scope	3.84	1.175	17
A structured pre-qualification system for awarding project	3.69	1.117	18
Involvement of contractor at planning and scheduling process.	3.66	1.262	19
Project manager from an independent firm to manage the project.	3.63	1.253	20
Valuation of indirect effects	3.54	1.283	21
Freezing design	3.42	1.519	22
Reduce contingency sum	2.67	1.223	23

Table 2 shown causes of variation and there ranking. Table 3 shows the possible control measures for variations on the construction projects the analysis was based on the perceptions of the respondents.

DISCUSSION OF FINDINGS

Table 2 indicates the thirty-one various causes of variations in the construction projects. These causes were ranked according to there level of importance. The most important causes of variations in the building projects that was ranked first on the list was change in plan or scope by owner and followed by change in specification by owner. It was revealed through the interviews with the professionals that the owners found it difficult to make quick decision of their needs. Project must be adequately conceived before commencement. Unforeseen problems ranked third and when this occurred adequate steps must be taken to avoid reworks and delays in the project completion. Change in the economic conditions causes variation. From the findings of Fisk (1997) economic conditions is one of the influential factors that may affects a construction project. This may affect the project adversely, depending on the timing of the occurrence of the variations. Another causes of variations that ranked fifth was differing site conditions. This type of variation can be avoided if adequate site test was carried out at the initial stage of the project.

Change in design by consultant ranked sixth. This is one of opinion given in the work of Ibrahim (2006).Adequate planning at early stage will eliminate this problem.

Owner financial difficulties ranked eight . It was gathered from the interview conducted that most project did not cash flow projection at the beginning. Therefore cash flow forecast must be prepared at the early stage to solve any financial problem that may arise. Another causes of variations that was indicated is change in government policies and lack of communication between the building team. This may be due to unstable in government policies. Poor procurement process ranked eleventh. The interview conducted revealed that must of the projects were not properly conceived before implementation. Other causes of variations are lack of strategic planning, weather conditions, errors and omission in design, inadequate working drawings details contractor's lack of judgement and experience, inadequate shop drawings details and lack of co-ordination etc.

Table3 indicates the twenty-three possible control measures for variations of the construction projects. These possible control measures were ranked according to there level of importance. The most important possible control measure of variations is by involvement of professionals at initial stages of project. This was highly supported by the respondents. This will make the professionals to agree on some issues that may later cause variations. Clear and thorough project brief ranked second. According to O'Brien (1998), clear and thorough project brief will help in clarifying the project objectives to all the participants. Thorough detailing ranked third, this will assist in identifying the errors and omissions in design at an early stage supported by O'Brien (1998).

Team effort by owner, consultant and contractor ranked forth while comprehensive co-ordination with proper communication ranked sixth. Value engineering at conceptual phase and knowledge base of previous similar projects ranked seventh and eight respectively. Prompt approval procedures ranked ninth by the respondents. Owner's involvement at planning and design phase. The respondents were also in support of the fact that owners must be involved during the planning and design phase. Use of collected and organized project data complied by owner, consultant and contractor ranged eleventh while ability to negotiate variation ranked twelfth. Clarity of variation order procedures was also ranked thirteenth, clarity of variation order procedures is an integral part of effective management of variation orders, and this will help in reducing the processing time and other mishandling issues (Mokhtar et al, 2007). Control the potential for variation orders that may arise through contractual clauses and the review of contract documents ranked fourteenth and fifteenth respectively. Other possible control measures are comprehensive documentation of variation order, variation order scope, a structured pre-qualification system for awarding project, involvement of contractor at planning and scheduling process, project manager from an independent firm to manage the project, valuation of indirect effects, freezing design and finally reduce contingency sum.

CONCLUSION

This study presented the professionals' views of the causes and controls for variations orders for some building projects in Lagos State as a case study. Through the questionnaire survey and interviews with the professionals who were involved new building projects, causes and effective controls of variations for these projects were identified. From a comprehensive tabulation of 31 causes of variations and with there mean item scores, causes of variations were ranked according to there significance. The most important causes were change in specification by the owners, unforeseen problems, change in economic conditions and differing site conditions. Also from the findings of the study, the professionals can control project variations by involving the professionals at the early stage of project, by having clear and thorough project brief, thorough detailing of design and ensuring team effort by owner, consultant and contractor during the preliminary stage of a project. This study will benefit the professionals involved with office and residential buildings in Nigeria. .

RECOMMENDATION

In light of the findings of this study, the following recommendations are suggested. The client should be actively involved in the initial stages of the project. This would ensure that the clients objectives are clearly spelt out and invariably variations caused by change in plan or scope would be greatly reduced. The consultants should ensure that the client's project brief is thorough. This may reduce variations caused by errors and omissions. It may also reduce the tendency of rework and demolition during the construction phase. The collaborative effort of the construction professionals should be encouraged. Regular site meetings and clear mode of communication cannot be over emphasized especially in reducing the effects of variations caused by unforeseen circumstances. Site investigation should be thoroughly done and taken seriously to reduce variations caused by differing site conditions.

REFERENCES

Akinsola, A.O. (1996). Neural Networks, Model for Predicting Building Projects' Contingency Allowance. *Proceeding of Association of Research in Construction Management*, ARCOM 96, 11 – 13 September, Sheffield Hallam University, England, 507 – 516.

Arain, F.M. and Pheng, L.S. (2005). The Potential Effects of Variation Orders on Institutional Building Projects, Facilities, 23 (11/12) 496 – 510.

Arain, F.M. and Pheng, L.S. (2006). Leveraging on Information Technology for Effective Management of Variations in Education Building Projects: A KBDSS Approach, *Centre for Education in the Built Environment*, Working paper 10, pp. 1 – 18.

Arain, F.M. and Pheng, L.S. (2007). Modelling for Management of Variations in Building projects. Engineering Construction and Architecture Management, 14 (5), 420 – 433.

Arain, F.M. and Pheng, L.S. (2008). Causes of Discrepancies Between Design and Construction Architectural Science Review. 47 (3), 237 – 249.

Assat, S.A. and AL – Hejji, S. (2006). Causes of Delay in Large Construction projects. International Journal of Project Management 24 (4), 349 – 57.

Cameron, I. Duff, R. and Hare, B. (2004). Integrated Gateways: Planning out Health and *Safety Risk. Research Report* 263, Glasgow Caledonian University, UK.

Construction Industry Institute (1994) Project Change Management Special Publication 43-1, Construction Industry Institute, University of Texas at Austin, Texas.

Chan, A.P.C. and Yeong, C.M. (1995). A Comparison of Strategies for Reducing variations. Construction management and Economics. 13(6), 476-473.

Fisk, E.R. (1997) Construction Project Administration 5th Edition. New Jersey: Prentice Hall.

Hanna,A.S.P.E., Calmic,R., Peterson, P.A. and Nordheim,E.V.,(2002).Quantitative Definition of Projects impacted by change Orders. Journal of Construction Engineering and Management, 128(1),57-64.

Hassainien,Amr. A.G and El Nemr, N.(2007).Management of change order claims in the Egyptian industrial construction sector. Journal of Financial Management of Property and Constuction.12(1),45-60

Hao, Q, Shen, W., Neelamkavil, J and Thomas, R., (2008) Change Management in Construction Projects. Proceedings of the CIB W78 25th International Conference on Information Technology: Improving the Management of Construction Projects through IT Adaptation, Santiago, Chile, July 15- 17, 387 – 396.

Ibrahim,N.H.B.,(2006). Variation Orders in University Technology Malaysia Construction Projects. M.Sc Thesis University of Technology,Malaysia.

Ibbs, C.W.; Wong, C.K.; and Kuak, Y.H. (2001) Project Change Management System. Journal of Management in Engineering ASCE, 17 (3), 159 – 165.

Kassim, M.A. and Loong, L.J. (2002). A Study on Variations in Sewage Construction Projects *Journal Teknologi*, 37 (B), 13 – 26.

Mohammed, A. A.(2001).Analysis and Management of Change Order for combined sewer over flow construction projects. Dissertation , Wayne State University.

M otawa, I.A., Anumba, C.J., Lee, S., Peria – Morak, F. (2007) An Integrated System for Change Management in Construction. *Automation in Construction*, 16 (3), 368 – 377

O'Brien, J.J. (1998). *Construction Change Orders.* New York; McGraw Hill.

Sambasivan, M. and Soon, Y.W. (2006). Causes and Effects of Delays on Malaysian Construction Industry, International Journal of Project Management, 25, 577 – 526.

Ssegawa, J.K., Mfolwe, K.M. Makuke, B., Kutua, B. (2002). Construction Variations: A Scourge or a necessity? *Proceedings of the First International Conference of CIB* W107, 11 – 13 November, Cape Town, South Africa.

CHALLENGES FACING THE SMOOTH IMPLEMENTATION OF GHANA'S PUBLIC PROCUREMENT LAW, 2003, ACT 663

Collins Ameyaw[1], Sarfo Mensah[2] and Ernest Osei-Tutu[3]
[1,2]*Department of Building Technology, Kumasi Polytechnic, Kumasi, Ghana*
[3]*Building and Road Research Institute, Kumasi, Ghana*

The Public Procurement Act (Act 663) is an ACT passed in 2003 to regulate public procurement in Ghana. The purpose of this law was to promote fairness, transparency and ensure that public procurement is carried out in non-discriminatory manner. The adoption of the Act has been faced with several challenges since its introduction in 2003. The aim of this study was to identify various bottlenecks hampering the smooth implementation of the law and attempt to suggest possible remedies for identified challenges. The study adopted multiple research approach; which include; review of relevant literature, interview and questionnaire survey of 49 District Assemblies and Metropolitan and Municipal Assemblies in the Ashanti and Brong Ahafo Regions of Ghana. The study identified; inadequate funding, political interference, poor dissemination of procurement information, low capacity of procurement managers were identified as the major challenges to the smooth implementation of the public procurement law in Ghana. The ability of procurement officials to ensure strict conformance with the law without political interference, would ensure that the objects of the Law are achieved.

Keywords: Ghana, public procurement, Public Procurement Authority, Public Procurement Act.

INTRODUCTION

This paper outlines the events leading to the public procurement reforms in Ghana and discusses challenges that confront the smooth implementation of the law. Some pragmatic ways, which if adopted, could improve the effectiveness of the law and reduce the operational challenges have been suggested. Substantial evidence in literature suggest that procurement problems relating to Ghana are similar to the situations in many African and some Asian countries. (Aniekwu and Okpala, 1988; Kumaraswamy, 1994; Rwelamila et. al. 1999). Due to this procurement reforms have been taken place in these countries. The challenges observed and the remedial steps suggested are therefore of wider importance to many developing economies.

The Government, in consultation with its development partners identified public procurement system as an area that required urgent attention in view of the widespread perception of corrupt practices and inefficiencies, and to build trust in the procurement system. As 50%-70% of the national budgets (after personal emoluments) is procurement related (World Bank, 2003), an efficient public

[1] ameyawc@yahoo.com
[2] sarfmen@yahoo.com

Ameyaw, C., Mensah, S. and Osei-Tutu, E. (2011) Challenges facing the smooth implementation of Ghana's Public Procurement Law, 2003, Act 663 *In:* Laryea, S., Leiringer, R. and Hughes, W. (Eds) *Procs West Africa Built Environment Research (WABER) Conference,* 19-21 July 2011, Accra, Ghana, 237-247.

procurement system will ensure value for money in government expenditure, which is essential in a country facing enormous developmental challenges.

In view of this, the government of Ghana in 1996 launched the Public Financial Management Reform Programme (PUFMARP). The purpose of this programme was to improve financial management in Ghana. PUFMARP indentified weaknesses in the procurement system. Some of these weaknesses included: lack of comprehensive public procurement policy; lack of central body with technical expertise; absence of clearly defined roles and responsibilities for procurement entities; absence of comprehensive legal regime to safeguard public procurement; lack of rules and regulations to guide, direct, train and monitor public procurement. The programme also identified that there was lack of rules and regulations to guide, direct, train and monitor public procurement; there was also no independent appeals process to address complaints from tenderers. These findings led to the establishment of Public Procurement Oversight Group in 1999. The aim of this group was to steer the design of a comprehensive public procurement reform programme which led to the drafting of a public procurement bill in September 2002 and passed into law on 31 December 2003. The Public Procurement Act, 2003, is a comprehensive legislation designed to eliminate the shortcomings and organizational weaknesses which were inherent in public procurement in Ghana.

The object of this paper was to identify the specific challenges, in the case of Ghana, that militate against the smooth implementation of the law and to proffer solutions to address such issues that confront the success of the law. Further this exploratory study aims at promoting discussion and reflection on steps needed to promote procurement reforms .Thus the implementation of the law may be enhanced, rather than being used as a panacea to the numerous bottlenecks hampering the success of the procurement law.

LITERATURE REVIEW

The challenges to the institutionalization of national laws are pervasive in developing countries, Ghana not being an exception. The National Public Procurement Authority of Sierra Leone, in its 2005 report, outlined several challenges bedeviling the operations of the Authority. Some of them included: inadequate funding; deficient staff strength and organizational and logistical limitations. The report recommended among other things, that the law would achieve its object if there is a concerted effort by all stakeholders, backed by very firm political will and adequate budgetary support, to streamline and improve public procurement procedures in Sierra Leone (NPPA Annual Report, 2005). Annual Reports of PPA, since its establishment, have always cited inadequate funding as the leading factor that raises barriers to smooth operations of the Authority. Lack of adequate office accommodation was specifically reported in 2008 and 2007 annual reports (PPA Annual Report, 2007 and 2008).

Political will is the demonstrated credible intent of political actors (elected or appointed leaders, civil society watchdogs, stakeholder groups, etc.) to attack perceived causes or effects of corruption at a systemic level (Sahr, 1999). Asek, (2006) described political will as the desire and determination of political actors to introduce as well as embark on reforms that will bring significant and persistent changes in the society. However, those who wield power, the moral courage or capacity to exercise that power to ensure the needed change. Historically, successful reform programmes around the globe indicate that the paramount success factor is strong political will demonstrated by a commitment from the leadership at all levels of government (Sahr, 1999). Kosack (2008) argued strongly that success chalked in several countries around the world in areas of access to basic education was due to political will of the leaders in those countries and their commitment to increasing access to education. New rules and campaign gimmicks adopted by politicians alone are not enough for procurement reforms (Philip, 2002). The principal challenge in assessing political will is the need to distinguish between reform approaches that are intentionally superficial and designed only to bolster the image of political leaders and substantive efforts that are based on strategies to create change (Sahr, 1999). However, political commitment is a necessary condition for procurement reforms to curb corruption. Without political will and commitment by the leadership of the country, grand corruption is perpetuated at an alarming rate with petty corruption becoming endemic and more difficult to stop (Philip, 2002). There are tangible indications of political will by some stakeholders at the lower level to effect change, but this cannot be achieved if those at the apex of the pyramid lean back (Szeftel, 1998). However, the battle against corruption should begin with a strong political will and explicit commitment to eradicate all its manifestations (Osei-Tutu et al, 2009).

Reform efforts are oftentimes unsuccessful due to the combined influence of inadequate strategies, political resistance, failure to sustain long-term reform efforts and the lack of knowledge about appropriate tools to establish systemic change (World Bank, 1994). Kagwe (2005) indicated that the perceptions among Kenyans about corruption in public service have unfortunately gone higher despite all the laws passed to fight against this menace. This was attributed to several factors including: loopholes in the legislative provisions of the public procurement and conflict of interest (Kagwe, 2005).

It is worth noting that studies have shown that corruption is pervasive in developing countries because of weak institutional infrastructures and the lack of effective monitoring mechanisms (Lengwiler and Wolfstetter, 2006). Public procurement has been perceived as an area of waste and corruption (Thai, 2005). If the procurement laws and regulations are not enforced to the letter, the issue of corruption will continue to cover headlines in both the print and electronic media.

Wilson (2004) argued that in a situation where there is huge system loopholes coupled with laxity in legal and administrative system, compounded by non-transparency and extensive discretionary powers at the hands of politicians, there will be a required effort to ensure strict enforcement of laws to achieve the purpose for which the laws were enacted. Studies in Uganda, Tanzania and Kenya have revealed that corruption in public procurement has mainly been through hidden violation of the laid down procurement rules (Transparency International, 2009). Lengwiler and Wolfstetter (2006) stated that corruption is persistent in developing countries due to weak institutional systems and lack of effective monitoring mechanisms. Low detection of breaches of the law (Kanaga, 1999); weak enforcement of rules (Larmour, 2006); and regulations will also strengthen the hands of wrongdoers to misapply the law with impunity

Another key challenge facing many governments is combating widespread corruption in the procurement process (Jones, 2007). Ghana remains one of the most corrupt nations in the world judging from the annual Corruption Perceptions Index (CPI) released by Transparency International in 2010. Corruption is said to be present in all societies (Sahr, 1999). Lengwiler and Wolfstetter (2006) revealed that the quantum of money exchanging hands through corruption in public procurement is estimated between $390-400 billion per annum in the world. It is also estimated that corruption in Sub-Saharan Africa is about 70 per cent of public contracts and these corruptions results in about 20-30 per cent rise in contracts sum. Cost of corruption in Africa is estimated around $148 billion a year (Mawenya, 2008). Corruption occurs throughout the procurement process and project cycle; with the root causes being attributed to the actions and inactions of project participants such as political officers, public servants, clients, consultants, contractors and suppliers (Osei-Tutu et al., 2009).

There is no evidence that the passage of the law and its implementation has so far made any significant impact in curbing the incidence of corruption in public procurement in Ghana. According to the 2010 annual Corruption Perceptions Indices (CPI) released by Transparency International, Ghana ranked as the 62nd most corrupt country respectively out of a worldwide survey. Corruptions and bribes are widespread in government contracts (www.transparency.org; accessed, 2010). With only 4.1 CPI score, corruption in Ghana is still a huge impediment to effective resource utilization and efficient service delivery. There is therefore no concrete evidence that Ghana has made serious gains through the enactment of corruption targeted legislations though their impact cannot be discounted completely.

Schiele and McCue (2006) described the public procurement implementation challenges as environmental factors. These include; market condition, legal environment, political environment, organizational and socio-economic environmental factors. It was further established that, regardless of the effort by the central government and its related agencies to overcome implementation challenges and the acknowledgement that the procurement department is capable of adding value to the organization, a large number of the internal customers act on their own and frequently bypass the procuring department.

The Country Procurement Assessment Report of Ghana in 2003 revealed that most staff members of Ministries, Departments and Agencies (MDAs) and District Assemblies (DAs) responsible for procurement were not procurement-proficient, even though they have been trained. The report contended that, application of the PPA and the Standard Tender and Contract Documents will not be successful without broad training and “refresher” programs and encouragement of officials in charge of procurement. Forgor (2007), outlined among other things, lack of proper training for the managers of the procurement process as another challenge that confronts procurement reforms. This supports the assertion that poor dissemination of procurement law is one of the major challenges facing the smooth implementation of public procurement laws Azeem (2003).

Political interference with the procurement process is also a big challenge to the implementation process and public procurement reforms. A good number of politicians think that they have the right to intervene in the procurement procedures thereby leading to capricious procurement decisions (World Bank, 2004).

The lack of career development path and low salaries of procurement personnel also militates against procurement reforms implementation (World Bank, 2003). Poor records keeping (World Bank, 2003b), delays in payment of contractors and suppliers have also been cited as some of the crucial factors that challenges the procurement reforms implementation (Azeem, 2007).

Low level or absence of capacity building for service providers has been identified as one of the factors inhibiting successful public procurement reforms. Many bidders are limited in various capacity issues including: lack of basic knowledge in the law, inadequate capacity to appreciate the standard tender documents, poor access to tender information and insufficient technical and managerial skills to be competitive in the tendering process (ODPP Annual Report, 2007). The office of the Director of Public procurement of Malawi, in its 2006/2007 Annual report outlined the following factors, among others, impeding the operation of the procurement law in Malawi: shortage of qualified personnel, lack of adequate financial resources, lack of adequate office space, non-compliance with some provisions of the law, poor records management by entities and overpricing of goods, works and services by bidders.

RESEARCH METHOD

The research methods adopted for this study consisted of a multiple research approach which includes; review of pertinent literature, exploratory interview, survey questionnaires and review of procurement documents (evaluation reports) of procurement entities surveyed. The literature review helped to position the study within its theoretical context whilst the preliminary exploratory interview helped to elicit relevant information from the respondents, to complement the main questionnaire survey. The collection of data from the field was done through activities such as conducting interviews, administering of questionnaires and reviewing of respondents' procurement processes conducted in 2008. The data collected were then analyzed using descriptive statistics.

The research was limited to Metropolitan, Municipal and District Assemblies (MMDAs) in the Ashanti and Brong Ahafo Regions of Ghana. The questionnaires were personally administered; with the help of some procurement consultants. A total of 49 questionnaires were administered and retrieved (27 from Ashanti and 22 Brong Ahafo). All the Forty-nine (49) questionnaires were retrieved from the respondents representing a response rate of 100 percent and that was used for the analysis. The high response rate of 100 percent achieved was as a results of the several follow ups done by the researchers and the high interest demonstrated by respondents in the subject matter of the study.

RESULTS AND DISCUSSION

In the public procurement Law the default method for all contracts is open competitive bidding, except otherwise provided for in the Act (Section 35). Restricted tendering and Sole sourcing are justifiable only on the grounds of providing greater economy and efficiency and subject to the approval of the Authority (Sections 38 and 40).

Table 1 - Contracts and the Procurement Methods Adopted

Procurement method	Procurement category			Total
	Goods	Works	Services	
National Competitive Bidding NCB	8	113	5	126
Price Quotation (PQ)	128	47	13	188
Sole Sourcing (SS)	68	17	12	95
Unkown	1	2	0	3
No. of Approval for SS from PPA	0	0	0	0
TOTAL	205	177	30	412

From table 1, a review of 205 goods contracts revealed that 33% were procured via Sole Sourcing (SS), 62% Price Quotation (PQ) and 5% National Competitive Bidding (NCB). From the survey (table 1) 23% and 46% of respondents had engaged in Sole Sourcing and Price Quotation respectively. However, there was also no evidence of approval from the PPA allowing for the usage of the sole sourcing. Further interview to establish why Sole Sourcing and Price Quotation seems to be the option for goods procurement revealed that lack of funds and the uncooperativeness of goods suppliers had been behind the high inclination towards Sole Sourcing without approval. Some respondents indicated that suppliers mostly refuse to respond to invitation to submit quotation with the reason that they have failed to win the previous bids. It was also observe from interview that procurement officials in public entities play on the ignorance of the PPA to create emergency situation when in fact it could be avoided. This is done to allow for the award of project to their preferred tenderers at a very high cost to the state. Procurement of consultancy services also recorded 40% of sole sourcing, 43% Price Quotation and 17% National competitive bidding. Results from works procurement showed a very high patronage of NCB and PQ. An encouraging 64% proportion was NCB whilst 27% PQ and 9% sole sourcing.

Table 2 - Bidders per Contract Package and Average Rate of Responsiveness

No. of Bidders/Contract Package	(SS) (1)	2	3	4	5	> 5	TOTAL
No. of Bids	95	17	230	25	9	6	382
No. of Bidders per Lot	95	34	690	100	45	41	1005
No. of Responsive Bidders	95	29	621	74	33	32	884
Average Responsiveness	1	1.7	2.7	2.96	3.7	5.3	2.3
Average No. of Bidders per Lot	1.00	2.00	3.00	4.00	5.00	6.83	2.63

It has become a common practice to find only one bidder being allowed to purchase about three (3) or four (4) tender documents, using different companies' particulars to process the bid for submission. This scenario is an illusion of the existence of competition; in reality, the client responsible for the procurement would know the winner of the bid even before tender evaluation is commenced. The results of the survey in table 2, revealed that, out of 382 contracts, a total of 1005 bidders competed representing an average 2.6 bidders per contract and 2.3 bidders responsive. The percentage recorded for the 2 or 3 minimum bidders per contract package was relatively higher i.e. 65%; few of the contracts (10%) had number of bidders being above four (4) and 23% being sole sourcing. This is observed to be a calculated attempt by some entities to limit competitiveness level by refusing to open up for more competitors in a given bid. Section 49 (1) provides that tender documents should be supplied to all prospective bidders who may want to submit a bid on any contract. It is not uncommon to hear contractors and suppliers complain about some deliberate efforts by some entities, especially at the local government level e.g. Metropolitan, Municipal and District Assemblies, to refuse to supply them with tender documents. This collaborates Crown Agents (1998) and Westring (1997) observation that there are many instances of a single contractor buying and pricing all the bidding documents, and the contractor/supplier, processing the documents under different contracting proposals. The average rate of responsiveness for all the contracts surveyed was 2.3 bidders per lot.

The Ghana Public Procurement Law, 2003, Act 663 Part III- stipulates procedures for the sizing of tender packages, soliciting and evaluating tenders and for contract award. Section 21 (5) states, "A procurement entity shall not divide a procurement order into parts or lower the value of a procurement order to avoid the application of the procedures for public procurement in this Act". Unfortunately, it has been observed from the survey that some entities engage in what is known as "breaking of bulk" especially in goods procurement, to allow for the use of price quotation (see table 1).

Procurement staff/entities, in circumventing the law, misapply the Section 21 (5) under the pretense of lack of funds and therefore procure goods in bits; thus splitting the contract to give way for the usage of price quotation procurement method which can easily be manipulated to favor their preferred tenderers.

Political interference with the procurement system stands as one of the most significant challenges to the success of the procurement reforms (World Bank, 2004). In Ghana, the public procurement authority is directly under the Ministry of Finance and Economic Planning with the Minister of Finance playing supervisory role over the Authority. This situation could have been an empowering circumstance for a committed government of the day to ensure that the law is functional and the Authority is given all the support it requires. However, this power is sometimes wrongly used to interfere in the procurement process. The handing over of state power to a newly elected government often leads to the replacement of the Technical Head of the PPA. This state of affairs would clearly disable the newly appointed Technical Head of the PPA to enforce the law. This was viewed as a challenge by interviewers in ensuring a smooth implementation of the law and thereby rendering the PPA impotent. OECD/OCDE (2003) argued that good governance is a fundamental building block of a just and economically efficient public procurement system. Procurement officers may be involved in malpractices, such as misusing the power of invitation by only inviting preferred firms, favouring certain firms at the short-listing stage, to design tender documents in favour of particular firms or release confidential information. While some procurement officers can, in their own interest, choose to violate procurement rules, they work in most cases under the influence of powerful politicians (OECD/OCDE, 2003).

The Ghana Public Procurement Authority (PPA) is a wholly sub-vented organization receiving periodic release from government for its operations. Other sources of funding include internal generation and assistance from development partners. Under section 3 of the law, the Authority's duties include: provide policy and regulatory oversight; provide training and capacity building for procurement officials; hear appeals and complaints; and, assist local industries to become competitive and efficient suppliers to the public sector. The Authority, in an effort to fulfill its' mandate, initiated a capacity building of procurement officials in the application of the law in 2007. However a discussion with some staff of the PPA cited inadequate funding as a major problem militating against the fulfillment of their mandate and thereby leading to the halting of a step which was applauded by all and up to date, many stakeholders remain untrained in the application of the Law and this is actually contributing to the over exploitation of the law. An interview with local government staff responsible for procurement surveyed indicated that, a good number of them were privileged to be part of the first procurement training programme. Unfornately, this did not reflect much on the application of the law. For example, when asked whether they communicate results of tenders to unsuccessful bidders as require by section 65 (9), 87% answered in the negative whilst only 13% answered in the affirmative. Another activity which was hardly hit by the lack of funding phenomena is the annual assessment of procurement activities of procurement entities throughout the country. The number of entities assessed each year was on the increase year by year. In 2007, 90 entities were assessed in Ashanti and Brong Ahafo regions and increased to 150 entities in 2008. Due to financial difficulties the exercise did not take place in 2009. An interview with some staff at the Kumasi offices of PPA again cited funding as an impediment to the implementation of the law. It was revealed that only

150 entities were assessed nationwide in 2010. The auditing of procurement activities is the barometer by which the PPA measures the level of compliance with the law. The result of this annual assessment actually shapes policies in public procurement in Ghana and aid in the combat against corruption which is perceived to be pervasive in public procurement (www.transparency.org).

Low capacity of procurement staff has been identifies as one of the paramount factors that inhibits the successful implementation of procurement reforms. The survey results revealed that only 5% of the 49 entities had procurement staff with qualification in procurement and 95% lacked procurement qualification. This finding collaborates ODPP Annual Report, (2007) which suggest that low capacity of procurement staff is hampering procurement reforms in developing countries.

Poor dissemination of procurement information from the policy makers to the implementers is a sure way of undermining the successful procurement reforms. The survey results on whether there has been any communication between the entities surveyed and the PPA, 45% had no formal correspondence with the custodians of the law whilst 55% have had some communication with the PPA. If there is a constant flow of information from PPA to the entities and vice versa, it informs the PPA of the lapses in the implementation process and helps to shape policy directions. It also helps the entities to build their capacity in the law and to seek assistance of any kind from the PPA especially in the area of capacity development and clarification of any section of the law.

Several studies indicate that Procurement Reforms and Mainstreaming (PRM) has been a valuable instrument for implementing pro-social equity policies and have historically been used by governments to encourage more equitable social benefit (Westring, 1997; Larmour, 2006; Cavill and Sohail, 2005). These suggest that any step to commit more resources in ensuring a smooth implementation of the procurement reforms would lead to improvement in reduction in corruption in the public procurement system which will also have a direct and considerable impact on the overall economic situation of the country, thus, resulting in budgetary savings and efficiency in public expenditures (Mawenya, 2008, 2007).

CONCLUSION

The common procurement methods being practice are the National Competitive Bidding, Price Quotation and the Sole Sourcing methods. All contracts executed under the sole sourcing methods did not have the needed approval for the Public procurement Authority. Lack of funds and the uncooperativeness of goods suppliers had been behind the high inclination towards using the method without approval.

It is observed and confirmed from this study that there is a calculated attempt by some entities to limit competitiveness level by refusing to open up for more competitors in a given bid.

The under listed are among factors that present themselves as major challenges facing the smooth implementation of the public procurement law in Ghana: lack of enforcement, lack of political will, inadequate funding, corruption, lack of capacity, loopholes in legislative provisions, lack of due diligence by the procurement authority and over exploitation of sole sourcing provision of the law. It is significant to note that, this study, along with other publications, have revealed that, the mere passage of the law, though important, is not the solution to the problems that necessitated the enactment of the law.

Further, there is an over exploitation of some inherent loopholes in the procurement law which needs to be plugged. The vulnerability of the head of the public procurement authority when there is a change of government also weakens acceleration of effective monitoring.

In a developing country like Ghana, public procurement reforms and implementation usually encounter some of the challenges discussed in this paper. The most important point is how the problems are tackled in order to find antidote. Procurement reform is a continuous process and there would certainly be many challenges along the way. Setting up the legal framework and the regulatory institution are the first and possibly the easiest steps in the reform process. Insisting on compliance with the act and curbing corruption from public procurement are the more difficult steps that may take relatively longer duration to achieve.

It is further suggested that there is a need to insulate the head of the organization from political interference and removal from office. There is clearly the need to resource the body mandated to oversee to the implementation and enforcement of the law. Building the capacity of procurement officers in various public institutions in the application of the law would also go a long way to reduce the incidence of misapplication of the law. More importantly, proper operationalization, such as procurement officials ensuring strict conformance with the law without wrong political interference, would ensure that the objects of transparency, fairness, non-discrimination in competition are realized. Ultimately, this will lead to the much-desired value for money, which is the aim of every procurement process.

REFERENCE

Anvuur, A. and Kumaraswamy, M.M. (2006) Taking Forward Public Procurement Reforms in Ghana , CIB W107 Construction in Developing Economies International Symposium, "Construction in Developing Economies: New Issues and Challenges", 18-20 January 2006, Santiago, Chile, CD Rom 9 pages

Aniekwu, A N and Okpala, D C (1988) The effect of systemic factors in contract services in Nigeria. Construction Management and Economics, 6, 171-182.

Azeem V. (2007) *"Impact of the Public Procurement Act, 2003 (Act 663) in Ghana Integrity Initiative's Perspective.* Paper Presented at a Special Forum on Improving Efficiency and transparency in Public Procurement through Information Dissemination.

Cavill, S. and Sohail, M. (2005), "Improving public urban services through increased accountability", Journal of Professional Issues in Engineering Education and Practice, American Society of Civil Engineers, Vol. 131 No. 4, pp. 263-73.

Crown Agents (1998) The World Bank Procurement Audit in Ghana. Value for Money Audit Report for Ghana, Crown Agents for Overseas Governments and Administrations Ltd, UK.

Forgor E. S. (2007) *Proposed amendments to make procurement flexible: the practical experiences of District Chief Executives with respect to the implementation of the Public Procurement Law, Decentralization Agenda,3rd March 2007, pp 1-3.*

Jones, S. David (2007), Public Procurement in Southeast Asia: Challenge and Reform. Journal of Public Procurement, Volume 7, Issue 1, 3-33

Kanaga, W.S. (1999), "Corporations must act ethically", Economic Reform Today, No. 1, Center for International Private Enterprise, Washington, DC, available at: www.cipe.org/publications /ert/e31/e31_1.pdf

Kagwe (2005), Kenyan Leaders Corrupt? No Way!, available on www.africanexecutive.com

Kumaraswamy, M. M. (1994) Growth strategies for less developed construction industries. In: Skitmore, R M and Betts, M (Eds.), 10th Annual ARCOM Conference, September 14-16, Loughborough University. Association of Researchers in Construction Management, Vol. 1, 154-163.

Kosack, S. (2008), Directing foreign aid for basic education : Taking account of political w ill

Larmour, P. (2006), "Administrative theory, interpersonal relations and anti corruption practice in Papua New Guinea", Policy and Governance discussion paper presented to Workshop on Collaborative Relations, Personal Aims and the Work of Organizations, National Research Institute, Boroko, available at: www.crawford.anu.edu.au/degrees/pogo/discussion_.

Lengwiler, Y. and Wolfstetter, E. (2006), "Corruption in procurement auctions", Governance and the Efficiency of Economic Systems, Discussions Paper No. 90, January, available at:www.sfbtr15.de/dipa/90.pdf

Mawenya, A.S. (2007), "Corruption in public procurement in Sub-Saharan Africa and how to prevent and combat it", paper presented at the Anti-Corruption Southern Africa Conference, February.

Mawenya, A.S. (2008), "Preventing corruption in Africa", occasional paper, SAIIA, Johannesburg.

NPPA Annual Report (2005), National Public Procurement Authority Annual Report 2005. Sierra Leone.

ODPP Annual Report (2007), Office of the Director of Public Procurement Annual Report, 2007, Malawi

Osei-Tutu, E, Badu, E, and Owusu-Manu, D. (2009), Exploring Corruption Practices in Public Procurement of Infrastructural Projects in Ghana, International Journal of Managing Projects in Business Vol. 3 No. 2, 2010 pp. 236-256. Emerald Group Publishing Limited

OECD/OCED (2003), Public Procurement: Lessons From Kenya, Tanzania And Uganda, Research programme on: The Integration of Developing Countries into the World Trading System by Walter O. and Paul Kamau, Working Paper No. 208, pp. 16-42

Palaneeswaran, E, Kumaraswamy, M M and Zhang, X Q (2001) Reforging construction supply chains: a source selection perspective. European Journal of Purchasing and Supply Management, 8(1), 7- 12.

Philip, M. (2002), "Conceptualizing political corruption", in Heidenheimer, A.J. and Johnston, M. (Eds), Political Corruption – Concepts and Contexts, 3rd ed., Transaction Publishers, London.

Rwelamila, P D, Talukhaba, A A and Ngowi, A B (1999) Tracing the African Project Failure Syndrome: the significance of 'ubuntu'. Engineering, Construction and Architectural Management, 6(4), 335-346.

Sahr J. Kpundeh, (1999), Integrity improvement initiatives in developing countries, pp. 91

Schiele, J.J. and McCue, C.P. (2006), "Professional service acquisition in public sector procurement", International Journal of Operations and Production Management, Vol. 26 No. 3, pp. 300-325

Stephen N. Asek (2006), Political Will and Sustainable Development. Available on: http://www.tigweb.org/youth-media/panorama/article.html?

Szeftel, M. (1998), "Misunderstanding African politics: corruption and the governance agenda", Review of African Political Economy, Vol. 25 No. 76, pp. 221-40Tom

Thai K. V. (2005), Challenges in Public Procurement, pp. 2 Transparency International (2009), The East African Bribery Index. Available on: http://www.tikenya.org/documents/EABIReport09.pdf. Accessed in 2011.

Westring, G. (1997), Ghana Public Procurement Reform, an Audit Report Prepared for the World Bank, Advokatfirman Cederquist KB, Stockholm.

World Bank (1994) Adjustment in Africa: Reforms, Results, and the Road Ahead. A World Bank Policy Research Report. New York: Oxford University Press.

World Bank (2003a), "Ghana 2003 Country Procurement Assessment Report", Washington, DC: Ghana Country Department, The World Bank.

World Bank (2003b), *"Economic Report on Ghana",* Washington, DC: Ghana Country Department, The World Bank.

World Bank (2004**),** *"Uganda Country Procurement Assessment Report" Vol. II Main Findings and Recommendations. Operational Quality and Knowledge services, African Region.*

CLAY EXPLORATION, AESTHETICS AND ENVIRONMENTAL SUSTAINABILITY: A CASE STUDY OF AKURE AND ADO-EKITI, NIGERIA

Ganiyu Sulayman Olubunmi[1] and Ganiyu Sikiru Abiodun[2]

[1]*Department of Fine and Applied Arts, Adeyemi College of Education, Ondo, Nigeria*
[2]*Department of Architecture, Federal University of Technology, Akure, Nigeria*

Clay, known by so many names, is one of the oldest building materials that are ubiquitous. Ancient as it is, clay, due to its physical as well as chemical properties, can be further explored for the aesthetics and sustainability of the built environment most importantly in the tropics where the temperature is dynamic. This paper therefore aimed at identifying the various uses to which clay can be put and a number of applications of clay either in its original form or as a processed and finished product for aesthetic or/and utility value especially as it relates to the built environment. To achieve this aim, relevant literature were reviewed to expose the varieties of clay and its environmental compatibility, the various procedures and techniques for transforming clay and the various end-uses to which clay could be put with particular emphasis on the built environment. A survey was also conducted through the administration of questionnaires in Akure and Ado-Ekiti (both in the South/Western Nigeria) to find out the extent to which clay is used either as aesthetic material or for the sustainability of the built environment. Based on the analysis and discussion of the results of the survey, the paper recommended the encouragement of the continuous use of clay for its environmental sustainability and aesthetic values in the built environment. Clay was also recommended for use based on its ability to assist in ameliorating some of the negative effects of climatic changes.

Keywords**:** Ado-Ekiti, Akure, clay, laterite, sustainability, aesthetics.

[1] sulayghan2000@gmail.com
[2] fadhikr2002@yahoo.co.uk

Olubunmi, G.S. and Abiodun, G.S. (2011) Clay exploration, aesthetics and environmental sustainability: a case study of Akure and Ado-Ekiti, Nigeria *In:* Laryea, S., Leiringer, R. and Hughes, W. (Eds) *Procs West Africa Built Environment Research (WABER) Conference,* 19-21 July 2011, Accra, Ghana, 249-249.

CLIENT-ARCHITECT BEHAVIOURS TOWARDS COST ADVICE IN NIGERIA: QUANTITY SURVEYORS' PERSPECTIVE

Baba Adama Kolo[1], Badiru Y. Yunusa[2] and Anita A. Dzikwi[3]
[1,3]Department of Quantity Surveying, Ahmadu Bello University, Zaria, Nigeria
[2]Department of Architecture, Ahmadu Bello University, Zaria, Nigeria

Cost advice (CA) during early stage of building projects is an imperative to achieving value for money, but receives little consideration in the Nigerian Construction Industry (NCI). Construction clients and architects are foremost beneficiaries of this function and contributor majorly to its success or failure. Problems related to the *'cost advice'* function significantly contribute to some of the inefficiencies and non-performances crippling NCI. This paper investigates *'behaviours'* of clients and architects as they relate to the *'cost advice'* function of quantity surveying (QS) practice. Data were gathered from 248 projects sought from quantity surveying firms. Descriptive statistics, correlation analysis and test of significance were carried out. Based on these outcomes regression analysis was employed to establish the impact of the behaviours to the outcome of *'cost advice'* function. Behaviours relative to engaging QS and provision of design information were found to be *'slightly less than normal'* while services required from the QS comes with some challenges. Based on the strength of the impact of these behaviours on CA outcomes, it is suggested that certain behaviours must be tightly monitored and improved upon to ensure success of the CA services offered by the QS during early stage of building projects.

Keywords: client-architect behaviour, cost advice, quantity surveyor.

INTRODUCTION

Boundaries of cost advice function within the construction industry globally is assuming unprecedented highs owing to what Cartlidge (2006) referred to as the 'catalyst for change'. This is towards achieving and improving value for money for public sector procurement in particular (Kelly, Morledge & Wilkinson, 2002).This catalyst influences procurement culture worldwide bringing with it adaptive measures for the evolving nature of the traditional cost advice function of quantity surveyors (Ashworth and Hogg, 2007). Liu and Fellows (2008) reviewed several culture-based literature and assert that' behaviour is an important manifestation of culture'.

In line with global trends, the Federal Government of Nigeria (FGN) stipulate that all public procurement must follow the path of value for money in its procedures and practices as contained in the Public Procurement Act (PPA) 2007 (FRN, 2007; ICRC, 2009). And as such, evidence exists of calls for the NCI to adopt Value Management (VM) (Omole, 2000; Ajator, 2004; Oke & Ogunsemi, 2009; APDC, 2010) which is a

[1] babaadamakolo@yahoo.com; bakolo@abu.edu.ng
[2] badirudeenyunusa@yahoo.com
[3] ninadzi@yahoo.com

Kolo, B.A., Yunusa, B.Y. and Dzikwi, A.A. (2011) Client-architect behaviours towards cost advice in Nigeria: Quantity Surveyors' perspective *In:* Laryea, S., Leiringer, R. and Hughes, W. (Eds) *Procs West Africa Built Environment Research (WABER) Conference,* 19-21 July 2011, Accra, Ghana, 251-260.

widely accepted methodology for achieving value for money (Kelly, Male, & Graham, 2004). This call for an integrative approach by the FGN will have significant implications for the CA services required by the NCI. For example VM methodology requires excellent working relationships that promote integrated team work. However, this is at dissonance with inherent practice in NCI (Kolo and Ibrahim, 2010). Again, for an integrative approach, Ashworth (2004) demonstrate that the eventual outcome of the CA function is a reflection of individual circumstance, nature of design and information available etc, which are termed as behavioural variables (BVs) within the context of this study and discussed in the next section.

The challenge posits by these inherencies of the NCI will impact on the theoretical and methodological considerations (e.g. purpose, applications, reactions etc) of the cost advice function which the QS offers in the NCI. Despite this, researches on CA in NCI have exclusively focused on factors affecting accuracy (see for example Odusami and Onukwube, 2008) and accuracy level (e.g. Oladokum et al., 2009). Therefore gaps exist in literature on behaviours and the CA function of the QS in NCI. A study of human behaviour is a domain of sociology, dealing specifically about social nature of the problems within a system. This study situates itself within this context. In construction, problems of social nature in recent times have been the focus of researches (Hughes, 2009, 2010; Leiringer, 2010). And the solutions to these social problems will bring about the needed change in service delivery of the industry (Hughes, 2010). Hence this paper contributes to this field of study. To do that, it investigates client-architect behaviours towards cost advice function of QS in the NCI by first discussing cost advice in Nigeria, bringing out 'expected behaviours' of both the clients and architects for successful CA services from the QS. Thereafter, the way the research was conducted is described in detail followed by the results of the investigations. Lastly, ways aimed at addressing the implications of the findings are suggested to establish a base for advancing researches in this aspect in the NCI.

COST ADVICE AND THE NIGERIAN CONSTRUCTION INDUSTRY

The Construction Industry is made up of complex nexuses of relationships and interactions in order to meet up the requirement of its clients, thus requiring highly specialised services. Therefore, it is necessary for clients to employ a range of different professional advisers to advice on funding, design, cost, construction, letting etc (Ashworth, 2008). In Nigeria, QSs are the professionals recognised by law to provide CA during the life cycle of construction projects (Adetola, 2001). And over the years the QS profession has been experiencing phenomena changes in her approach to providing CA. Akintoye (2001) highlights these changing pattern from a global perspective and characterised the challenges posed by these changes within the NCI as focusing more on client's satisfaction. Adetola (2001) further stated that the re-directioning of the QS practise in Nigeria is more of 'value and wealth generation through cost and financial engineering' rather than preparation of bills of quantities and financial statements.

Adetola's assertions tends to locate the significance of the QS within the early parts of construction projects which essencially is the strategic stage (Cartlidge, 2006). This is in line with global practice, thus: 'the (cost) advice is particularly crucial at the early stages of project inception. It is at this time major decisions, often affecting the size and quality of the works are determined' (Ashworth, 2004). However, in spite of the changing nature of the QS profession within the NCI, certain challenges do exist.

Adebola (2001) informed that though QSs were duly recognised by law in 1990 it has largely been excluded from projects in the engineering subsector of the NCI . For instance heavy engineering, civil engineering, petroleum, oil and gas installations, and power installations. Adetola (2001) also noted that government, which is the major client of the NCI have been quite unfair to the QS in that services rendered are either partially reimbursed or totally not reimbursed. Some of the reasons advanced for the non involvement of the QS in these areas include ignorance by the public sector of benefits derivable from the services of the QS and corruptive tendencies (Adebola, 2001; Aje & Awodele, 2006).

CLIENT – ARCHITECT BEHAVIOURAL ISSUES

Behaviour is defined as 'the way in which somebody behave' and behave is 'to act in a particular way that expresses general character, state of mind, or response to a situation or other people' or 'to perform in or react to particular conditions or circumstances' (Encarta, 2010). This section contextualises the particular ways clients and architects act and characterise their response towards the CA function of the QS. The objective of the design process is the satisfaction of client's requirement, which is obtained when the 'best' design solution has been discovered within the constraints imposed by or on the project (Ferry, Brandon, & Ferry, 1999). In order to keep within these constraints, some compromises are necessary and it is the duty of the QS to provide information of the implications of these compromises to aid design decisions. This point to the aspect of how clients act in engaging QS on projects. Late engagements of QS have been reported in Nigeria (Anago, 2001; Oladapo, 2006).

To achieve value for money at the design stage, Ferry, Brandon, & Ferry (1999) advice that such responsibility particularly cost planning - a process of CA, should not be solely placed on the shoulders of the QS. But that the architect must cooperate and contribute to the process. This gives an instance of behaviour of the architect in terms of collaborating with the QS towards the success of the CA function. Ashworth (2004) brings out the behavoural repercussion of this instance thus: 'a designer who is either unable to or unwilling to provide quantitatlve and qualitative information must therefore expect that the cost advice will, by necessity, be vague'. Within the NCI, there are calls to improve upon the relationships that exist between members of the design and construction teams for the purpose of achiecing project success (Adetola, 2001; Akingbohungbe, 2006; Kolo & Ibrahim, 2010).

From the aforementioned, a study of behaviours of client-designer towards cost advice at early stages of projects can be viewed from three aspects: engagement of firms, design information and client-designer responsiveness in terms of provision of requisite information and reaction to the advice. The concept of behaviour within literature is inferred from the established practices i.e. 'the way client – architect are 'expected to act' in terms of engagement of QS and their subsequent reaction to the CA provided. The theories of these practices have been exhaustively explained and conceptualised (see Ferry, Brandon & Ferry, 1999; Ashworth, 2004; Cartilidge, 2006). For lack of space and need for brevity, we have merely outline the behaviours and their attributes. For the purpose of this study three aspects relative to CA are evident – engagement, design information and response. Engagement involves the stages at which QS are brought into the project e.g. at inception, design, information production etc; and form, which relates to who brings the QS in, for instance the client or architect. Design information focuses on establishing the following behaviours, the sufficiency of information contained in the brief, frequency and sufficiency of design information given by the architect. Finally, the third aspect, response measures behaviours in terms of the type of cost advice requires e.g. cost limit, cost plan, BOQ; time allowed for the CA function; and both the client and architect response to the CA e.g. accepting or rejecting the CA. The paper further assumes that where behaviours are consistent with practice as established in literature, they are termed as ‘normal’ and as ‘abnormal’ otherwise. This is clearly in line with Graham’s (1995) assertion cited in Liu and Fellows (2008) that ‘moral reasoning is one of the possible explanations in determining what constitutes good behaviour’.

RESEARCH METHOD

Research Approach

There however can be two aspects to the study of behaviours – *identifying and/or establishing behaviours* and *explaining the behaviour*. This study focuses on identifying behaviours of clients and designers towards cost advice function of the QS. A number of methods seem adequate for studies of this nature namely: survey research, observation research and the case study method (Moser and Kalton, 2001). The type of data required for a study, which entails the investigation of QS practice to establish behaviours necessitates the adoption of methods that would produce a wide coverage of data collected on a variable-by-case-data basis (DeVaus, 1991). This involved gathering responses based on the same data structure set from as many cases as possible. The survey research method was chosen for this study, been a much appropriate method for studies of this nature as suggested by DeVaus (1991). This was also used by Liu and Fellows (2008) in a related study on behaviours of QS in Hong Kong.

Survey Sample

The target population for the survey research are QS in the NCI. In establishing the sample from the identified population of a survey research, De Vaus (1991) identified two types of samples: probability and non-probability samples He advised that the probability samples are preferred *"because they are more likely to produce representative samples and enable estimates of the sample's accuracy"*. Hence, the choice of the probability sample type for the purpose of this study. In deciding on the sample size that would be representative of the population De Vaus' advised that *".... the size of the population from which we draw the sample is largely irrelevant for the accuracy of the sample. It is the absolute size of the sample that is important."* This was adhered to for the purpose of this work and the parameters in De Vaus’s sample size model provided further guide in deciding on the sample size. Based on the model, an initial sample size of 150 was drawn.

Survey techniques/Methods

Basically, data can be collected by observation, in-depth interview, document analysis, questionnaire amongst other known survey methods. The questionnaire technique has been found to be apt descriptive researches and was adopted for this study. Of the three methods of administration identified by De Vaus viz: face-to-face, telephone and mail, the mail was adopted. This is due to the unsurpassed 'plus' inherent in and enjoyed by this method - ability of handling long questionnaire and complex questions, identification of non-response items, efficient response rate in terms of general and specialized samples amongst others (Frankfort-Nachmias and Nachmias 2009).

The questionnaire 'set' consists of close ended question types divided into two main sections - *General Information* about Respondent/Firm and basic description of projects for which information were provided; and *Client/Architect Based Information*. The questionnaire was designed to elicit factual information from the respondents which were easily gleaned from project files. On completion of a pilot, a total of 150 sets of questionnaires were distributed to selected QS firm in Nigeria. A return rate of 65.3% was considered high for a research of this nature as researches in similar areas with lower response rates have been reported. Of the returned questionnaire, 41.32% of them i.e. 62 were usable for the purpose of achieving the goals of the study. However, since respondents were requested to provide project specific information for up to nine (9) current projects, information for at least four (4) projects were given in each of the usable questionnaires. Hence, project-based data were provided for 248 projects which formed the basis for analysis in this study. The units of measurement for each of the behaviours identified in the previous section are shown in Table 1.

RESULTS

Cost-related Behaviours of Clients and Architects

The success of any cost advice depends on the inputs and reactions of both clients and members of the design team – in this case, architects (Ashworth, 2004). Table 1 shows the general characteristics of project surveyed in this study in terms of building types, client types and project status. It further shows the BV investigate for which the most common occurrence statistics i.e. mode (Frankfort-Nachmias and Nachmias 2009) has been adopted in this study as an indication of the existence of a behaviour.

Table 1 – Frequency Distribution of Client/Architect Cost-related Behaviour Variables (*n = 248*)

Variables	%	Variables	%	Variables	%	Variables	%
Building type		**Client type**		**Project status**		**Clients brief**	
1 - Commercial	*27.4*	1 – Public	*54.8*	0 - Didn't Say	*0.4*	1 - Not sufficient	*21.0*
2 - Educational	*10.9*	2 – Private	*25.4*	1 – Abandon	*12.9*	2 – Sufficient	*62.5*
3 - Industrial	*13.7*	3 - Institutional	*19.4*	2 – Completed	*58.5*	3 - Very sufficient	*16.5*
4 - Residential	*47.6*	4 – Others	*0.4*	3 – Others	*28.2*		
5 – Others	*0.4*						
Engage Stage		**Engage Form**		**Cost Advice**		**Time Allowed**	
0 - Didn't Say	*4.8*	1 - Client	*59.7*	1 - Cost limit	*12.9*	0 - Didn't Say	*49.2*
1 - Inception	*49.2*	2 – Architect	*32.7*	2 – Prel cost plan	*11.3*	1 - Not sufficient	*25.8*
2 - Outline proposal	*25.8*	3 – Others	*7.7*	3 - Final cost plan	*0.4*	2 – Sufficient	*16.1*
3 - Design stage	*2.0*			4 – BOQ	*23.4*	3 - Very sufficient	*8.9*
4 - Productn inform	*18.1*			5 – None	*4.8*		
				6 - All of the above	*47.2*		
Freq of Des Info		**Arc Design info**		**Arc Response**		**Client Response**	
1 - Less frequent	*14.5*	1 - Not sufficient	*17.7*	0 - Didn't Say	*6.9*	0 - Didn't Say	*10.9*
2 - Frequent	*37.9*	2 – Sufficient	*48*	1 - Design to CA	*70.2*	1 - Design to CA	*66.1*
3 - Very frequent	*47.6*	3 - Very sufficient	*34.3*	2 - Unwillingly	*10.9*	2 - CA as academic	*8.9*
				3 - Design not to	*12.1*	3 - Indifferent to CA	*14.1*

The data set best describes public residential buildings which were completed at the time of collecting the data. From a general viewpoint, the client brief provided at the start of construction project is 'sufficient' for the purpose of cost advice during design stages. Though a fair number of QS are engaged at the 'inception stage' of projects, some of them are 'not engaged by the client' with more than half of them 'not providing all the services required' at the pre-tender stage. This goes against the principle of continuity wherein lies the gains of cost control (Seeley, 1996). A major mismatch however exist between the stage of engagement and cost advice produces where in more than 80% of QS are 'engaged before production information stage' and up to a quarter of them 'were asked to prepare BOQs'. This will definitely affect the accuracy of the BOQ since at this stage design information will not be sufficient for the purpose of BOQ (Ashworth, 1999; Ferry et al., 1999).

In terms of the time given for the purpose of CA function, Clients still 'do not give sufficient time' for the cost advice function of the QS as only 25% of the respondents believe that the time allowed is either sufficient or very sufficient. However this particular variable had a relatively high response of 'didn't say' (46%) and hence will distort the patterning of the client's behaviour in terms of time allocation to the QS in Nigeria. But this notwithstanding, the finding further supports the rush-style behaviour of project implementation in Nigeria. Though design information given by architects are believed to be 'sufficient' and are 'provided very frequently', efforts should however be upped by architects to improve upon the sufficiency of design information they provide. In spite of the lack of a coordinated cost control mechanism exhibited by clients, they do 'ensure that designs are kept within the limits of the cost advice' provide by the QS while architects also endeavour to 'design within the cost advice'.

Modelling Client/Architect Behaviour and Outcome of the CA Function

1. Behaviour – Outcome Relationships

Behaviour and character, aside individualising an entity, further dictates to a very large extent its responses to external stimuli i.e. the resultant outcome of the interaction. As identified earlier the client-architect behaviour will determine cost advice function in terms of project status, the cost advice eventually provided, and both the client and architect reactions to it. Table 2 below shows the existence of significant relationships between behaviours and the aforementioned outcomes based on correlation analysis tested at 99% confidence level.

Table 2 - Correlation between Behaviour/character and CA Outcomes (Showing only those which are significant at 99%)

Character/Behaviour	Project status	Cost advice provided	Clients Response	Architect response
Building type	-	-	0.267	-0.469
Client type	0.326	0.170	-0.391	-
Stage of Engagement	0.485	-	0.162	0.187
Form of Engagement	-	0.198	-0.240	-0.150
clients brief	0.214	-	-	0.609
Time allowed	-	-0.531	-	0.303
Architect's design info	0.186	0.199	0.182	-
Frequency of Design Info	0.609	0.363	-	-

Table 2 reveal that project status do have positive relationships with client type, stage of engagement, client brief, sufficiency of design information, and frequency of the design information. Frequency of design information has the greatest degree of relationship with project status having a correlation coefficient of 0.609 while sufficiency of design information has the lowest at 0.186. Cost advice provided is positively related with client type, form of engagement, architect design information and frequency of design information but negatively related to time allowed for CA function. The reverse relationship suggest that more time is given for simpler CA functions like establishing cost limit and preparing cost plans than that given when preparing BOQ and where all CA services are required. Client response positively correlates with building type, stage of engagement and architect design information while it negatively related to client type and form of engagement. The strengths of the relationships in this outcome variable are weak ranging from 0.162 to 0.391.

This finding is not surprising, it is expected that client response to the CA should not be dependent on project particulars and behaviours. But the existence of significant relationships is indicative of an unhealthy trend in the NCI especially for public projects given the requirements of the PPA currently in use. The PPA 2007 requires that projects must strictly comply with budget provision. Architect's response is negatively related to building type and form of engagement while it is positively related to stage of engagement, client brief and time allowed. Its highest degree of relationship is with client brief having a correlation coefficient of 0.609 and building type -0.469. Expectedly, this should be the case particularly with that of client's brief because as the brief becomes less sufficient on cost-related information, such deficiencies will lead to the architect disregarding the essence of CA provided there from.

2. Impact of Client-Architect Behaviour

The coefficient of correlation established in the previous section identified those BVs that significantly correlate with the various CA outcomes i.e. project status, cost advice provided, client's and architect's responses. This section establishes the impact of the associative BVs with each of these CA outcomes. Regression analysis is employed in establishing these impacts, which is a robust technique for establishing influences and impact but poor at determining causality (Mohammed, 2007).

The outcome of the analysis performed is shown on Table 3, displaying the standardised coefficients of β values for each of the BVs and their respective p-values. The p-value of the ANOVA statistic i.e. 0.000 indicates that the established impacts of the BVs are statistically significant to the various responses variables i.e. the CA outcomes. The r2 is indicative of the extent to which the BVs explained the variations of impact in the responses variables (RVs). The statistics as shown in Table 3 reveals that the BVs explained 82 – 96% of the impact variations in the RVs.

Table 3 – Impact of Client-Architect Behaviour on CA Outcome

Variables	***β***	**Sig.**	**Variables**	***B***	**Sig.**
Project Status			***Cost Advice***		
Client type	0.162	0.000	Client type	0.497	0.000
Stage of Engagement	0.160	0.000	Form of Engagement	0.193	0.000
client's brief	0.196	0.000	Time allowed	-0.359	0.000
Architect's design info	0.001	0.990	Architect's design info	0.442	0.000
Freq of providing DI	0.508	0.000	Freq of providing DI	0.073	0.423
ANOVA	*0.000*		*ANOVA*	*0.000*	
r^2	*0.963*		r^2	*0.938*	
Client's Response			***Architect's Response***		
Building type	0.369	0.000	Building type	-0.384	0.000
Client type	-0.341	0.000	Stage of Engagement	0.423	0.000
Stage of Engagement	0.330	0.000	Form of Engagement	-0.016	0.715
Form of Engagement	-0.221	0.002	Clients brief	0.773	0.000
Architect's design info	0.771	0.000	Time allowed	0.180	0.000
ANOVA	*0.000*		*ANOVA*	*0.000*	
r^2	*0.820*		r^2	*0.899*	

A major influence on project status is the 'frequency with which the architect provides design information' to the QS by exacting a 0.508 positive change to the project status per unit change relative to the other four influences. In essence then, this is a variable whose behaviour amongst architects should be closely monitored for CA success at the very early stages of building project. Though the other project status related variables do have minimal impact (their impact are statistically significant except for the sufficiency of the design information provided by the architect) on project status, they should also be closely monitored for effectiveness of CA function. The infinitesimal impact of 'sufficiency of design information' should not be surprising because at early stages of building projects the paucity of design information is widely recognised in the NCI.

Three BVs highly impacts on the cost advice provided by QS in the NCI, namely: client type (0.497), time allowed (-0.359) and sufficiency of design information provided by the architect (0.442). The inverse impact of time allowed implies that for a unit increase in the time allowed for instance say from 'not sufficient' to 'sufficient', the nature of the cost advice will tend to change from say 'BOQ production to final cost plan' or from 'final cost plan to the mere establishment of cost limit'. Two variables do not potentially impact on the cost advice provided namely form of engagement (0.193) and frequency with which design information are provided by the architect (0.073). Though the former does not exhibit any statistical significance in its impact but latter should nonetheless be closely considered during early stages of projects alongside the other three variables.

Clients have been known to either do nothing or ensure that designs are in consonance with the CA provided; sufficiency of architect's design information is found to have the greatest impact (0.771) on client's response compared to the others. The others fairly impact both negatively and positively. For instance, client type exacts a -0.341 impact which means that as client type changes from 'public' to 'private', client response is decreased by a value of 0.341. This may mean moving from say seeing the 'CA as an academic exercise' to 'ensuring that designs are within the CA'. In the case of architect's response to the CA, client's brief has the greatest impact (0.773) followed by stage of engagement of the QS. The negative impact of building type on architect's response implies that as building type change from commercial to education, architect's response is more likely to change from not designing to CA to unwillingly designing to CA.

CONCLUSIONS

Despite the urgency in call for researches on CA in the CI, brought about by the wake of the 'catalyst for change' in the construction industry and further worsen by the challenges facing QS in the NCI, attention has only been focused on issues that deal with accuracy. Evidences do exist in literature that the success of the quantity surveyor's CA function is largely dependent on the behaviours of clients and designers particularly during early stages of construction projects. This is against the popular thinking of considering the factors as oppose to the reasons for this factors which is the direction of this study. On a general level, client-architect behaviours towards CA in the NCI can be described as 'slightly less than normal' because in more cases the behaviour are less than that expected i.e. normal, compared to those in which they were exceptional i.e. above normal. In fact none of the behaviours attained this status. Instances in which behaviour can be described as 'normal' includes: client provides QS with briefs that are sufficient in information. Their behaviour towards engagement is that they engage QS early by that the engagement is done by clients themselves. However in some instances, abnormal behaviours were evident. For instance despite the fact that clients do engage QS early enough in projects, they required them to prepare BOQs. Some other abnormalities include insufficient time given for the purpose of CA and the near insufficiency of design information provided by the architect. Hence, there is need for improvements in these behaviours by clients and architects for effectiveness in the CA function. The reason for this is further corroborated by the existence of significant relationships and the impact these behaviours do have on the CA related outcomes. Another way at leveraging the challenges pose by the existence and influences of these behaviours is the re-consideration of the CA tools and methods adopted during the design stage. This however calls for researches that will relate methodological issues to behavioural concepts by expanding Liu and Fellows' (2008) research to study clients and designer and localising their research instrument to fit the NCI.

REFERENCES

Adebola, O. (2001). Quantity Surveying and National Development: The Public Sector Perspective. In G. O. Moneke, *Quantity Surveying and Total Cost Management: Context, Issues, and National Development* (pp. 134 - 150). Abuja: Nigerian Institute of Quantity Surveyors.

Adetola, F. O. (2001). Quantity Surveying and National Development: The Private Sector Perspective. In G. O. Moneke, *Quantity Surveying and Total Cost Management: Context, Issues and National Development* (pp. 110 - 133). Nigerian Institute of Quantity Surveyors.

Aibinu, A. A., & Jagboro, G. O. (2002). The Effect of Construction Delays on Project Delivery in Nigerian Construction Industry. *International Journal of Project Management , 20*, 593-599.

Ajator, U. (2004). Value Management and Buildability Assessment as Indispensable Tool for Efficient, Cost-Effective Building Production. *The Quantity Surveyor , 48*, 2 - 9.

Aje, I. O., & Awodele, O. A. (2006). A Study of Ethical Values of Quantity Surveyors in Nigeria. In D. R. Ogunsemi (Ed.), *Ethical Issues and the Challenges in Construction Professionals' Service Delivery* (pp. 14 - 31). Akure: NIQS Ondo State Chapter.

Akingbohungbe, D. O. (2006). Development, Building Industry: The Context and Challenges for National. In D. R. Ogunsemi (Ed.), *Ethical Issues and the Challenges in Construction Professionals' Service Delivery* (pp. 32 - 42). Akure: NIQS Ondo State Chapter.

Akintoye, A. (2001). Quantity Surveying: An Art or Science? A Researcher's Perspective. In G. O. Moneke (Ed.), *Quantity Surveying and Total Cost Management: Context, issues and National Development.* Nigerin Institute of Quantity Surveyors.

Anago, I. T. (2001). The Role of the Quantity Surveyor in National Development. In G. Moneke (Ed.), *Quantity Surveying and Total Cost Management: Context, Issues and National Development* (pp. 1 - 18). Abuja: Nigerian Institute of Quantity Surveyors.

Ashworth, A. (2004). *Cost Studies of Buildings* (4th Edition ed.). Oxford: Pearson Prentice Hall.

Ashworth, A. (2008). *Pre-contract Studies: Development economics, tendering and estimating.* London: Blackwell Publishing.

Ashworth, A. and Hogg, K. (2007) Willis's Practice and Procedure for Quantity Surveyors, 12th Edition, Blackwell Publishing, UK.

Cartlidge, D. (2006) *New Aspects of Quantity Surveying Practice*, 2nd Edition. Butterworth-Heinemann, Oxford.

Federal Republic of Nigeria. (2007). The Due Process Handbook. *The Public Procurement Act* . Nigeria.

Ferry, D. J., Brandon, P. S., & Ferry, J. D. (1999). *Cost Planning of Building*, 7th Edition. Oxford: Blackwell Science.

Frankfort-Nachmias, C. and Nachmias, D. (2009) Research methods in the social sciences, 5th Edition. Hodder Education Ltd.

Hughes, W. (2010) Built environment education, research and practice: Integrating diverse interests to make an impact. In: Laryea, S., Leiringer, R. and Hughes, W. (Eds). *Proceedings of the West Africa Built Environment Research (WABER) Conference*, pp 1- 8.

ICRC. (2009). *Transitional Arrangement for Implementing Public Private Partnership.* Abuja: Infrastructure Concession Regulatory Commission.

Kelly, J., Male, S., & Graham, D. (2004). *Value Management of Construction Projects.* London: Blackwell Science Limited.

Kelly, J., Morledge, R., & Wilkinson, S. (2002). Best Value in Construction. In J. Kelly, R. Morledge, S. Wilkinson, J. Kelly, R. Morledge, & S. Wilkinson (Eds.), *Best Value in Construction* (pp. 1 - 11). Oxford, UK: Blackwell Science in conjunction with RICS Foundation.

Kolo, B.A. and Ibrahim, A.D. (2010) Value management: How adoptable is it in the Nigerian construction industry? In: Laryea, S., Leiringer, R. and Hughes, W. (Eds). *Proceedings of the West Africa Built Environment Research (WABER) Conference*., pp653-663.

Leiringer, R. (2010) Handmaidens and Ivory Towers: The role and responsibility of construction management researchers as agents of change. In: Laryea, S., Leiringer, R. and Hughes, W. (Eds). *Proceedings of the West Africa Built Environment Research (WABER) Conference*, pp 27- 29.

Liu, A. M. M., and Fellows, R. (2008) Behaviours of quantity surveyors as organisational citizens. *Construction Management and Economics*, 26 (10 – 12) 1271 – 1282.

Mohammed, R. E. (2007). *An Exploratory System Dynamics Model to Investigate the Relationships between Errors that Occur in Construction Documents in Saudi Arabia and their Possible Causes.* PhD Thesis, Heriot-Watt University, School of Built Environment.

Moser, C. and Kalton, G. (2001) *Survey methods in social investigation*. Aldershot: Ashgate.

Oke, A., & Ogunsemi, D. (2009). Competencies of Quantity Surveyors as Value Managers in a Developing Economy. *COBRA 2009 The Construction and Building Research Conference of the Royal Institute of Chartered Surveoys* (pp. 23-38). Cape Town: Royal Institute of Chartered Surveyors.

Okuwoga, A. A. (1998). Cost-time Performance of Public Sector Housing Projects in Nigeria. *Habitat International , 22* (4), 389-385.

Omole, A. O. (2000). Quality of Professional Service and Ethics. *The Quantity Surveyor , 33*, 2-7.

CONSTRAINTS IN REAL ESTATE DEVELOPMENT FINANCE IN GHANA

Nkyi Benjamin Appiagyei[1] **and Ayirebi Dansoh**[2]

Department of Building Technology, Kwame Nkrumah University of Science and Technology, Kumasi, Ghana

Corporate Real estate finance in Ghana is fraught with problems emanating from infrastructural inadequacies with a preponderance of equity finance. Property owners use their own equity, barter arrangements and remittances from abroad to finance substantial volumes of their investment. Poor access to debt finance relates to demand-side problems, particularly a lack of information about available sources, rather than a lack of available credit. The financial market, however, is critical to the development of the real estate industry. The aim of the research is to identify and analyze the nature and the causes of financial market constraints in corporate real estate development in Ghana. A questionnaire survey and interviews were conducted to ascertain from corporate real estate developers and financial institutions (commercial banks, development, merchant banks) the underlying causes of difficulties in real estate finance. Financial constraints are identified under demand and supply of debt and equity finance as well as information and knowledge constraints.

Keywords: corporate real estate, debt, equity, financial constraint.

INTRODUCTION

The major financial lending institutions which supply funding to corporate real estate developers are banks. Apart from this source, all others are under developed in developing countries. Owing to the small size of corporate real estate developers, they are confronted with challenges in accessing finance from banks. They are usually required to meet strict loan requirements. Lack of material security or collateral has been found as the most serious bottleneck in receiving financial assistance from financial institutions, (Binks and Vale, 1990). But there are other sources of difficulties in the access of finance by corporate real estate firms in developing countries. Regardless of the immense role that real estate plays in the economy of every nation, and in spite of the ingenuity of the emerging lending industry, there are inherent difficulties impeding the financing of the corporate real estate industry. The aim of this study is to identify and analyze the nature and the causes of financial market constraints in corporate real estate development.

Financial constraint defines the difference between the demand and supply of external finance by lending institutions over a given period and measures the need for external funds by corporate real estate firms. Though the banks contribute to the difficulty of the corporate real estate firms' access to finance, the firms themselves also contribute to these difficulties.

[1] benjinba@yahoo.com
[2] adansoh@consultant.com

Appiagyei, N.B. and Dansoh, A. (2011) Constraints in real estate development finance in Ghana *In:* Laryea, S., Leiringer, R. and Hughes, W. (Eds) *Procs West Africa Built Environment Research (WABER) Conference*, 19-21 July 2011, Accra, Ghana, 261-271.

DEMAND FACTORS

Real estate finance is seen as remaining in a primitive state compared to the rapid development of the banking industry (Jaffee and Russel, 1996). This has resulted in a clear segregation between the real estate sector and the financial market in Ghana. Access to finance for real estate development is influenced by the characteristics of the corporate real estate institutions such as age, size (number of employees, turnover, profitability, net worth, etc) and legal status. Relative to developed countries, corporate real estate developers in Ghana are small in size. According to Ofei, (2001), most small and medium sized firms in Ghana felt constrained in their access to credit. Some corporate real estate developers are reluctant to surrender equity to outsiders because of the perceived loss of independence, control and freedom of action, dilution of earnings and the cost involved (Mason and Harrison, 1999).

In addition, some developers are also reluctant to seek external equity because they are often unfamiliar with the investors, with their protocol and criteria and often the implications of an external equity investment (Binks and Vale, 1990). Many corporate real estate developers are inhibited in accessing funding due to lack of information and awareness. Lack of knowledge or imperfect information is the main reason why small and medium scale industries (SMIs) failed to approach appropriate funding bodies (Bannock and Partners, 1991; Harvey, 1992). However, Confederation of British Industry, CBI (1993) pointed out that the root of the problem often lies with the owner managers themselves. This is because, they tend to react late to information and they do not approach the appropriate persons for advice until a funding crisis occurs. Poor financing planning is also found to be one of the challenges of corporate real estate developers (Hankinson, 1997). Most researchers agree that financial planning in businesses is a key to survival (Bates, 1991). Unfortunately, while many corporate real estate managers are aware of the benefits of financial planning, they fail to pay reasonable attention to these activities and they only plan when they are already faced with a need for funds.

Since short term loans are the most available forms of finance in Ghana, it becomes a challenge for corporate developers who acquire loans to pay back within the agreed period due to their inability so sell their products in the short term. Real estate investment periods take a longer time for recuperation, particularly when viewed from the land acquisition and development stage, through the construction to leasing or eventual sale of the property. The World Bank estimates that registering formal ownership/lease over a piece of unencumbered land in Ghana is the third longest registration process in the world (World Bank, 2004). Corruption and land disputes, especially involving public lands in urbanizing areas, have been experienced by significant majorities (CDD Report, 2000). Corporate real estate developers in Ghana are expected to have a personal contribution in a form of a deposit (between 20% and 30%), pay the interest on the loan and the principal in the form of monthly or annual repayments. Given the loan-to value ratio (between 70% and 80%) and the low level of returns in the country, it makes it difficult for most of the corporate real estate developers to qualify (Boamah, 2002, and Asare, 2004). Finally, the assessment of the credit worthiness of corporate real estate developers is made difficult as many potential borrowers have only a limited association with banks with the use of credit for transaction being uncommon.

SUPPLY FACTORS

Banks are the basic financial lending institutions that make up the supply sources of finance. In the course of business transaction, the unwillingness on the part of suppliers of finance to supply it on the terms and conditions required by corporate real estate developers leads to the difficulties in obtaining finance.

Most financial institutions believe that it is risky and administratively expensive to lend to small firms, including real estate developers, (Berger and Black, 2011) and even if these firms do get external finance, they are usually required to pay a higher rate of interest and offer a higher level of security and collateral (Economist, 1994). It is believed that, as firms grow in size, they may enjoy less expensive financial options since “the prospective lenders have a greater degree of trust in large firms, and accordingly a lower perception of risk” (Menkhoff, Neuberger, and Suwanaporn, 2005).

Many researchers conclude that the access to credit by small firms is restricted primarily because of stringent lending conditions imposed by financial institutions. Loans from banks in the initial years are difficult, as younger firms are less likely to command bank loans since they have no established track records (Binks, 1990).

The cost of lending to small corporate real estate developers are bound to be high because of the small amounts involved in each loan and consequently greater returns are expected by lending institutions (Binks, Ennew and Reed, 1990; Confederation of British Industry, 1993). The documentation, supervision and collection are also often more expensive than when loans are made to larger firms.

Also small firms suffer a number of genuine disabilities, by comparison with larger firms, in seeking finance from external sources; most of these disabilities reflect the higher costs of lending in small amounts or the higher risk of lending to small borrowers. They do not result from imperfections in the supply of finance and, indeed, the ability and readiness of the financial institutions to exploit every new legitimate demand for funds is one of the greatest strengths of the financial systems (Beitel, Schiereck and Wahrenburg 2004, Cybo-Ottone and Murgia 2000),

Basically, it is a high-risk proposition to lend finance to small real estate firms, (Hall, 1989). In contrast, the degree of risk involved in lending to large firms “is assumed to be lower than that involved in the case of small firms, as large firms have a more sophisticated management, permit greater access to their financial reporting, and are well known in the financial world”, (Petersen, M. and Rajan, R. (2002).

Financial institutions are also unwilling to lend because of the high failure rates of small firms (Smallbone, 1990). The “financial characteristic which distinguishes small firms from large is their relatively high probability of failure”, (Black, 2011). Research has shown that the mortality rate of small firms was high among younger firms. In the United Kingdom, the mortality rate of new firms can be as high as 33percent within two years of starting and 60 percent within five years (Pettit and Singer1985). In the United States, the mortality rate of small firms is 70 percent and most of these failures occur in the first year of operation, (Bain, 1990). This characteristic of small firms makes it difficult for financial institutions to advance credit to them.

Government assistance is one of the important sources of external finance for corporate real estate development. It is the responsibility of the government to strive to create the economic conditions necessary for stability to enable any form of housing finance market to thrive (Karley, 2002).

The Ghana government in 1990 established the Home Finance Company (HFC) with the objective to provide the service and raise funds for real estate finance. On its inception it was owned equally by the Government of Ghana, Merchant Bank (Ghana) and the Social Security and National Insurance Trust (SSNIT) (HFC, 2008). The assumption behind this approach was that the government, representing society, can be more risk tolerant as compared to banks, which have the object of maximising risk adjusted profit. The HFC provides funding to prospective home owners but does not fund the operations of corporate real estate developers. The Government of Ghana intervention has helped to establish the Ghana Real Estate Developers Association (GREDA) as an initiative for public and private sector participation in housing investment and delivery. GREDA draws together representatives of Government departments, property professional bodies, brokers and major developers to co-ordinate public policy and the private sector.

However in Ghana corporate real estate developers access finance for development at the same inter-bank loan rate with no form of discount. Since the collapse of the Bank for Housing and construction in the mid 1990s which aimed to develop formal debt finance systems for the construction sector, Ghana has not benefited from any special construction bank to ease the financial constraints facing the developers.

RESEARCH METHOD

Data for the research was drawn from personal delivery of questionnaire survey to identify the nature and causes of financial market constraints in real estate development in Ghana. The items relating to financial variables leading to the perceived existence of financial difficulties were extracted from a review of literature and preliminary interviews with senior managers of banking and real estate companies on debt and equity constraints as well as information inadequacy in the financial market environment.

The questionnaire was pilot-tested on 6 companies selected from the list of Ghana Real Estate Developers Association (GREDA) members with offices in Accra, Ghana. A random selection form this list is expected to give a sample with characteristics similar to the population. This sample gave a Cronbach's alpha of 0.72. Nunnaly (1978) has indicated 0.7 to be an acceptable reliability coefficient and therefore the 0.72 suggests a good reliability result.

A major observation from the pilot test was the difficulty in identifying respondents with adequate information on the companies' financial management record and decision making process. In response, initial checks were made through telephone - to identify individuals for the survey. A total of 69 questionnaires were sent to GREDA members in good standing and financial institutions (commercial, development, merchant banks). Realising the need to obtain a high response rate, the total design methodology suggested by Dillman (1978) was followed, and 38 responses (yielding a 55% response rate) were received. An estimate of non-response bias was calculated by testing the differences in the means of 3 variables in the two groups which indicated no significant differences.

Respondents described their current positions as managers, financial manager, managing director, chief accountant and CEO. Their functions involved sales of houses, debt contracting, advance payment negotiation, inviting negotiating equity and debt contracts with relatives, friends and banks. These individuals were generally involved in financial management decision making as well as activities in the company. One questionnaire was rejected because the respondent, from his position held and activities in the company, was judged to have inadequate knowledge and could not be relied upon to give accurate information.

The investigators examined three aspects of the data to determine the suitability of using Principal Component Analysis (PCA) as a data reduction technique: (1) bivariate correlations; (2) the Kaiser–Meyer–Olkin (KMO) measure of sampling adequacy; and (3) Bartlett's test of sphericity.

PCA was conducted and three components were extracted for the supply factors and three components for demand factors using Kaiser's criteria, which retains only those components whose variance is greater than 1.0. A varimax rotation was applied to the components to ensure the components were uncorrelated. These three components for the supply factors explained over 70% of the variation in the data. For the demand factors, the principal components analysis revealed the presence of three axes with eigenvalues exceeding 1.0, explaining 31.85 per cent, 21.34 per cent and 15.57 per cent of the total variance respectively, resulting with a cumulative variance of 68.76%.

The corresponding scree plot of eigen values (Figure 1) for the supply factors shows a change (or elbow) in the shape of the plot after the third component number. The scree plot for the demand factors (Figure 2) also shows a change in the shape of the plot after the third component number.

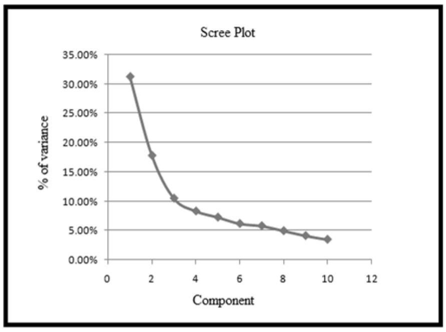


Figure. 1 Scree plot of eigenvalues (supply factors)

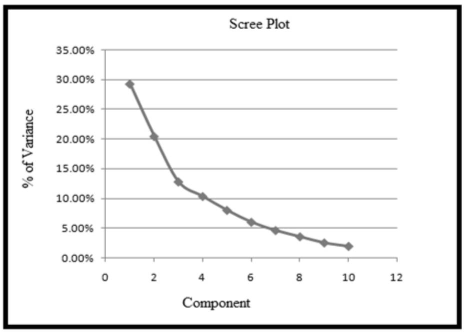


Figure. 2 Scree plot of eigenvalues (for demand factors)

Furthermore, Bartlett's test of sphericity, which tests the hypothesis that the variables are collinear, was significant at the r, 0.01 level. Hence, PCA was found to be a suitable data reduction technique.

RESULTS AND ANALYSIS

Constraints in real estate capital acquisition

Initial results are presented in 2 sections. Firstly, the results and analysis of data on the difficulties in the acquisition of external finance for real estate development is presented. The second part presents the initial result of the causes of financial difficulty under both demand and supply.

One of the obstacles for the growth of firms is the limited access smaller firms have to credit. The respondents were asked to identify if there is a difficulty in the lending system with regard to financing their operations. The majority (79.2%) of them were found to have difficulties with the financial lending system while (20.8 percent) have no financial acquisition difficulties. This confirms studies which show that, most small and medium sized firms felt constrained in their access to credit. (Ofei, 2001; see also Gokel and Akoena, 2002) reported that, a good majority of the firms in Ghana, 62%, felt fully constrained in accessing funds while 19% felt partially constrained. Only 12 percent felt unconstrained in accessing funds. This means a good majority of firms (81 percent) felt somewhat constrained in having access to funding.

Tenure of Financial Difficulty

The study adopted a definition for short, medium and long-term finance following responses from interviews with GREDA members and financial institutions (leasing and commercial banks, development, merchant and building societies) in Ghana. Short-term finance in this study has a repayment period of less than one-year, medium-term has between one and three (1-3) years repayment period with long-term finance extending over three years. Firms were asked as to the type of finance tenure they had most difficulty accessing.

Respondents were further asked to indicate the severity of financial difficulties on a scale of 1-5, where one (1) is ‘not severe and five (5) is ‘very severe. They were to provide multiple responses to all three options. A severity index was developed by calculating weighted averages of the responses (table 4.3.3). The most severe difficulties occur with long term financing (I = 4.90), medium term (2.98) and short term (2.04).

Table 1 Severity of difficulty associated with loan by tenure

Financial difficulty tenure	index
Short Term Difficulty (Less than 1 year)	2.04
Medium term difficulty (1-3 years)	2.98
Long term difficulty (more than 3 years)	4.90

There is inadequate credit for medium and long-term investments therefore most credit in Ghana is short-term. Further responses from the financial institutions (commercial banks, development, merchant and building societies) in the survey indicate that a number of factors constrain the availability of longer-term credit, the most important being the term structure of deposits. As a result of the short-term structure of deposits, banks are limited in their ability to make long-term loans. Generally, the lack of long term deposit instruments and the existence of secondary markets for loans, severely limit the long term lending capabilities of the lending system. As a result, the money deposit finance institutions are unable to provide needed long-term credit.

Causes of Financial Difficulty

Literature review and preliminary studies suggested some possible factors that could be hindering the acquisition of finance for real estate development. Factors identified as the cause of financial difficulty were grouped under two main headings of supply and demand factors.

Supply Factors

Principal Component Analysis was performed on these factors yielding three components that were extracted using Kaizer's criteria which retains only those components whose variance is greater than one. The result of the component analysis is as shown in the table below.

Table 2 Rotated Component matrix of factor analysis of financial supply difficulty factors

Supply Factors	PC1	PC2	PC3
Lack of adequate lending policies	-0.277	0.803	-0.484
High Lending Cost	-0.099	0.472	0.755
Stringent lending conditions	0.036	-0.515	0.701
Absence of co-operating banking institutions	-0.052	0.883	0.231
Failure to establish a legal framework	0.904	-0.057	-0.326
Limited capacity of banks	0.892	-0.305	0.145
Too rapid expansion of real estate firms	0.133	0.034	0.601
Lack of perceived viability of proposal	0.943	0.015	-0.675
Lack of credit history	-0.121	0.959	0.077
When the firm has exceeded the limit of its borrowing	0.862	-0.402	0.106

From Table 2, the first principal component (PC1) identified four major factors. A closer look at these factors suggests that they may be inherent in restrictive monetary policies of lending institutions. Monetary policy has been strictly limited by macroeconomic stabilization agreements made with the IMF and World Bank in conjunction with IMF loans, the HIPC (Heavily Indebted Poor Country) initiative and the PRSP (Poverty Reduction Strategy Paper) process.

Under the standard financial programming methods implemented by the IMF, target ceilings are set for central bank monetary and credit expansion and floors are established on net foreign reserves (Barth and Hemphill 2000) for good descriptions of these programmes). The original motivation for these restrictions were to ensure the ability of program countries to reduce their foreign debt and remain solvent, including protecting the ability of the IMF to get repaid. Recently, other goals, such as reducing inflation, increasing foreign exchange reserves and "creating room for private investment," for that matter, real estate development, have been emphasized. The main targets are Net Domestic Assets ceilings (NDA), which are sometimes called domestic credit ceilings, directly limit the amount of credit that the Bank of Ghana can create, and Net International Reserve floors (NIR), which require monetary and fiscal policy to operate so to preserve a minimum level of international reserves.

The second principal component (PC2) resulted in three factors. It is reasonable to suggest that these factors may be inherent in one principal factor, mainly financial and legal policy of lending institutions.

Respondents complain that Ghana has an inadequate legal system for collateralised lending and an extremely difficult land ownership and titling environment, which together constitute a major problem for mortgage lending. Consequently, only a limited number of banks extend mortgage bonds to borrowers. Also some real estate developers lack the "track record" and reputation to make them attract funding from financiers. Due to the inadequate legal system, it becomes difficult for banks or lending institutions to enforce repayment by defaulted borrowers.

The Bank of Ghana is responsible for formulation of all financial policies binding the operations of financial institutions. With no specialised legal institutions to enforce contracts effectively and in the absence of bankruptcy laws and procedures, banks' attitude to contract enforcement is rather subtle. The first line of action is often to persuade delinquent borrowers to resume their payments. The majority of bankers in the survey indicated that delinquency and default was generally not wilful, but resulted from poor returns on investments, particularly due to bad management of projects. Banks have occasionally been forced to re-finance projects in the hope that these will revive distressed borrowers. Banks suffer severe losses as results of the unavailability of adequate information to enable them arrange special loan contracts for borrowers who have not wilfully defaulted.

From Table 2, the third principal component (PC3) identified three factors. A close look at these factors suggests that they may be inherent in risk aversion transaction conditions of lending institutions. Transaction costs of lending, refers to the cost of administering credit and the cost of the risk of default. These are the costs involved in establishing and conducting financial relationships. Difficulties arising from transaction conditions are caused by the asymmetric distribution and costly acquisition of information. Consequently, economic transactions are conducted in highly uncertain and risky environments, which engender eminently more volatile returns to investment. Often, lenders have little information about the expected success of projects. This raises their risk perception and increases their reluctance to advance the financing requested of them.

In many developing countries, even with relatively well developed general banking systems financial institutions may not be prepared to take on the risks involved in developing a broadly based formal housing finance system without support. Government intervention is therefore seen as necessary to jump start a formal mortgage system

Financiers demand collateral or security so that in default of the debt, the funds can be recovered. Because some real estate firms lack assets to provide as collateral, and lack the “track record” necessary to establish their reputation, the financiers tend to put in place stringent lending conditions by charging higher interest rates, processing fees and insurance costs to all borrowers to cover the cost of additional monitoring requirements as well as the likelihood of bad debts and default on outstanding commitments. If banking institutions were co-ordinated in such a way to share the cost of funding to real estate developers, the risk involved in financing would not be so great as to warrant excessively high lending conditions.

Demand Factors

Demand factors associated with raising real estate finance are the internal constraints that the developers face in accessing finance from lending institutions. Seven factors were identified.

Nearly 89.58 % of real estate firms are unable to provide suitable collateral so as to enable them demand financial aid. Real estate firms graded this inability of providing acceptable collateral highest importance (code 5). Lack of personal financial contribution is an important factor restraining real estate firms from demanding financial aid.

In order to clearly interpret the eigenvalues loadings, these principal components were further subjected to factor rotation using the varimax with Kaiser normalization method (Kaiser, 1970, 1974).

Table 3 Component matrix of factor analysis of demand difficulty factors associated with raising funding for real estate firms.

Demand Factors	PC1	PC2	PC3
Lack of adequate financial control	0.798	0.245	-0.05
Absence of forward planning	0.790	0.055	-0.088
Deficiencies in the financial and managerial skill	0.476	0.681	-0.466
Real estate firms inability to repay loan on time	-0.341	0.851	0.054
Inability of real estate firms to provide acceptable collateral	0.066	0.635	-0.088
Inability of real estate firms to provide a viable business plan	0.693	-0.244	0.490
Lack of internal financial contribution	0.034	-0.464	0.925

The seven factors have been summarized into three components explaining the demand difficulty factors associated with raising funding for real estate developers. The first principal component (PC1) consists of three factors which can be grouped as resource planning of corporate real estate developers. . The preparation of business plan is the most important step in expanding existing business or launching new ventures. The business plan is the principal tool for raising finance. From an investor's viewpoint, a major consideration in deciding whether or not to supply capital is the quality of the business plan presented by the potential borrower. Firms' seeking to attract funding need to formulate a coherent business strategy, analysing the market opportunity and competitive advantages of its products, together with a clear implementation plan, bearing part of the risks of the business in order to induce investors in their assessment for offer of funding.

The deficiencies in the financial and managerial skill and competence of the real estate developers were found to be a factor. This deficiency results in a mismanagement of the finance of these firms thereby making it difficult for loans to be repaid on time. This makes it difficult for banking and financial institutions to advance loans to real estate developers.

The second principal component (PC2) consists of three factors. These factors are inherent in the credit rating position of corporate real estate developers.

The findings is consistent with the notion that collateral and personal guarantees also affect the incentives of creditors, as they will either substitute for or complement information production by financial intermediaries (Manove, Padilla, and Pagano, 2001; Rajan and Winton, Boot 2000; Longhofer and Santos, 2000). The presence of collateral and personal guarantees may also depend on the length and intimacy of the relationship between creditors and borrowers (Boot, 2000).

From Table 3, the third principal component (PC3) mainly, Lack of personal financial contribution is however, associated with financial strength of corporate real estate developers.

In order to enhance the lender's incentive to monitor, loan contracts must be structured in a way that makes the lender's payoff sensitive to the borrower's financial health. Rajan and Winton (1995) argue that collateral and personal contributions may serve as a contractual device to increase the lender's monitoring incentive, because collateral is likely to be effective only if its value can be monitored. Moreover, the use of collateral as an incentive will be more extensive when the value of such collateral depreciates rapidly according to business conditions (e.g., accounts receivable and inventories), than when the value of collateral is relatively stable (e.g., real estate). Internal and external sources of finance under perfect capital markets should be perfectly substitutable (Modigliani and Miller, 1958), so that the availability of internal funds should not affect investment decisions. It is reasonable to suggest that real estate developers need to generate enough cash flow to offset any funding they receive.

CONCLUSIONS

The study identified the factors that contributed to the difficulties in accessing finance for real estate development in terms of demand and supply. These factors were informed by the literature review. Upon analysis of these factors, it was realized that as much as banking and lending institutions contributed to the financial difficulties, the real estate developers themselves also contributed to their difficulty in accessing finance in other forms.

The deficiencies in the financial and managerial skill and competence of corporate real estate developers were found to be a factor. This deficiency results in a mismanagement of finance of these developers thereby making it difficult for loans to be repaid on time. In this regard, it becomes difficult for banking and financial institutions to advance loans to real estate developers. At times, banking and financial institutions would expect borrowers to provide counter-part funding to projects they are financing. This strategy is used by the financial institutions as part of a risk sharing strategy. The inability of real estate developers to provide this form of internal contribution also affects their success in acquiring finance.

On the side of the supply which is mainly made up of the Banks and other financial institutions, the interim result showed that, some of the difficulties of real estate finance could be attributed to them. Some of these factors were correlated under the following headings; restrictive monetary policy, financial and legal policy and risk aversion transaction conditions.

REFERENCES

Asare. E. L, (2004), Residential Mortgage Market in Ghana: Nature and Implications, Unpublished MPhil Thesis, Department of Land Economy, University of Cambridge UK

Bannock, G and Partners Ltd. 1991. Venture capital and the equity gap. A study commissioned by National Westminster Bank Barth, Richard and William Hemphill, 2000. *Financial Programming and Policy: The Case of Turkey.* Washington, D.C.: IMF Institute, IMF.

Bates, T. 1991, Comercial bank financing of white and black-owned small business start-ups, *Quarterly Review of Economics and Business.* 31 (1). Spring: pp. 64-80.

Beitel, P., Schiereck, D. and Wahrenburg, M. (2004), "Explaining the M&A success in European bank mergers and acquisitions", European Financial Management, Vol. 10, pp. 109-40.

Berger, A. N., and Black, L. K., 2011, Banking and Finance 35 (724-735)

Binks, M. R. Ennew C. T. and Reed G. V. (1990) *Finance Gaps and Small Firms,* Paper presented to Royal Economics Society Annual Conference. Royal Economics Society,

Binks M and Vale P, Entrepreneurship and Economic Change 1990. McGraw-Hill Book

Binks, M., Ennew, C. and Reed, G. (1988), *Small Businesses and Banks: A Two Nation Perspective*, Forum of Private Business, Knutsford.

Boamah, N (2002), The Impact of Liberalisation on Residential Property Financing in Ghana, Unpublished MPhil Thesis Department of Land Economy, University of Cambridge

Bolton Report (1971). Report of the Committee of Inquiry on Small Firms, Buckley, R. M. (1996), Housing finance in Developing Countries, Macmillan Press Ltd

Boot, Arnoud W. A. (2000). "Relationship Banking: What Do We Know?" Journal of Financial Intermediation 9, 7-25

Booth, Laurence, Aivazian, Varouj, Demirgüc-Kunt, Asli, and Vojislav Maksimovic (2001): Capital Structures in Developing Countries. The Journal of Finance, Vol. 56, pp. 87 - 130.

Centre for Democratic Development, CDD-Ghana Research Paper 4, August 2000,

Corruption and other constraints on the Land Market and Land Administration in Ghana: A Preliminary Investigation,

Confederation of British Industry, 1993. Finance for growth

Cybo-Ottone, A. and Murgia, M. (2000), "Mergers and shareholder wealth in European banking", Journal of Banking and Finance, Vol. 24, pp. 831-59.

Gockel, Augustine F. and Sesi K. Akoena. 2002. "Financial Intermediation for the Poor:

Credit Demand By Micro, Small and Medium Scale Enterprises in Ghana. A Further Assignment for Financial Sector Policy?". Geneva: ILO. IFLIP Research Paper 02-6.

Hankinson, A. Bartlett, D. and Ducheneaut, D. (1997). The key factors in the small profiles of small medium enterprise owner-managers that influence business performance, *International Journal of Entrepreneurial Behaviour and research*, Vol. 3 (4) pp 168-175.

Harvey, D. 1992. Small business, big banks. Certified Accountant, October, 26-27, *Management* Autumn pp.47-60. Management Science 30.10 pp1161-1183

Jaffee, D. and Russel, T. (1996). 'Imperfect Information, Uncertainty, and Credit Rationing', *Quarterly Journal of Economics*, Vol. 90, pp. 651-66.

Karley, N. K (2002), "Alternative Options to Mortgages in Ghana" in Housing Finance International 2 Vol. 17

Longhofer, Stanley D. and João A. C. Santos. (2000). "The Importance of Bank Seniority for Relationship Lending." Journal of Financial Intermediation 9, 57-89

Manove, Michael and A. Jorge Padilla. (2001). "Collateral versus Project Screening: A Model of Lazy Banks." RAND Journal of Economics 32, 726-744

Mason, C. M. and Harrison R. T. (1999), "Informal Venture Capital and the Financing of Emergent Growth Businesses." *The Blackwell Handbook of Entrepreneurship.* (eds)Menkhoff, L, Neuberger, D, and Suwanaporn, C, 2004, Journal of Banking and Finance 30 (1-21)

Miller D. and Friesen P.H. (1984) "A lower individual study of the corporate life cycle"

Modigliani, F. and Miller, M. (1958), "The Cost of Capital, Corporation Finance, and the Theory of Investment," *American Economic Review* 48, 261-297. Nottingham

Ofei, Kwadwo Ansah. 2001. "Terms and Access to Credit: Perceptions of SME/Entrepreneurs in Ghana". University of Ghana, Legon.

Pettit, R. and Singer R. (1985) "Small Business Finance: A Research Agenda." *Financial*

Rahaman, M. M, 2011, Access to financing and firm growth, Journal of Banking and Finance 35 (709-723)

Petersen, M. and Rajan, R. (2002). Does Distance Still Matter? The Revolution in Small Business Lending. *Journal of Finance* **57**(6): 2533-2570.

Rajan, Raghuram and Andrew Winton. (1995). "Covenants and Collateral as Incentives to Monitor." Journal of Finance 50, 1113-1146

World Bank, *Doing Business in 2005,* London, 2004.

CONSTRUCTION PARTICIPANTS' PERSPECTIVE ON MULTI-CRITERIA SELECTION PRACTICE IN LAGOS STATE, NIGERIA

Folasade Omoyemi Alabi[1]

Quantity Surveying Department, Yaba College of Technology, Yaba, Lagos, Nigeria

The awards of contract to qualified contractor contribute to its successful delivery, which is a desirable goal of every construction participant. However, in Nigeria the award of contract has been perceived as lacking transparency which makes the adoption of multi-criteria selection practice in contractors' selection a viable option. This study investigates the perception of the construction participants on the use of multi-criteria selection practice. The research method involves the review of literatures and administration of structured questionnaires to construction participants using a purposive sampling technique. The data were analyzed using descriptive analysis while mean items score was used to present responses obtained on a modified Likert scale instrument. The study revealed that most organizations viewed prequalification as a standard procedure for the execution of construction projects. In addition, the decision criteria and evaluation of contractors are considered to be based on the size, type and complexity of projects while both clients and contractors are found to benefit from multi-criteria selection practice. The study recommends that prequalification of contractors must be done periodically for developing a standing list of contractors.

Keywords: contractor selection, multi-criteria selection, Nigeria.

INTRODUTION

In trying to select the most suitable and qualified contractor for the contract, the task facing a construction client is a multiple criteria decision making process, in which a large number of criteria need to be evaluated (Sonmez, Yang and Holt, 2001 citing Hatush and Skitmore, 1998; Martin 2008). Jennings and Holt, (1998) define multi-criteria selection practice as a selection based on evaluation of tender submissions against criteria predetermined by client and considered important by advisor in terms of achieving successful project completion. Using a multi criteria approach for evaluating contractors with respects to their economic and technological aspects, quality standards, past performance and other characteristics assist in solving the problem of poor performance by contractors (Odusami, 1998).

Earlier studies (Drew and Skitmore, 1993; Odusami, 1998; Onwusonye, 2006) note that prequalification seeks to ensure that invitation to bid are extended only to those who have adequate capabilities and structures taking into cognizance the contractor experience in relation to past performance on similar contracts, capabilities with regard to personnel, equipment and construction facilities, financial position and other associated structure. Moreover, prequalification is employed to screen out those

[1]foalabi02@yahoo.co.uk

Alabi, F.O. (2011) Construction participants' perspective on multi-criteria selection practice in Lagos State, Nigeria *In:* Laryea, S., Leiringer, R. and Hughes, W. (Eds) *Procs West Africa Built Environment Research (WABER) Conference*, 19-21 July 2011, Accra, Ghana, 273-279.

contractors having low capabilities; the remaining bidders are then evaluated for further consideration (Topcu, 2004).

Sadly this area has been neglected in the Nigerian construction industry and in most cases; prequalification of contractors has always been based on whom you know and not whether the contractor can perform (Odusami, 1998). In support of this view, Onwusonye (2006) adds that the award of contracts in Nigeria has been perceived as lacking transparency, inflated contract cost and process that were closed discretionary and well designed conduct for abuse of public power. This led to poor performance of contractors especially on government sponsored projects. Consequently the Nigerian government established what is called "due process" in order to introduce transparency in construction procurement system. Under due process, contactors are initially prequalified before being allowed to tender with the aim of ensuring that qualified contractors are selected and the minimum project cost is achieved (Mafimidiwo, 2009). However, in the private sector, the multi-criteria selection practices are influenced by the clients' organization policies and consultants' advice.

To date, much construction procurement research has investigated aspects of tendering strategies (Mafimidiwo, 2009), prequalification and selection of contractor from the clients and consultants view points (Odusami, 1998; Ng and Skitmore, 1999; Plebankiewicz, 2010), and from the viewpoint of contractors (Jennings and Holt, 1998). Therefore, taking a cue from past studies (Drew and Skitmore, 1993; Holt, Olomolaiye, and Harris, (1995); Jennings and Holt 1998); this study intend to investigate the construction participants' views on the use of multi criteria selection practice in Lagos state, Nigeria

LITERATURE REVIEW

Farooq (2005) observes that the overall objectives of the project unite a diverse collection of project participants who are involved in the award and execution of contracts in the construction industry. Most of the clients recognized the role of the construction practitioners in the overall success and final cost of the project. Thus, construction owners have developed many different ways of selecting contractors who will be responsible for the execution of the project. These different ways of selecting contractors according to Farooq (2005) have been based on several factors ranging from the circumstances of the prospective owners to the extent of advice or guidance supplied by the project consultants.

Banaitiene and Banaitis (2006) note that the selection of an appropriate contractor is the most critical for project success, as the decision may result in the success or failure of the entire project. The objective of prequalifying contractors as noted by Drew and Skitmore (1993) is to obtain an optimal level of competition that is, obtaining the lowest bid at a minimum cost of bidding. This requires engaging the minimum number of contractors to obtain a genuine competitive bid. Plebankiewicz (2010) adds that the aim of prequalification is often not only contractor competence evaluation, but also limitation of potential contractors. In such case it is necessary not only to judge whether the contractor fulfils basic criteria, but also to what degree they are fulfilled.

Holt, et al (1995) posit that prequalification of contractor provides some degree of confidence in the client that the firms selected will meet project needs. Such confidence however, is a function of the integrity of the prequalification regime. Banaitiene and Banaitis (2006 citing Palaneeswaran and Kumaraswamy 2001) point out that contractor prequalification is generally preferred by clients to minimize risks and failures and to enhance the performance levels of selected contractors by means of established minimal capacities below which contractor will not be considered.

Drew and Skitmore, (1993) identified potential problems faced by clients using prequalification criteria, which includes: inflated development costs; difficulties in developing quantifiable criteria and formalizing the decision making process to make objective and sound decisions; and the possibility of higher contract prices when reducing the numbers of contractors. Potential problems for contractors include the possibility of unfair exclusion from the bidding process, and the expenditure of resources on promotion and public relations to secure an opportunity to participate in the bidding process.

Holt et al (1995) identify four main areas of deficiency in contractor selection as lack of a universal approach to contractor selection; long term confidence attributed to the results of prequalification; dependency on tender sum in tender evaluation/final selection methods; and an over reliance on subjective analysis. Banaitiene and Banaitis (2006) also identify three prime causes of inadequate contractors' selection thus: inappropriate criteria; inappropriate significance attributed to the criteria; inappropriate methodology applied for the contractor evaluation and selection task. Consequently, improper contractor prequalification and selection practice has been identified as a major contributor to abandoned projects and to the construction industry inefficiency.

However, Ng and Skitmore (1999) posit that multi-criteria selection practice will improve chances of contract award and that both clients and contractors benefit from it. For clients, it will aids in distinguishing unwilling and inexperience contractors from willing and experience contractors. For contractors, it will minimize the number of unqualified contractors who might enter unrealistic tenders, provide a direct opportunity to decline without fear of future disqualification, and protect contractors from being awarded contracts they are not capable of performing. Also, due to reducing the number of bidders, the probability of each tenderer winning the contract is increased.

RESEARCH METHOD AND DESIGN

To achieve the study objective, a literature review on multi-criteria selection practice was carried out, supported with self administered questionnaires which are similar to the approach used in related studies (Odusami, 1998; Mafimidiwo, 2009). The study population comprises of construction participants operating in Lagos metropolis being a major commercial city in Nigeria. The categories of organizations identified as having experiences in the use of multi-criteria selection practice are Private and Public clients, Architectural, Quantity Surveying, Civil/Structural engineering and Building/Service engineering firms. The sampling technique adopted for the study is purposive because of the fuzzy nature of the data on construction participants in Nigeria. Data analysis was done by using descriptive statistics while mean item scores was used to present responses obtained on a modified Likert scale instrument.

DATA COLLECTION

The questionnaire comprises of two parts. Section A sought to get information about the organization of the respondent, respondent discipline, and the category of project the respondent organization undertakes. Section B sought information about the type of projects where multi-criteria selection practice is used; and reasons for prequalification of contractors, among others. In addition, the respondents were requested to rank in the order of importance the prequalification objectives and the decision rules in contractors' selection among others.

RESULT AND DISCUSSION OF FINDINGS

A total of fifty-five questionnaires were administered and forty-five (82%) were retrieved and analyzed. According to figure 1, the highest responses (16) came from public authority while the lowest (7) was from private clients. The contracting and consulting organizations recorded 12 and 10 responses respectively.

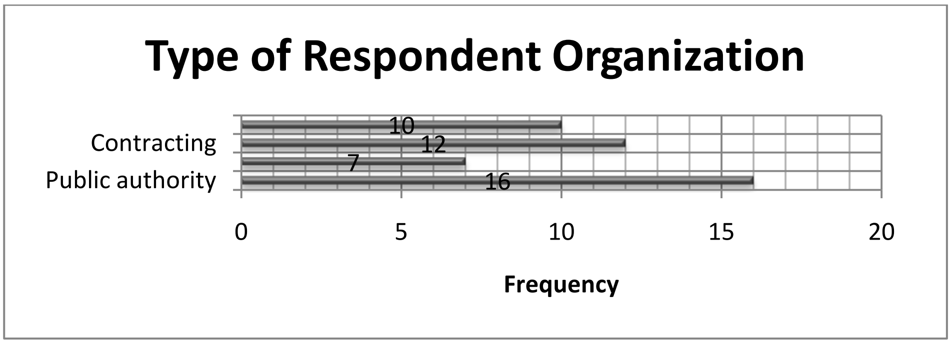


Figure 1: Type of Respondent Organization

Table 1 identifies the types of projects on which prequalification of contractors are carried out. Building works ranked the highest with 44.44% followed by Building/Civil Engineering works (40%) while civil engineering works and Civil/Building maintenance work recorded 13.33% and 4.44% respectively. This is expected as the most common form of construction project is building works when compared with others.

Table 1: Projects where multi-criteria selection practice is used

Types of work	Frequency	Percentage
Building work	20	44.44
Building /Civil Engineering works	18	40
Civil Engineering work	6	13.33
Civil /Building Maintenance	2	4.44
Others	2	4.44

Notes: Very Strong = 5, Strong = 4, Moderate = 3, Low = 2, Very low = 1

On reasons for prequalification by firms as indicated in table 2, the majority of the respondents (57.77%) viewed it as a standard procedure for the execution of construction project while the need to comply with due process was given by 22.22% of the respondents. Other reasons are indicated in their order below. These findings support Holt *et al*. (1995) position that no matter how construction is procured, a method of contractor selection must still be employed.

Table 2: Reasons why organizations prequalify

Reasons	Frequency	Percentage
Standard procedure	26	57.77
Comply with due process	10	22.22
Ensure most suitable contractor is employed	7	15.56
Public accountability	3	6.67
Client's demand	2	4.44
Wide usage	1	2.22

Notes: Very Strong = 5, Strong = 4, Moderate = 3, Low = 2, Very low = 1

According to table 3, the predominant prequalification criteria and decision rules used in selecting contractors for construction projects are determined by the size, nature and type of projects according to the majority (84.44%) of the respondents. In-house guidelines of the client's organization (8.89%), client's requirements/strategies (6.67%) and individual's experience (6.67%) are not significant factors. This view support Banaitiene and Banaitis (2006) conclusion that evaluation criteria for bids of contractors must be selected considering the size and complexity of a construction project.

Table 3: Determinant of prequalification criteria and decision rules used for projects

Decision criteria	Frequency	Percent age
According to the size, nature and type of project	38	1
According to in - house guidelines of the clients	4	2
According to clients requirements / strategies	3	3
According to individual's experience	3	4
Notes: Very Strong = 5, Strong = 4, Moderate = 3, Low = 2, Very low = 1		

As shown in table 4 all the listed client prequalification objectives are highly rated by the respondents. This finding supports the view that prequalification objectives aim at ensuring projects success hinged on quality, cost and time performance (Drew and Skitmore, 1993; Banaitiene and Banaitis, 2006).

Table 4: Prequalification objectives

	Mean item score	Rank
Quality	4.76	1
Value for money	4.69	2
Time	4.31	3
Safety	4.17	4
Cost	4.16	5
Risk	3.62	6
Notes: Very Strong = 5, Strong = 4, Moderate = 3, Low = 2, Very low = 1		

The levels of importance of twelve decision criteria for prequalification of contractors were ranked very highly by respondents as shown in table 5. Performance was ranked 1st, followed by financial stability, reputation, and others respectively. This finding supports past studies (Jennings and Holt 1998; Ng and Skitmore, 1999; Plebankiewicz, 2010).

Table 5: Level of importance of decision criteria

Decision criteria	Mean item score	Rank
Performance	4.67	1
Financial stability	4.38	2
Reputation	4.51	3
Standard of quality	4.49	4
Integrity	4.36	5
Health & safety	4.22	6
Resources	4.13	7
Management capability	4.00	8
Quality assurance & control	3.78	9
Working capital	3.73	10
Current workload	3.67	11
Level of technology	3.60	12
Notes: Very Strong = 5, Strong = 4, Moderate = 3, Low = 2, Very low = 1		

The prime causes of inadequate contractor selection are indicated in table 6. Long term confidence on the result of prequalification was ranked highest followed by others as shown below. Holt et al (1995) and Jennings and Holt (1998) studies corroborate these findings where lack of cyclic review of prequalification criteria was said to exist among others.

Table 6: Causes of inadequate contractor selection

	Mean item score	Rank
Long term confidence on the result of prequalification	4.17	1
Inappropriate criteria selection	4.07	2
Dependency on tender sum in tender evaluation	4.02	3
Inappropriate significance attributed to the criteria	3.84	4
Notes: Very Strong = 5, Strong = 4, Moderate = 3, Low = 2, Very low = 1		

According to table 7 the majority of the respondents (88.89%) are of the view that both the clients and contractors benefit from multi-criteria selection practice while a very small minority (8.89%) believed that it is only the clients that benefit from multi-criteria selection practice. This outcome is supported by earlier study by Drew and Skitmore (1993) where it was observed that both the clients and the contractors benefits from prequalification exercise.

Table 7: Who benefits from multi-criteria selection?

	Frequency	Percentage
Client	4	8.89
Contractor	1	2.22
Both	40	88.89
Neither	-	-
Total	45	100

CONCLUSION

The selection of an appropriate contractor is considered to be very critical to project success which informed the adoption of multi-criteria selection practice in contractor selection. The study takes a cue from other related studies and discovered that most organizations in Nigeria viewed prequalification as a standard procedure for the execution of construction projects coupled with the need to comply with “due process”. The predominant prequalification determinant in selecting contractors was found to be based on the size, nature and type of projects while the prequalification objectives such as quality, value for money, time and safety were highly rated by the respondents indicating their importance in ensuring projects success. The respondents agreed with literatures on the importance of performance, financial stability, reputation, among others as decision criteria for prequalification of contractors and also established that both clients and contractors benefit from multi-criteria selection practice.

The study further identified the prime causes of inadequate selection of contractor as long term confidence in the results of prequalification and inappropriate criteria among others. Therefore, the study recommends that while using multi-criteria selection practice, contractors’ qualification must be evaluated by determining and defining appropriate evaluation criteria and the prequalification of contractors must be done periodically for developing a standing list of contractors.

REFERENCES

Banaitiene, N & Banaitis, A 2006, 'Analysis of criteria for contractors' qualification' *Technological and Economic Development of Economy*, vol.12, no.4, pp.276-282.

Drew, DS & Skitmore, MR 1993, 'Prequalification and competitiveness' *International Journal of Management Science*, vol.21, no.3, pp.363-376.

Farooq, A 2005, 'Efficacy of contractor prequalification models' Thesis proposal submitted to the Department of Construction Engineering and Management,

King Fahd University of petroleum and Minerals.

Hatsush, Z & Skitmore, M 1998, 'Contractor selection using multicriteria utility theory:

an additive model' *Building and Environment*, vol.33, pp.1283-1300

Holt, GD, Olomolaiye, PO, & Harris, FC 1995, 'A review of contractor selection practice in the U.K construction industry' *Building and Environment*, vol.4, no.30, pp.553-561.

Jennings, P & Holt, GD 1998, 'Prequalification and multi-criteria selection: a measure of contractors` opinion' *Construction Management and Economic*, vol.16, pp.651-660.

Mafimidiwo, BA 2009, 'A review of tendering strategies for project procurement in the Nigerian formal and informal sectors' *The Yaba Journal of Environmental Research*, vol.1, no.2, pp.140-154.

Martin, B 2008, *Estimating and tendering for construction work*, 4th edn, Butterworth-Heinemann Publications, Oxford,

Ng, ST & Skitmore, RM 1999, 'Client and consultant perspectives of prequalification criteria' *Building and Environment*, vol.34, pp.607-621.

Odusami, KT 1998, 'Prequalification and selection of contractor' *Journal of construction in Nigeria*, vol.13, no.1, pp.23-28; 30-32.

Onwusonye, SIJ 2006, *Tendering, estimating and contracting arrangement in building project (principle and practice)*. Intercontinental Education Books and Plublishers, Owerri.

Palaneeswaran, EA & Kumaraswamy, M 2001, 'Recent advances and proposed improvements in contractor prequalification methodologies' *Building and Environment*, vol.36, pp.73-87

Plebankiewicz, E 2010, 'Construction contractor prequalification from polish clients' perspective' *Journal of Civil Engineering and Management*, vol.16, no.1, pp.57-64.

Sonmez, M Yang, JB & Holt, GD 2001, 'Addressing the contractor selection problem using an evidential approach' *Engineering, Construction and Architectural Management*, vol. 8, no.3, pp.198-210.

Topcu, YI 2004, 'A decision model proposal for construction contractor selection in Turkey' *Building and Environment*, vol.39, pp.469-481.

COST IMPLICATIONS OF BIODEGRADATION OF KHAYA GRANDIFOLIOLA (DRY LAND MAHOGANY) BY ASPERGILLUS SPP IN RESIDENTIAL BUILDINGS

I. H. Mshelgaru[1] and A. D. Abdulazeez
Department of Building, Ahmadu Bello University, Zaria, Nigeria

Degradation of timbers in building due to microorganisms was reported to cause enormous economic loses and species of Aspergillus are among the major contributors to the degradation of timbers in Nigeria. This research aimed at evaluating cost of implications of the biodegradations of *Khaya grandifoliola* by Aspergillus in residential buildings empirically. Decayed *Khaya grandifoliola* samples were collected on residential buildings to extract, cultivate and identify the Aspergillus spp present. The cultivation went through serial dilutions and inoculations on sabouraud dextrose agar in petri dishes for 72 hours at 30^{o}C. The species were identified through visual and microscopic observations. Percentage rate of degradation were determined under controlled laboratory conditions by inoculating known weights of *Khaya grandifoliola* with the Aspergillus spp and incubating in a minimal medium for 24 weeks at 30^{o}C. Weight loses and spore counts were recorded at 4 weeks intervals. A pattern of the degradation was forecasted for 24 months. an accumulative weight lost of 16% for this period was obtained. Methods and costs of repair and replacement of the decayed portions were investigated. Residential Buildings constructed of *Khaya grandifoliola* will experience considerable high cost of maintenance if conditions favourable to the Aspergillus spp.

Keywords: Aspergillus, biodegradation, cost, *Khaya grandifoliola*, residential building.

BACKGROUND

Mahogany is a type of timber commonly used as structural and non structural constructions of buildings in the dry land region of the savanna. The specific species is known as *Khaya grandifoliola*. Mshelgaru (2010) indicated that *Khaya grandifoliola* is from the family of Meliaceae and is locally known in the Nigerian timber market as 'madachi', 'oganwo', 'ono' and 'dalchi'. Its timber is reddish, becoming very dark with age, fairly hard, and is distinguished from other timbers in the region by the close network of the thick circum-medulary lines of the parenchyma which is visible to the naked eye (Usher and Ocloo, 1979 and Erickson, et al; 2005). *Khaya grandifoliola* is known for its durability, high strength-to-weight ratio and many positive structural and aesthetic properties that earn it its popularity. But like any other timber *Khaya grandifoliola* provides specialised ecological niches in which many organisms are evolved in using it as food (Lappalainen, et al; 2001; The Hidden Forest, 2011).

[1] hassangaru468@gmail.com

Mshelgaru, I.H. and Abdulazeez, A.D. (2011) Cost implications of biodegradation of Khaya grandifoliola (dry land mahogany) by aspergillus spp in residential buildings *In:* Laryea, S., Leiringer, R. and Hughes, W. (Eds) *Procs West Africa Built Environment Research (WABER) Conference,* 19-21 July 2011, Accra, Ghana, 281-289.

The microorganisms that deteriorate timbers are generally from the phyla of basidiomycetes and ascomycetes where Aspergillus hails (Pe´rez, et al; 2002). These families are kwon to cause the most serious damage in timber structures around the world. Decays in timber are categorized into soft-rot, white-rot, and brown rot (Usher and Ocloo, 1979). This classification is based on the macroscopic characteristics of the advanced stages of the decays. Among the white-rot fungi are the Aspergillus spp which specialized in destroying hardwoods (Morris, 1998). Fungi have varying ability to reduce the strength of timbers. Smulski (1996) showed that the white-rot or the brown- rot fungi can affect several strength and mechanical properties of timber much before significant weight loss is reached. This gradual reduction in strength is as a result of the break down of the lignocellulose, lignin and cellulose of the cell walls.

Aspergillus spp can utilize *Khaya grandifoliola* for food because of their ability to produce a large number of enzymes. They were reported to have the abilities to destroy various types of timbers in buildings (Lappalainen et al; 2001; Mshelgaru and Olonitola 2010). Morris (1998) and Highley and Flournoy (1994) cited *Aspergillus clavatus, A. flavus, A. parasiticus, A. fumigatus, A. niger, A. oryzae, A. terreus, A. ustus,* and *A. versicolor* as some of the ubiquitous species among the 200 species of Aspergillus identified world wide (The Hidden Forest, 2011). *Aspergillus* spp are saprophytic filamentous organisms that are capable of enzymatically degrade complex cellulosic structures of timber, into simple digestible products for food (The Hidden Forest, 2011). The cellulose, hemicellulose, and lignin make up about 45% of the dry weight of the timber and the hemicellulose potion makes 25–30% of total weight of a dried timber. Beesely (1987) and Lappalainen et al (2001) explained that the fine, threadlike strands called mycelia of the Aspergillus grow and spread throughout the microscopic cell walls to excrete the enzymes that digest the cell walls. The rate and extent at which this occurs depend on the duration of the condition favorable for the growth (Malloch, 1997).

The activities of fungi on timber do not only affect functional properties but also affect social status and cause economic losses of buildings. It was reported (Morris, 1998) that in 1945 timber structures in the coastal region of British Columbia experienced a much preventable loss as a result of decay by fungi , particularly in and around residential buildings. Beesely (1987) has estimated the annual costs of timber damage in the United States to be two billion dollars a year and that this number grows every year. Morris (1998) also reported an estimated yearly cost of 4000 million Euros spent on maintenance of fungi damage buildings components in Finland However, the economic advantages of the same fungi are also huge, especially in industry and health (Albinas and Bronius, 2007).

MATERIALS AND METHODS

Sample Collections

Bulk samples of ten grammes were aseptically collected on deteriorated timber components on residential buildings that had shown visible signs of deteriorations. Information on age and designations of buildings were also gathered to determine the condition of the component and to know how the deteriorations observed developed.

Cultivation of Microorganisms

Sabouraud Dextrose Agar (SDA) were used as the culture media and were prepared according to manufacturers' specifications of glucose 40.0g, peptone 10.0g , streptomycin 0.01%, agar 15.0g, and distilled water 1000ml. This was poured into

20ml petri dishes and sterilized at 121^{o}C for 15 minutes and then allowed to solidify. A stock of one gramme of decayed sample collected from residential buildings was dissolved in 10 millilitre of peptone water. These were thoroughly shaken to dislodge the fungi spores that may be present. From this, dilutions, of 0.5 millimeters of the second and fourth series were inoculated on to the petri dishes already labeled. The inoculums were then spread over the entire surface using a sterile glass rod spreader. The SDA plates were incubated at 30^{o}C for 72 hours, after which developed colonies were identified and isolated and then counted with the aid of magnifying electronic counter.

IDENTIFICATIONS AND ISOLATION OF ASPERGILLUS SPP

Visual observations with the aid of dissection microscope and light microscopes were the main techniques used to identify the fungi. Microscopic observations were conducted. During this observation attentions were paid to distinguishing characteristic such as growth morphology, presence and forms of conidia, septa, conidiophore, appendage, hyphae, texture, catenation, and colour features which distinctly differentiate one species or genera from another. The information obtained were referred to relevant fungi dichotomous and picture keys from text books (Barnett, 1993) and online (Malloch, 1997; Kleagerb, 2011; The Hidden Forest, 2011) sources for inferences for the identifications.

Determining Biodegradability of *Khaya grandifoliola* by Aspergillus spp

To determine the biodegradability sound *Khaya grandifoliola*, known weight of sterile samples of the *Khaya grandifoliola* were inoculated with Aspergillus spp in a minimal medium and incubated for 24 week at 30^{o}C. The temperature and moisture supply were controlled and maintained throughout the period of the study. Cumulative percentage lost of weight due to the biodegradation process was recorded at every 4 weeks interval.

RESULTS AND DISCUSSION

Prevalence of Aspergillus spp on *Khaya grandifoliola*

The prevalence of Aspergillus spp on decayed samples of *Khaya grandifoliola* is shown in fig 1. The determination of prevalence was conventionally based on cultivation methods from a serial dilution (Smulski, 1996). High prevalence of Aspergillus spp on samples of *Khaya grandifoliola* is an indication of involvements of the organisms in the biodegradation (Erickson, *et al*; 2005). The high prevalence (samples H1-H15) and the repeated encounter of the same species on the *Khaya grandifoliola* were indications of dependence on this species of timbers for food for survival.

Although the experiments conducted suggested that not all of the Aspergillus spp available could break down the *Khaya grandifoliola* cell tissues; Highley and Flournoy (1994) reported that fungi are the major biodegradants of timbers (Mshelgaru and Olonitola 2010). Similar studies (Pe´rez, et al; 2002) were reported to have linked these genera and confirmed its saprophytic characteristics on timber species.

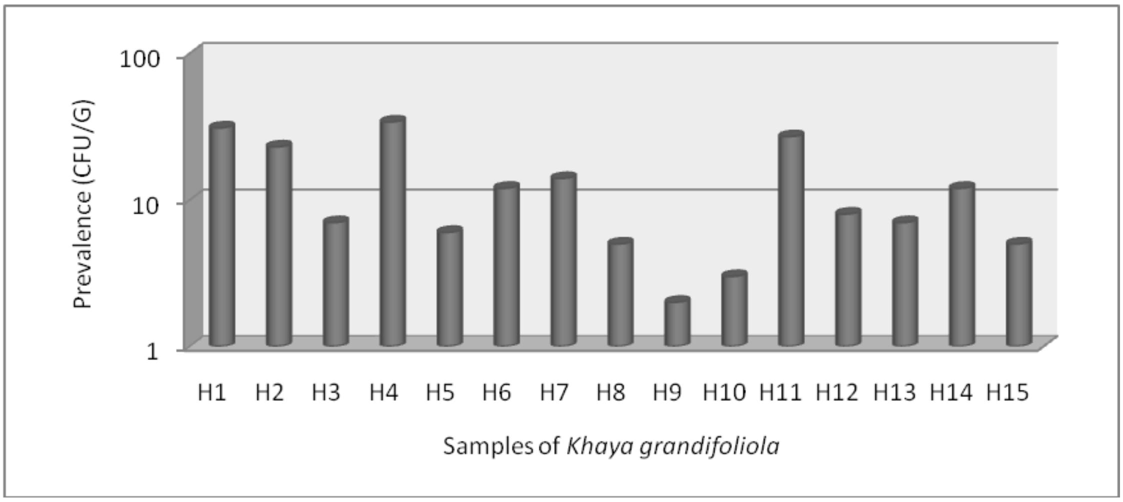


Figure 1: Prevalence of Aspergillus spp on *Khaya grandifoliola*

Potentials of Aspergillus spp to Utilise *Khaya grandifoliola*

In order to confirm and assess the involvements of Aspergillus spp in the biodeteriorations of the *Khaya gradifoliola* samples, sterilized sound samples (not deteriorated) were inoculated with the Aspergillus spp and incubated for 15 days.

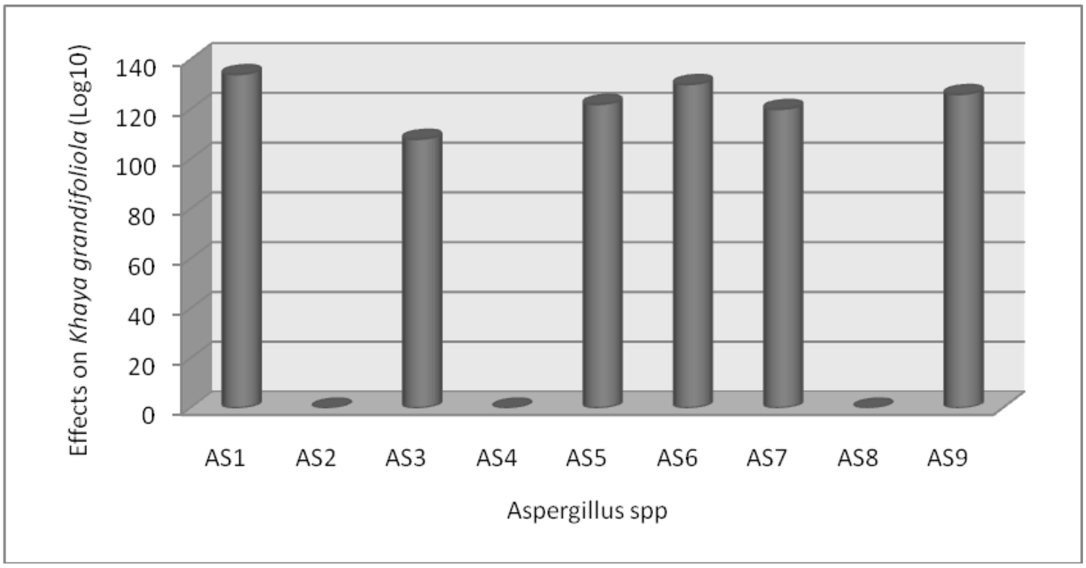


Figure 2: Effects of Aspergillus spp on *Khaya grandifoliola*

Figure 2 shows the intensity of attack of the Aspergillus spp. The figure indicates how viable this species are in the current settings. Species AS2, AS4 and AS8 exhibited properties that suggested their inability to degrade *Khaya grandifoliola* while the rest prolifically degraded it under the same conditions. Most of the species can degrade the timber.

Degree of Degradation of *Khaya grandifoliola* by Aspergillus spp

Figure 3 shows the extents of degradation of 20 samples of *Khaya grandifoliola* from different sources under the attacks of Aspergillus spp. The isolated genera and species were challenged with steriled samples of the *Khaya grandifoliola* as in Fig 2. The natural characteristic of the *Khaya grandifoliola* were displayed under the influence of various species of Aspergillus.

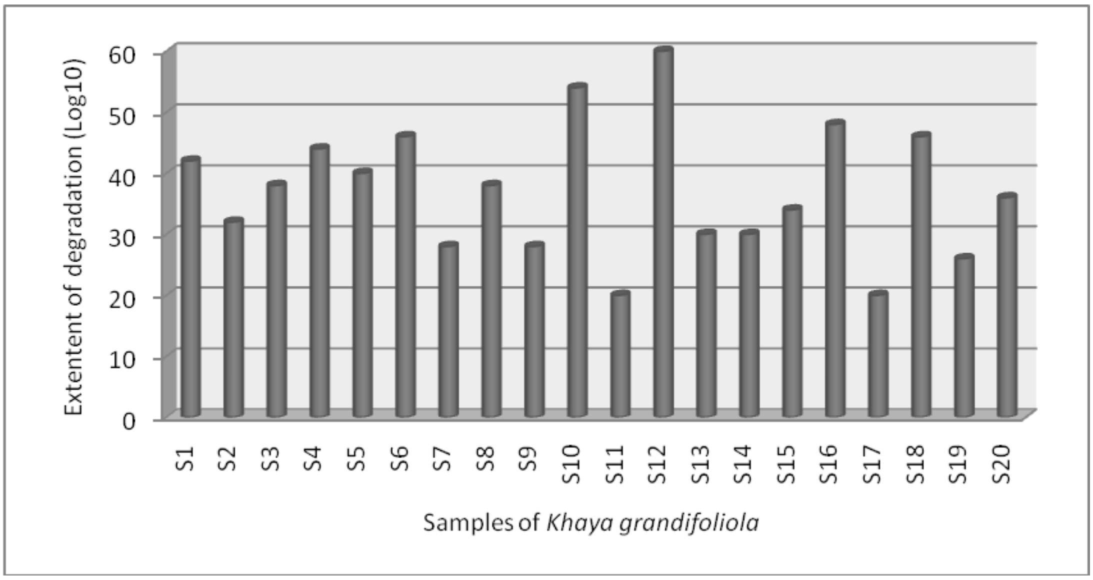


Figure 3: Extents of degradation of *Khaya grandifoliola* Aspergillus spp

The degradation is higher in samples S12 and S10 compared to S11 and S17. The differences result from natural resistance and degrading characteristics of the organism. The studies conducted by Usher and Ocloo, (1979) adopted this method to categorise some West African timbers according to their natural resistances.

Biodegradation Pattern of *Khaya grandifoliola* due to Aspergillus spp

1. Degradations of Khaya grandifoliola by Aspergillus spp Under Laboratory Conditions

Table 1: Percentage lost of weight of *Khaya grandifoliola* attacked by *Aspergillus spp*

Time	Sample	Mass Loss (%)	Average Percentage Mass loss
12^{th} Week	K1a	0.24	
	K2a	0.25	0.246
	K3a	0.27	
	K4a	0.23	
16^{th} Week	K5b	0.64	
	K6b	0.67	0.648
	K7b	0.65	
	K8b	0.63	
18^{th} Week	K9c	1.68	
	K10c	1.66	1.653
	K11c	1.65	
	K12c	1.62	
24^{th} Week	K13d	2.42	
	K14d	2.31	2.482
	K15d	2.67	
	K16d	2.53	

Table 1 shows cumulative percentage lost of weight of *Khaya grandifoliola* for the period of 24 weeks. Lost of weight for four and eighth week were inconsistent and insignificant. The experiment measured the growth activities of *Aspergillus spp* at a controlled laboratory conditions, moisture, oxygen, thermal loads and other activating factors were at 100%. An empirical damage function of the timber and the timber-decaying fungi was developed.

Usually, when microorganisms are moved from favourable conditions, to harsh conditions; they tend to either cease to grow permanently or retard until they are able to produce appropriate enzymes capable of digesting the new environment to source for food to survive (Highley and Flournoy, 1994). The slow down disrupts process of biodegradation and kills wanted fungi. This could have been the cause of the inconsistency recorded at the earlier stage of the experiment. To reduce the negative effect of this phenomenon, a small quantity of yeast extracts was added to the minimal medium to guaranty survival of days. But since the aim of the experiment was to study the activities and the behaviour of healthy organisms; the radical shift in metabolic activities was prevented by incorporating KH_2PO_4 and K_2HPO_4 into the media (Smulski, 1996) to serve as a buffer.

The results obtained employing 16 samples were progressive and consistent. Perhaps, because the period of the experiment fail short of when growth of the fungi will retard as a result of physiologically abnormality. These organisms degrade cellulose by secreting enzymes that convert the cellulose into compounds that they absorb. This attack depletes the cellulose content of the wood and leaves a residue rich in lignin. Lappalainen et al (2001) described characteristic of such degraded timber as dark in color, loses of strengths, and become soft, punky, and cross-checked, or fibrillated.

2. Forecasted Degradations of Khaya grandifoliola

Figure 4 presents the forecasted trend line of the degradation of the *Khaya grandifoliola* for a period of 24 months. 16% lost was forecasted for this period. Erickson et al (2005) reported 66% lost of weight at an advanced stage of biodeterioration.

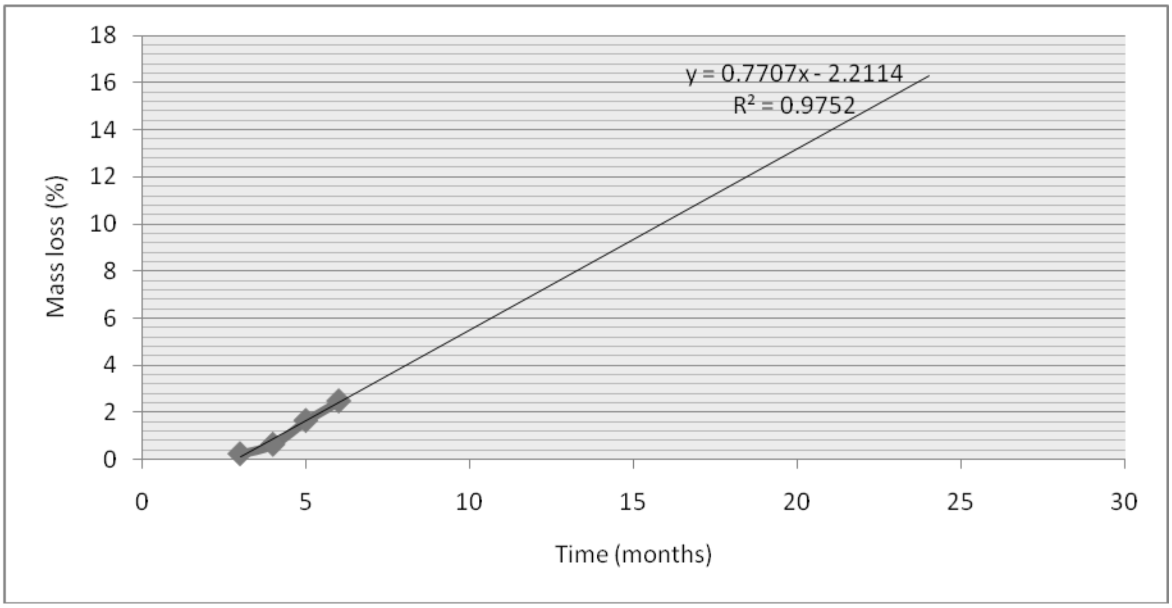


Figure 4: Trend of degradation of *Khaya grandifoliola* by Aspergillus spp

As degradation progresses, the metabolic activities of the growing organisms population may eventually change the nature of the environment to a point where it will become highly unfavourable and the population will become physiologically abnormal or dies or inhibit further growth (Erickson, et al; 2005), even when the activation factor were still available. This may be brought about by, a drastic change in the hydrogen ion concentration (pH) being either acidic or basic, or by the accumulation of toxic organic metabolites, or by the depletion of oxygen (Smulski, 1996). A condition similar to the laboratory condition can be attained in service when water activity (A_w) Levels is > 0.90, RH value at 90% (The Hidden Forest, 2011), oxygen level in the air is at 20%, and atmospheric temperature is 30°*C*. (Lappalainen et al; 2001).

DISCUSSION

When timber lost its values it needs refurbishment (Richardson, 1995) in order to restore its functionality. The deteriorations due to Aspergillus results to high cost of maintenance that can inflate the life-cycle cost of buildings (Worldsworth, 2001; Forest and wood products research and Development Corporation, 2001). This will eventually render the entire building uneconomical to maintain. On degradation, the *Khaya grandifoliola* does not only loss physical mechanical, acoustic and insulation properties but also loss desirable colours, increased fire hazards; (Highley and Flournoy, 1994) and pollute with missions of volatile organic compounds, toxins and odour; becomes more nutritional to insects, causes sick building syndrome and allergens (Pe´rez, et al; 2002; Mshelgaru and Olonitola 2010). The subsequent effects of all, boarder on the comfort and well being of the building occupants and environmental impacts, which can be interpreted to money.

To remediate partially decayed non structural timber components, cleaning and reinforcement with a sound member may suffice; but for a structural member a complete replace of the deteriorated member may be necessary. The elements of cost related works in remediating deteriorated *Khaya grandifoliola* may include the followings;

1. In-place treatment

Clean-up of small area (fewer than 3 patches and each parch smaller than a square meter) of fungi problem can be removed by the maintenance staff at less cost (The Hidden Forest, 2011). But cleaning-up a moderate and a large contaminations, a consultant firm must be consulted. Treating an infected, but serviceable timber can be done not only to kill the active fungi (Aspergillus), but also to guard against future infections epoxy (Beesely, 1987), in which case the services of the consultant firm is also required.

2. Remediation of decayed potions

In *s*ome instances replacement of rotted timber may not be better option than repair and this may include restoration of the lost properties (Albinas and Bronius, 2007). In repairs for conservation, for example, the goal is to preserve as much of the original part as possible. After a successful repair, it is a good option to the restored component can be stabilized with. Epoxies are useful for consolidating rotted timbers, restoring lost portions of molding's and carvings, and for strengthening weakened structural members (Worldsworth, 2001).

3. Replacing decayed components

This operation comprises the costs of removal, material and construction or installation. It starts with removing the deteriorated and damaged components as indicated on the plan design, to be replaced with a new one. The Hidden Forest (2011) stresses that to achieve good replacement, understanding of the cause of infection and the philosophy of the biodegradation is necessary prerequisite. Removal is done as much as practicable and economical until sound timber reached, especially with beams, columns, and other critical members whose load-carrying ability may be compromised as result of the deterioration. This is because difficult-to-detect incipient decay can extend well beyond visibly rotted areas. Even though, Lappalainen et al (2001) and the Hidden Forest (2011) pointed out that there's no known way of accurately determining residual strength of decayed timber in place; Erickson et al (2005) suggested strength-to-weight ratio values, velocity of ultrasonic and other visual means can good guides. The cost of the *Khaya grandifoliola* is relatively expensive due to scarsity. Mshelgaru (2010) recorded differences of 30% in the the market prices of 'fairly used' and brand new ones.

CONCLUSION

This study of biodeterorations of *Khaya grandifoliola* by Aspergillus spp suggested that most of the spp available on the residential buildings had the ability to degrade and the damage they caused was enormous. The procedure used in this study (incubation) is associated with limitation of not being able to capture the presence of some species that could be equally significant in the deterioration (The Hidden Forest, 2011) due to domination by privilege species, if any. Another limitation is the use of 'colony counting' to determine the prevalence instead of the preferred 'spore counting technique, which has better accuracy.

A lost of weight of about 16% in 24 months was forecasted based on the experiment in the laboratory under controlled conditions. The conditions for the deteriorations in the buildings that will warrant such an optimum deterioration can hardly be met under a normal situation (Mshelgaru and Olonitola 2010). Therefore, it is not likely that the rate of deterioration can be as high as 16% in two years. But where it is coincidently possible, the implication will be frequent maintenance work to keep residential buildings that have *Khaya grandifoliola* components functioning as required.

REFERENCES

Albinas L. Bronius J. (2007) Microbiological Destruction of Constructional and Decoration Materials of Buildings. Materials Science (Medžiagotyra). vol.13, no. 1. pp 70-73.

Barnett, H. L. (1993) Illustrated Genera of Imperfect Fungi. Second edition, Burgess Publishing Company. West Virginia, Morgantown, West Virginia.

Beesely, J. (1987), wood deterioration in buildings: a guide to the indication and treatment of wood deteriogens, technical bulletin 7.1 Australian Council of National Trusts, Melbourne.

Dinwoodie, J. M. (2000) Timber: Its Nature and Behaviour. Second edition, published by E & FN Spon. 11, New Fetter lane, London.

Erickson, K. E. L. Blanchette R. A. and Ander P. (2005) Microbial and Enzymatic Degradation of Wood and Wood Components. Springer-Verlag. Berlin, New York P. 407

Forest and wood products research and Development Corporation, (2001), Environmental Friendly Housing Timber- Principles. first edition, Australia.

Highley, T. L. and Flournoy D. (1994) Decomposition of Cellulose by Brown-rot fungi. International biodeterioration and biodegradation, vol.11, p. 191-221.

Kleagerb, L. (2011), Dichotomous Keys. www.thermes.mbl.edu./biological Bulletin accessed on 1/04/2011

Lappalainen S. Kahkonen E. Loikanen E. Palomaki E. Lindroos O. Reijula K. (2001) Evaluation Priorities for Repairing in Moisture damaged School Buildings in Finland. Journal of Build Environment. Vol. 36, No. 981-986.

Malloch, D. (1997) An Introductory Guide to the Study of Mould (fungi). Mould: isolation, cultivation, identification. Department of Botany University of Toronto Canada.

Morris, P. I. (1998) Understanding Biodeterioration of Wood in Structures. Forintek Canada Corporation Specialist Inc. Shutsbury, Massachusetts, USA.

Mshelgaru I. H. (2010) Biodeterioration of Timbers in Building and Building Performance: sustainability implications under the Nigerian Microclimates. Lambert Academic Publishing AG & Co. KG. Germany.

Mshelgaru I. H. and O. S. Olonitola, (2010) Health and Safety Conditions of Building Maintenance sites in Nigeria: evaluating the post occupancy contaminations of timber buildings by microorganisms. Academic Journals- African Journal of Environmental Science and Technology.

Pe´rez, J. Mun˜oz-Dorado, T. de la Rubia, J. Martı´nez (2002) Biodegradation and Biological Treatments of Cellulose, Hemicellulose and Lignin: An overview. International Microbiology, volume 5: pages 53–63

Richardson, B. A. (1995) Remedial Treatment of Buildings. Second edition. Butterworth-Heinemann limited oxford.

Seeley, I. H. (1987) Building Maintenance. Second edition. Published by Macmillan press limited London

Smulski, S. (1996) Wood-Destroying Fungi in Residential Construction. Wood Science Specialist Inc. Shutsbury, Massachusetts, USA.

The Hidden Forest (2011) Fungi Classification, Fungi Identification Guide, What Fungi do www.hiddenforest.co.nz accessed 20/02/2011

Usher, M. B. and Ocloo, J. K. (1979) Natural Resistance of 85 West African Hardwood Timbers to attack by Termites and Microorganisms. Bulletin of Tropical Pest. Number 19.

Worldsworth, P. (2001), Lee's Building Maintenance Management, Fourth edition.Blackwell Science and the Estate of Reginald Lee.

CRITICAL SUCCESS FACTORS FOR THE IMPLEMENTATION OF TOTAL QUALITY MANAGEMENT (TQM) IN REAL ESTATE DEVELOPMENT IN GHANA

Kobina Afoah Imbeah[1] and Ayirebi Dansoh[2]

[1]*Project Manager, State Housing Company Limited, Kumasi, Ghana*

[2]*Department of Building Technology, Kwame Nkrumah University of science and Technology, Kumasi, Ghana*

Research in recent times has come up with accounts of successful and unsuccessful efforts at implementing TQM, with growing interest in identifying elements of management that account for successful implementation of TQM. Most current studies focus on superior quality companies in advanced industrial environments, leaving companies in the developing economies largely unstudied. This paper identifies the critical factors contributing to the successful implementation of TQM in real estate firms in Ghana. A survey of 62 real estate development companies registered with the Ghana Real Estate Developers Association (GREDA) was conducted to establish managers perception of factors required for a successful implementation of TQM.. Eleven factors were identified, viz: Top management commitment and leadership, Employee welfare and commitment, Employee training and development, Customer focus, Planning, process control and process evaluation, Supplier management, Continuous Improvement, Team Work, Information analysis and evaluation. These are factors to be given attention to minimize difficulties related to the implementation of total quality management and ensure the successful implementation of total quality management in this industry.

Keywords: Total Quality Management, critical success factor, real estate, Ghana.

INTRODUCTION

Global competition has increased as countries increasingly embrace the free market model and open up their borders for external investments and trading (Lee, 2002). To stay competitive, companies have to focus their business strategies on strategic advantages through the enhancement of business excellence and performance. Quality management provides an effective approach to achieving this goal. Companies are striving to adopt and implement different quality management systems like ISO or BS-based quality and Total Quality Management (TQM).

Total Quality Management is a quality management system which pursues excellence in customer satisfaction through continuous improvement of products and processes by the total involvement and dedication of everyone involved in the process or the product (Chase et al., 2001; McAdam *et al*., 2002). When applied effectively, TQM enables a company to improve long-term relationships, create a harmonious team

1 kaimbeah@yahoo.com
2 adansoh@consultant.com

Imbeah, K.A. and Dansoh, A. (2011) Critical success factors for the implementation of Total Quality Management (TQM) in real estate development in Ghana *In:* Laryea, S., Leiringer, R. and Hughes, W. (Eds) *Procs West Africa Built Environment Research (WABER) Conference,* 19-21 July 2011, Accra, Ghana, 291-303.

spirit, enhance professionalism and skills in all spheres of the construction sector, encourage open addressing of problems and help to achieve the intended project objectives and benefits (Low and Peh, 1996).The construction industry has generally lagged behind other industries in implementing reform through total quality management principles (Metri, 2005).Also, most studies examining the implementation of TQM have been based on advanced industrial environments, and the subject of these investigations has largely been big companies with advanced management systems. Sila and Ebrahimpour (2002) reviewed 347 published articles on TQM from 1989 to 2000 and observed that the majority of these studies were conducted in USA, U.K and Australia. This suggests that the operating environment of companies as well as their corporate background and traditions have a role to play in the successful implementation of TQM. Real estate development companies in Ghana generally undertake Mass Housing Building Projects and account for up to about 60% of all building projects (Zawdie *et al*, 2000). The term Mass House Building Projects (MHBPs) is used in the construction industry to describe mass production techniques of housing development projects (Ashley,1980), and is defined as "the design and construction of speculative standardized residential house unit usually in the same location and executed within the same project scheme (Ahadzie et al 2007). Unlike many one –off projects undertaken by general construction firms, the responsibility for the management of the design and construction of these projects lie within a single real estate development organisation.

The peculiarities of management in small and medium companies, the characteristics of developing economy environments and the management demands of real estate development necessitate investigation of factors influencing the implementation of TQM in the real estate industry in Ghana. This paper identifies the critical factors contributing to the successful implementation of TQM in real estate firms in Ghana.

The paper is structured by first describing Total quality management with its importance to firms' productivity and results. The next, is critical success factors identified in other frameworks and quality awards. Discussions of the data collected and its analysis. The subsequent section discusses the findings of the study. The conclusion and recommendations follow after this section. Finally, list of references are detailed at the end of the paper.

TOTAL QUALITY MANAGEMENT

Companies in the construction industry provide infrastructure for the economy and constitute an important backbone of many economies, yet they face problems of instability, low productivity, poor quality and lack of standards (Metri, 2005) in the face of high fragmentation in the industry. Total Quality management provides an effective approach to prevent or reduce these problems and provide higher quality services and products. Its management and control processes are designed to focus on the entire organisation and all of the employees in providing products or services that satisfy the customers (Talha, 2004).ISO defined it as the management approach of an organization, which concentrates on quality, based on the participation of its members which aims at long-term success through satisfaction and benefits to all members of the organization and society (ISO 8402, 1994). Zhang et al.,(2000) defined TQM as a management philosophy for continuously improving overall business performance based on leadership, supplier quality management, vision and plan statement, evaluation, process control and improvement, product design, quality system improvement, employee participation, recognition and reward, education and training, and customer focus.

TQM is different from traditional management as its philosophy seeks to integrate all organizational functions including marketing, finance, design, engineering and production, customer service whilst focusing on meeting customer(internal and external) needs, employees satisfaction and organizational objectives by means processes being carried out right, first time and every time. . It embraces principles, processes, practices and procedures necessary for providing customer satisfaction and achieving improvement in productivity and business performance (Love et al., 2000)

Total quality control/management evolved in the early 1960s in a four-phase process. A dramatic increase in user quality requirements resulted in increasing customer demand for higher-quality products, leading the manufacturer to recognize the inadequacy of existing in-plant quality practices and techniques. All these contributed to excessive quality cost, due to such items as inspection, testing, laboratory checks, scrapping and reworking imperfect products, and customer dissatisfaction. These problems highlighted the dual quality challenge: Providing significant improvement in the quality of products and practices while at the same time, effecting substantial reductions in the overall cost of maintaining quality. Statistical quality control could never meet the challenge; thus, a totally new concept was developed based upon the principle that in order to provide genuine effectiveness, control must start with the design of the product and end only when the product has been placed in the hands of a customer who remains satisfied (Feigenbuam, 1991).

However, there is evidence of disappointing results in many organisations' attempt to implement quality management due mainly to obstacles in implementation (Wan Yusoff et al, 2006; Abdulaziz and Tawfiq, 1999). Obstacles in implementation arise from improper attitudes and perception of management and employees, inadequate resources and training as well as inappropriate environments for implementation. In reality, no firm can fully implement TQM; it is a continuous improvement process and as such never ending. Its culture and philosophy must infiltrate an organization, and can thrive only under senior management when it establishes it as a top management priority and commit itself to it success.

The application of total quality management programs enables companies to improve long-term relationships, product and process improvement, create a harmonious team spirit, employee job satisfaction, increased revenues, reduction in quality costs, improved customer service and market competitiveness, enhance professionalism and skills in all spheres of the construction sector, encourage open addressing of problems, subcontractors with proper quality management systems, and closer relationships with subcontractors and suppliers and help to achieve the intended project objectives and benefits (Low and Peh, 1996; Low and Teo., 2004; Khan,2003; Reed et al.,2000). Thus, Competitive advantage is created in these firms by providing that environment of sustainability of competitiveness of a firm against intense global competition through continuously improving every facet of the firm (Reed et al., 2000; Cheng and Liu, 2007).

Critical Success factors (CSF) for TQM

To successfully implement TQM it is important to identify the factors required for the implementation process. Saraph et al (1989) defined CSFs as "critical areas of managerial planning and action that must be practised to achieve effective quality management in a business unit". These factors may be constructs with latent variables which cannot be measured directly, but can still be assessed indirectly from their manifestation. Saraph et al. (1989) in a pioneering study developed a quality management instrument, identifying eight (8) critical success factors of TQM: Role of divisional top management and quality policy, Role of quality department, Training, Product/service design, Supplier quality management, Process management/operating, Quality data and reporting and Employee relations. Their study had considerable influence on later studies, and subsequent research has resulted in the development of different frameworks and constructs based on varying perceptions and objectives (Zhang, 2000).Although these frameworks or models have different TQM approaches, they all lay emphasis on leadership, strategic planning, customer and market focus, human resources focus, process management, continuous improvement, supplier management and business results in one way or the other. (Ritchie and Dale, 2000; Conca et al 2003).

Constructs or elements of critical success factors identified in frameworks for TQM point to two categories of factors; soft and hard dimensions of TQM (Kanji., 1995; Powel., 1995; Dow et al.,1999; Oakland., 2000). “Hard” components of TQM concentrate on the tools and techniques, systems and the supplementary measurement and control of the work process, ensuring conformance to performance standards and the reduction of variability whereas “soft” components relate to areas behavioural concerns such as increasing customer orientation, employee management, organizational and quality culture. These dimensions are interrelated and are together are very important for the successful implementation of TQM.

A great deal of research has been conducted in the field of TQM and its implementation. The study by Sila and Ebrahimpour (2002) reviewing 347 articles on TQM from 1989 to 2000, identified seventy–six studies that employed factor analysis to extract factors for successful implementation of TQM. Out of these, they compiled twenty five TQM constructs which are widely used by researchers to measure TQM implementation. Their study revealed eight common cores of the factors viz: customer focus and satisfaction, employee training, leadership and top management commitment, teamwork, employee involvement, continuous improvement and innovation, and quality information and performance.

Literature also reveals that different countries have adopted similar TQM factors as criteria for quality awards under different titles (Metri, 2005). However, the criteria for all these quality awards are derived from three basic frameworks: the Malcolm Baldrige National Quality Award (MBNQA), the European Quality Award (EQA) now called European Foundation for Quality Management (EFQM) Excellence Award and the Deming Prize.

RESEARCH METHOD

Sampling

The study drew its sample from real estate development companies registered with the Ghana real estate development association (GREDA). Membership of the association currently, stands at 353. 96.2% are operating in the capital city Accra, 2.6% in Kumasi and 1.2 in the other regions. However, the study was limited to Accra and Kumasi due to the insignificant membership in the other regional cities. 103 structured questionnaires were sent to quality managers to elicit their perceived importance of the nine construct adopted for this study. Each construct had a number of items which were to be measured on a five point Likert scale of 1-5 where, 1=not significant, and

5=exceedingly significant. A total of 67 were returned, of which 5 were invalid, giving an effective response rate of 60.2%.The questionnaires were in two Sections. Section one seeks personal information on respondents and company characteristics and Section two, aimed at identifying factors critical for successful TQM implementation.

TQM Construct Development and Measure

In developing and validating measures for TQM construct, the method by Conca et al (2004) was chosen for the study. This method was developed by psychologists and it has been widely accepted in the development of an instrument for measuring variables in social sciences Conca *et al*., (2004).

Table 1.

Construct no.	**TQM construct**	**Critical success factors identified in literature**	**No. of items for questionnaire**	**Sources of items for questionnaire**
1	Top management commitment and leadership	Top management commitment and leadership	7	Saraph et al(1989) Kaynak,H(2003) Baidoun et al (2003) Aspinwall et al (2005) ISO:9001:2000
2	Human resource management	Employee relations Employee involvements Education and Training Recognition and Reward	12	Kaynak(2003) Baidoun et al(2003) Seraph et al(1989) Conca et al(2004) ISO:9001:2000
3	Customer management	Customer management	7	Baidoun et al (2003) Conca et al(2004) Rao et al(1999)
4	Supplier quality management	Supplier quality management	7	Conca et al(2004) Kaynak(2003) ISO:9001:2000
5	Process management	Process management Product/service design	6	Baidoun et al(2003) Conca et al(2004) ISO:9001:2000
6	Information Analysis and Evaluation	Information and Analysis Evaluation	6	Conca et al(2004) Kaynak(2003) ISO:9001:2000
7	Planning	Planning Vision and Plan Statement Communication	8	Conca et al. (2004) Seraph et al (1989) ISO:9001:2000
8	Continuous Improvement	Continuous Improvement Benchmarking Statistical process control	8	Conca et al (2004) Baidoun et al(2003) ISO:9001:2000
9	Teamwork	Teamwork Role of the Quality Department Learning	4	Flynn et al(1994)

For this paper, the method was pursued in three stages namely,

- Literature review to identify critical factors (Table 1)
- Developing the measuring construct by selecting initial quality items (Table 1).
- Data analysis. This includes Reliability, detailed item analysis and construct validity measurement (see results).

Selection of factors for survey

This study identified factors from frameworks employed for these three awards along with highly referenced publications or frameworks from studies of quality management. From the summary of available studies, a total of 20 critical factors were identified (Table 1). The factors were regrouped to ensure that factors addressing similar issues were combined into one construct. A final list of nine constructs for this study: 1. Top management commitment and leadership; 2.Quality planning; 3.Customer focus; 4. Human resource management; 5. Process management; 6.continous improvement; 7.supplier management; 8. Information Analysis and Evaluation; 9.Teamwork (Table 1).

RESULTS

Profile of respondents and firms

The greater the experience of the respondent in a sector, the greater the understanding of the industry and the necessary requirement of the sector. The modal frequency (41.9) of the respondents had 5-10 years of experience in the business. Overall, 58% of respondent had over 5years of experience. Managers outnumbered technical personnel by a ratio of roughly 2:1. Respondents were all university or polytechnic graduates. BSc and MSc graduates made up 71% of the number. Respondents in the study were thus expected to have reasonable knowledge and experience in building construction or quality management in the real estate industry.

Table 2: Profile of respondents and firms

Experience of respondents (years)	0-2	2-5	5-10	Over 10 years
Frequency of response	10	16	26	10
Position of respondents		Technical	management	
Frequency of response		19	43	
Educational Level	HND	Bsc	Msc	
Frequency of response	18	33	11	
No. of employees	Up to 20	21-50	Over 50	
Frequency of response	19	36	7	
Age of company(years)	Under 5	5-10	10-20	Over 20
Frequency of response	-	21	37	4
Annual volume of units produced	Up to 50	51-100	Over 100	
Frequency of response	35	21	6	

Reliability

Data from the likert scale ranking was subjected to factor analysis. The internal consistency of the set of measurement items refers to the degree to which items in the set are homogenous (Badri, 2007).It can be determined using a reliability coefficient such as Cronbach's Alpha (Cronbach, 1951). Internal consistency is usually computed for a scale based on a set of items under the scale or construct .It can also be calculated for any subset of the items under a particular scale or construct. Reliability analysis was performed for the items of each scale using internal consistency method by determining the Cronchbach's Alpha.

Table.3 shows the construct/scale and the original items under each construct/scale and the items dropped from the original scale to achieve higher reliability coefficient. Item 7 from the top management and leadership construct is dropped during the reliability analysis. The reliability for each constructs was again recalculated after performing detailed item analysis and some items eliminated.

Table 3 Internal consistency of Critical Success Factors

Construct(Scales)	Initial items	Number of Items	Items Deleted by number	Alpha Before deletion	Cronchbach's Alpha After deletion
Top management commitment and leadership	1-7	7	1	0.755	0.799
Human Resources Management	1-12	12	none	0.812	0.877
Customer Focus	1-7	7	none	0.830	0.879
Planning	1-8	8	none	0.846	0.901
Process Management	1-6	6	none	0.873	0.873
Supply management	1-7	7	none	0.843	0.907
Continuous improvement	1-8	8	none	0.927	0.955
teamwork	1-4	4	none	0.811	0.811
Information analysis and Evaluation	1-6	6	none	0.852	0.852

The minimum advisable level is 0.7(Nunnally.1978; Nunnally and Bernstein., 1994;Seraph et al.,1989) for a new instrument. From the table, reliability coefficient ranges from 0.799 to 0.955 which is greater than the recommended 0.7. The rating are within the set limit even though they are slightly lower than some of the works cited. In Zhang (2000) for instance the coefficient ranges from between 0.84-0.92; Seraph et al., (1989) between0.71- 0.94 and higher than Conca et al.,(2004)which ranges from 0.52-0.82.

Item analysis

A detailed item analysis evaluates the assignment of items to the scales in an instrument. This is done by correlating each item with each scale. The corrected item-total correlation (i.e., the correlation of each item with the sum of all other items) (Hair et al., 1998; Malhotra and Grover, 1998; Torkzadeh and Dhillon, 2002) are used to determine if an item belongs to the scale as assigned, or is part of another scale, or should be eliminated. If an item does not correlate highly with any of the scales, it is eliminated (Nunnally, 1978). The value of that item to scale correlations should be greater than 0.5. Those lower than 0.50 do not share enough variance with the rest of the items in that scale. For that reason, item(s) should be deleted from the scale (Zhang, 2000; Conca et al., 2004).

Seraph et al (1989), Zhang et al (2000.) and Conca et al (2004) used this method to evaluate the assignment of items to scale in developing their instrument for measuring the critical factors of quality management.

Table 4 shows the correlation matrix for the nine scales or measures of the constructs. Most of the items had high correlations with the scales to which they were assigned relative to all the other scales, except items; 4, 7, 9, 11 of Human resources construct; item 3 of customer focus construct; item 7 of planning construct; items 4and 7 of supply management and item 2 of continuous improvement construct which has correlation less than 0.5 with the scale they were assigned to and as such they were eliminated accordingly. The rest were judged to be appropriately assigned to their scale.

Table 4. Detailed Item Analysis (Item to Scale Correlation)

Constructs/Scale	Item numbers											
	1	2	3	4	5	6	7	8	9	10	11	12
Top management commitment and leadership	.751	.624	.562	.652	.620	.595	--	--	--	--	--	--
Human Resources Management	.589	.581	.565	.169	.570	.655	.407	.574	.161	.585	.269	.665
Customer Focus	.742	.698	.119	.538	.690	.716	.718	--	--	--	--	--
Planning	.597	.796	.832	.706	.617	.793	.363	.562	--	--	--	--
Process Management	.687	.721	.534	.714	.635	.768	--	--	--	--	--	--
Supply management	.784	.754	.791	.321	.678	.778	.170	--	--	--	--	--
Continuous improvement	.886	.212	.905	.859	.735	.700	.871	.878	--	--	--	--
Teamwork	.526	.741	.550	.724	--	--	--	--	--	--	--	--
Information analysis and Evaluation	.762	.590	.733	.616	.634	.533	--	--	--	--	--	--

Note: Item number in this table is the same as the question number in the instrument;
The symbol "--" means not available

Validity

The validity of a measure refers to the extent to which it measures what is intended to be measured (Nunnally, 1978). A measure has content validity if there is general agreement among the subjects and researches and that the instrument has measurement items that cover all aspects of the variable being measured (Badri, 2007). Content validity is judged by the researchers subjectively. An initial questionnaire was sent to three experts on the subject (an academician well versed in quality management studies, a project manager in a real estate firm, and a quality management consultant) to check the comprehensiveness of the items under each construct. The feedback from these experts was used to improve the content as well as ease understanding to eliminate ambiguity and duplication of test. The final questionnaire had 65 initial quality items for evaluation.

A measure has construct validity if it measures the theoretical construct that it was designed to measure. This analysis is done using SPSS.16.0 to perform factor analysis (Principal component) for each construct. In performing factor analysis each measure was assumed to be a separate construct. In this analysis (shown in tables 5,6, 7) each factor must be one dimensional that is to say, all items in each scale should load on to one factor**.** When items in a scale or construct load on more than one factor, the rotated (varimax) solution was examined. All items with loadings less than 0.5 in each scale are eliminated.

Kaiser-Meyer-Olkin (KMO) measure is performed to check the degree of inter-correlation among the items and the appropriateness of factor analysis. Kim and Mueller (1978) suggested that KMOs in the range of range of 0.5-0.6 are considered poor, those in the range of 0.6-0.7 are average, those in the range of 0.7-0.8 are considered good, 0.8-0.9 are great and values greater than 0.9 are superb. From Table 5 most of the KMO values obtained are greater than 0.7 which indicates that the data is adequate and appropriate for factor analysis

Measures of TQM

It can be observed from Table 5 that seven (7) factors or construct had one factor component except human resources management and process management. This means that, items in the seven construct or measure formed or load unto a single factor out of the Nine (9) measures.

Table 5 Summary of the factor matrix for each measure

Constructs/factors	KMO	Item loadings Range	Eigen value	Percentage of variance explained
Top management commitment and leadership	0.730	0.680-0.771	3.056	50.927
Customer Focus	0.777	0.657-0.832	3.796	63.270
Planning	0.651	0.702-0.900	4.529	64.695
Supply Management	0.877	0.814-0.892	3.655	73.091
Continuous Improvement	0.864	0.760-0.939	5.508	78.685
Teamwork	0.698	0.703-0.893	2.297	64.923
Information analysis and Evaluation	0.795	0.685-0.852	3.511	58.510

The other two constructs in which the items did not load unto one factor are Human resource management and Process management. This result was obtained according to the rule of Eigen values being greater than one, which are listed in tables 6 and 7 with its rotated and unrotated factor matrix.

Process Management

In the case of Process Management construct, two factors emerged as shown in Table 6. Items number 1, 3 and 5 which are process flow chart, testing and reviewing for specification and clarity of instruction respectively can be described as "**Process control**" constituting a factor separate from the remainder of process management items. The remaining items 2, 4, 6 formed another factor that can be interpreted as "**Process evaluation**".

Table 6 Factor matrix process management

	Un-rotated		Rotated (Varimax)	
	Factor 1	Factor 2	Factor 1	Factor 2
1	.783	.498	.276	**.886**
2	.830	-.398	**.890**	.232
3	.653	.107	.430	**.503**
4	.830	-.451	**.925**	.192
5	.734	.586	.183	**.921**
6	.862	-.216	**.797**	.392

Human Resources Management

For human resource management, Table 7 lists the un-rotated and rotated factor matrix (Varimax) for its construct. From the table it is clear that items 1, 2, 3, and 10 constituted a factor which can be deduced as the "**employee welfare and commitment factor**" whilst the other items (5, 6, 8, and 12) in this construct also constituted another factor which can be described as "**employee training and development factor**".

Table 7 Factor matrix human resource management

	Un-rotated		Rotated(Varimax)	
	Factor 1	Factor 2	Factor 1	Factor 2
1	.798	-.475	**.901**	.223
2	.698	-.425	**.796**	.188
3	.682	-.306	**.700**	.261
5	.685	.518	.123	**.850**
6	.759	.194	.404	**.672**
8	.663	.308	.256	**.685**
10	.788	-.160	**.673**	.440
12	.808	.376	.311	**.835**

The analysis process led to the identification of eleven factors (measures) of TQM (Table.8). These eleven factors are the driving force that may lead to satisfactory implementation of TQM.

Table 8 Measures of TQM

Constructs	ITEM NUMBERS	New CRITICAL FACTORS
Top management commitment	1-6	Top management commitment
Human resource management	1,2,3&10	*Employee welfare and commitment factor*
	5, 6, 8&12	*Employee training and development factor*
Customer Focus	1,2,4-7	Customer Focus
Planning	1-6,&8	Planning
Process management	1, 3 &5	*Process control*
	2, 4, 6	*Process evaluation*
Supply management	1-3 and 5,6	Supply management
Continuous improvement	1 and 3-8	Continuous improvement
Teamwork	1-4	Teamwork
Information Analysis and Evaluation	1-6	Information Analysis and Evaluation

DISCUSSION

In the TQM philosophy, total customer satisfaction is the goal of entire system, and a persistent customer focus is what will get a firm to better performance. Customers may be either internal or external and for a construction organization to outperform its competitors there is the need to anticipate and respond quickly to customers' demands with new ideas and technologies and to produce constructed facilities that satisfy or exceed customers' expectations. This give emphasis to the fact that the visibility and support that management takes in implementing a total quality environment is critical to the success of TQM implementation (Low and Teo, 2004).Most quality initiatives have failed due to lack of management commitment. Management can be committed to quality through communication, defining quality values, expectation and focus, and provision of resources for quality improvement. However, management participation in quality activities is not enough to contribute to quality improvements as Costs of total quality is difficult to control by management alone (Khan, 2003). Employees are encouraged to show commitments to quality issues. When workers themselves are committed to delivering quality, they take greater initiative towards meeting product and process specifications; detecting and eliminating bottlenecks; improving product and process designs and setting realistic yet challenging performance targets. This is better enhanced if resources are provided for employees for effective training and developmental activities. According to Low and Teo (2004) Teamwork also provides companies with the structured environment necessary for successfully implementing and continuously applying the TQM process. The eventual aim of the team approach is to get everyone, including contractors, designers, vendors, subcontractors, and owners involved with the TQM process.

CONCLUSION AND RECOMMENDATION

This study intended to identify the management areas that should be given attention for a successful quality management in Real estate companies. Eleven critical success factors of quality management were identified.viz, Top management commitment and leadership, Employee welfare and commitment, Employee training and development, Customer focus, Planning, process control and process evaluation, Supplier management, Continuous Improvement, Team Work, Information analysis and evaluation. It is believed that attention to these factors will minimize difficulties related to the implementation of Total quality management and will enhance best performance in companies implementing Total quality management.

REFERENCES

Abdulaziz A.B., and Tawfiq, H.A., (1999), "ISO 9000 quality standards in construction", Journal of Management in Engineering, pp 41-45

Ahadzie, D.K., Proverbs, D.G., and Olomolaiye, P. (2007), "Critical Success Criteria for Mass House Building Projects In Developing Countries", International Journal of Project Management" Vol. 19, No. 7 26, pp. 675-687

Ashley, D.B. (1980), "Simulation of Repetitive –Unit Construction", Journal of Construction Division, Proceedings of ASCE, Vol. 106, Co. 2, pp. 185-198

Badri,M.A., (2007), "Dimensions Of Industrial Location factors: Review And Exploration" Journal Of Buisness And Public Affairs, Vol., 1, No.2 pp 1-27

Baidoun, S. and Zairi M. A. (2003), "Proposed Model of TQM Implementation in the Palestinian Context", TQM and Business Excellence, 14(10), 1193–1211

Black, S.A., and Porter, L.J., (1996), "Identification of The Critical Factors Of TQM", Decision Sciences pp., 27, 1–21

Chase, R.B., and Aquilano, N.J., and Jacobs, F.R., (2001), "Operations Management for Competitive Advantage", 9th Edition, McGraw-Hill, Boston, MA

Conca,F,J.,Llopis,J.&Tari,.JJ (2003),"Development of a measure to assess quality management in certified firms" Journal of Operational Reasearch,Vol.156,No2004,pp 683-697

Cronbach, L. J., (1951), "Coefficient alpha and the internal structure of tests", Psychometrika, 16, pp., 297-334

Dale, B.G., (1999), "Managing Quality", Blackwell Publishers, Oxford.

Dow,D ., Samson,D . and Ford, S. (1999), "Exploding The Myth: Do All Quality Management Practices Contribute To Superior Quality Performance", Production and Operations Management,8, pp., 1–27

Feigenbaum, A.V., (1991), "Total Quality Control", McGraw-Hill, New York

Flynn,B . B.,Schroeder, R. G. and Sakakibara,S, (1994), "A Framework For Quality Management Research And Associated Instrument", Journal of Operations Management,Vol., 11., pp . 339–366

Hair, J.F., Anderson, R.E., Tatham, R.L., and Black, W.C., (1995), "Multivariate Data Analysis with Reading", Prentice-Hall, Englewood Cliffs, NJ

ISO 8402 (1994),"Quality Management and Quality Assurance –Vocabulary" International Organisation for Standardization

Kanji, G. K., (1995), "Quality and Statistical Concepts, In Total Quality Management: Proceedings of the first world congress (Ed: Kanji, G. K.), London: Chapman and Hill

Kaynak, H., (2003), "The Relationship between Total Quality Management Practices and Their Effects on Firm Performance", Journal of Operations Management, Vol., 21 No., 4, pp., 405-435.

Khan,H.J (2003) "Impact of total quality management on productivity", The TQM Magazine, Vol. 15 ,No. 6, pp.374 - 380

Lee, P. M. (2002), "Sustaining Business Excellence through A Framework of Best Practices In TQM", The TQM Magazine, Vol. 14, No. 3, pp 142-149

Love, P. E. D., Li, H., Irani, Z., and Holt, G. D. (2000), "Rethinking Total Quality Management: Toward A Framework For Facilitating Learning And Change In Construction Organizations", The TQM Magazine, Vol. 12, No. 2, pp 107–116

Low, S. P. and Teo, J.A. (2004) "Implementing Total Quality Management in Construction Firms", Journal of Management in Engineering, Vol. 20, No. 1, pp 8-15

Low, S. P., and Peh, K. W. (1996), "A Framework for Implementing Total Quality Management in Construction" The TQM Magazine, Vol. 8, No. 5, pp 39– 46

Malhotra, M.K. and Grover, V. (1998), "An Assessment of Survey Research in POM", From Constructs To Theory, Journal of Operations Management, Vol., 16, pp., 407-425

McAdam, R. and Kelly, M., (2002), "A Business Excellence Approach To Generic Benchmarking In Smes, Benchmarking" An International Journal, 9(1), 7-27

Metri, B.A., (2005), "TQM Critical Success Factors for Construction Firms", Management Economics, Vol.10, No 2, pp.61-72

Nunnally, J.C., (1978), "Psychometric Theory", Seconded. Mc- Graw-Hill, New York.

Oakland, J., (2000), "Total quality management – Text with cases", 2nd edition, Butterworth-Heinemann

Powell, T.C., (1995), "Total Quality Management as Competitive Advantage: A Review and Empirical Study", Strategic Management Journal, Vol. 16, pp 15–37

Reed, R., Lemak, D.J., Montgomery, J.C., (1996), Beyond Process: TQM Content and Firm Performance, Academy of Management Review 21, pp 173–202

Saraph, J.V., Benson, G.P., and Schroeder, R.G., (1989), "An Instrument for Measuring the Critical Factors of Quality Management", Decision Sciences Vol. 20, pp 810–829

Sila, I. and Ebrahimpour, M. (2002), "An Investigation Of The Total Quality Management Survey Based Research Published Between 1989 And 2000". International Journal of Quality and Reliability Management, Vol. 19, No. 7, pp 902-970.

Talha,M.(2004) "Total Quality Management(TQM):An Overview", Journal of the Bottom Line: Managing Library Finances, Vol.17, No.1,pp.15-19

Torkzadeh, G. and Dhillon, G., (2002), "Measuring Factors that Influence the Success of Internet Success" Information Systems Research, Vol., 13 No., 2, pp., 187-204 Vol. 15 ,No. 6, pp.374 - 380

Wan Yusoff, W.M., Abdul Ghani and K., Norizan, M., (2006), "Quality Management in Contracting Quality Management In Building And Construction", Proceedings of Eureka Conference, Hamar/Lillehammer, June, pp 61-64

Yusof, S.M. and E. Aspinwall, (1999), "Critical Success Factors for Total Quality Management Implementation in Small and Medium Enterprises", Total Quality Management, Vol. 10, No.4&5, pp 803-809

Zawdie, G. and Langford, D.A. (2000), "The State Of Construction And Infrastructure In Sub Saharan Africa And Strategies For A Sustainable Way Forward", Proceedings of the 2nd International Conference in Developing Countries: Challenges Facing The Construction Industry In Developing Countries, pp 15–17, Accessed on 31/03/10 at http://www.odsf.co.za/cdcproc/1stproceedings.html

Zhang, Z. Waszink, A. and Wijngaard, J., (2000), “An Instrument For Measuring TQM Implementation For Chinese Manufacturing Companies”, International Journal of Quality and Reliability, Vol. 17, no. 7, pp. 730-755

Zhang, Z., (2000), “Developing A Model Of Quality Management Methods And Evaluation Their Effects On Business Performance”, Total Quality Management, Vol. 11, No. 1, pp. 129-137.

DESIGNS AND CONSTRUCTION OF BUILDINGS IN GHANA: THE DISABILITY FACTOR

Kwaku Owusu[1] and Nana Buabeng Owusu-Ansah[2]
[1]*Building Department, Sunyani Polytechnic*
[2]*Development Unit, Methodist University College*

It is estimated that 10% of Ghana's population suffer from some form of disability. The blind, deaf and physically disabled people are the most visible. Despite the magnitude of the disability percentage of the population, most designers and constructors in Ghana fail to factor the disabled people. It is against this background that many saw the passage of the Disability Bill into law in June 2006 by Parliament as the turning point for the disabled people regarding design and construction of buildings in Ghana. This study examines the extent to which the disability is factored in designs and construction of buildings in Ghana. To achieve the study objectives, a comprehensive literature search and survey was carried out in the Accra metropolis among property owners and People Living with Disability (PWD). Interviews were also conducted using an interview guide for Estate Developers, Architects and Engineers as well as officials from the Law Enforcing Agency (Accra Metropolitan Assembly & Town and Country Planning) to solicit their views. The results suggested that though the disability law has been passed almost all estate developers or construction companies are not seriously factoring disabled people in their construction designs. The study concluded that, massive education should be embarked upon by all stake holders in educating the general public, professionals and clients about the importance of the disability law and the need to make buildings disabled friendly.

Keywords: design, Disability Law, disabled friendly, inclusive design.

INTRODUCTION

Ghana has gone through a lot of transformation in terms of General Building Construction such as residential, commercial and institutional buildings before and after independence (1957) from the British. Since this era, Accra and Kumasi, the capital and second capital cities respectively, have especially witnessed a change from low-rise to mid-rise buildings in both public and private sector. Yet a cursory look at development of buildings in Ghana, obviously, shows that with this transformation, the design and construction of most of these buildings did very little to consider the disabled in the Ghanaian society despite the fact that they form 10% which is a major/recognisable constituent of the country's population. (UNICEF, 2000)

Many private and public buildings like residential flats/apartments, shopping centers, office buildings medical clinics and hospitals, schools and universities, recreational centers and athletic stadia, government buildings and houses of worship are without mechanisms like ramps, lifts, and escalators etc. which make these buildings not disabled friendly. What makes the situation worse is the fact that designers and

[1] kwacus@yahoo.com

Owusu, K. and Owusu-Ansah, N.B. (2011) Designs and construction of buildings in Ghana: The disability factor *In:* Laryea, S., Leiringer, R. and Hughes, W. (Eds) *Procs West Africa Built Environment Research (WABER) Conference,* 19-21 July 2011, Accra, Ghana, 305-313.

constructors tend to forget the axiom that ‘every human being will one day become a disabled either through accident or old age’. Over the years, due to cultural beliefs about disabilities, attitudes towards persons with disabilities which often include shame, prejudice, and exclusion from the community looked entrenched. Culturally, people with disabilities are often isolated, discriminated against and considered inferior while a section of the society consider them as a cursed group; others subject them to various abuses that commutatively make them bitter against society in Ghana. Design and construction of buildings in most cases have not given consideration in making public buildings easily accessible to the disabled people in Ghana. This act of discrimination has continually deprived disabled persons, their fundamental human rights in the field of planning and resources allocation, (Wellington, 1992). It is against this background that some pressure groups advocated for the passage of the Disability Bill into law in June 2006. The purpose of the Disability Act, 2006 (Act 715) is to fight and protect the rights of people who are living with disability. For professional and stakeholders in the building industry; the Act stipulates in Section 60 that “*The owner or occupier of an existing building to which the public has access shall within ten years of the commencement of this Act make the building accessible to and available for use by a person with disability*” (AllAfrica.com, 2009). The implications are that new buildings and old/existing buildings being refurbished must comply with the Act.

Since 1981, expert knowledge about the needs of disabled people in buildings has been incorporated into the Ghana Building Standards which is now complemented by the availability of home improvement grants for disabled people, and the requirements of the Building Regulations. (building.standards@south-ayrshire.gov.uk 2009). There are so many legislations concerning the disabled factor in the whole world. Among them include : the Disability Discrimination Act 1995, the Disability (Employment Regulations 1996) and the Workplace (Health, Safety and Welfare) Regulations 1992.these legislations must be considered by those designing buildings as well as those employing staff who work within them and people using them. The Disability Discrimination Act 1995 has been introduced to prevent discrimination against disabled people. According to the Act, by October 2004, providers of goods and services must have taken into consideration all disabled people gaining entry into the building and using it. This legislation is covered under civil law and is not controlled by the Local Authority, although all public buildings including those where the public have access must comply with the Act. All people providing service to the public are affected by this legislation. It is for this reason that when designing buildings or carrying out alterations or refurbishment the design must make provision for all sections of society; i.e. access for all (Internet content rating association, 2006).

The foregoing clearly indicates that before the People Living with Disability Act (PWDA), there have been other efforts aimed at ensuring that building facilities are disabled friendly. The aim of the paper is to investigate/find out whether disabled people are properly or adequately factored in the design and construction of buildings in Ghana after the introduction of PWDA. To attain the needed results the following objectives were devised:

- Identify whether architects and engineers consider the disability factor in public and domestic buildings after the passage of the disability law in Ghana.
- Identify some of the problems people living with disability go through in domestic and public buildings (i.e. washrooms, offices, etc)

- To determine the degree at which building owners refurbish their buildings to be disabled friendly and to ascertain whether the disability laws are being enforced in the modern buildings

SIGNIFICANCE OF THE STUDY

Though the disability law has been passed, a scan of buildings just around indicates that some estate developers or construction companies are not factoring disabled people in their construction. This attitude frowns on the Disability Act and other legislation on disabled people. Again, it discriminates against disabled people and put them at a disadvantage despite the fact that it is essential for people with disabilities to live independently in their communities. Housing must be accessible and supportive to help people with disabilities to live independent and self directed lives. (disability.gov, 2009) This has raised the question whether the introduction of the disability law can help solve the discrimination the disabled people go through in the design and construction of buildings in Ghana (Thus at the designing and construction stage of domestic and public / commercial buildings).

According to ***Kent (2003),*** owners of some historic buildings in UK are compelled by law to carry out alterations to make their buildings accessible to disabled. This is how serious elsewhere, the laws are looked at in terms of implementation. The Disability Discrimination Act makes it mandatory to put up structures that are disabled friendly and must not discriminate against them. According to the scan what is happening around is quite different from what the Act says. In most cases where attention has been given, the provision of the PWDA has been misconstrued by some building industry players to mean provision of ramps to ground floors.

Again, it is conservatively estimated that in Ghana, about 10% of the population are known to be Persons with disability. It must however be noted that quite a number of people with disability are for cultural reasons not disclosed. It is even estimated that the undisclosed number might even be the same as disclosed (UNICEF, 2000). This information connotes that the number of persons with disability in Ghana is more than the 10% (that is more than 2.3million). Due to the high rate of undisclosed disability in the rural areas as a result of predominance of cultural norms, disability in Ghana by record has a higher urban incidence, with the national capital region (Greater Accra) dominating (Annor, 2002). Therefore it is in the interest of all Ghanaians to champion the course of disables because the chances of becoming a disable are greater than anticipated.

RESEARCH METHOD

Research questions

The major research questions for this study are as follow:

- What extent has the introduction of the disability law changed the designs and construction of buildings to suit disabled people?
- Are building owners refurbishing their buildings to make them disabled friendly?
- What problems do disabled people go through in traditional, domestic and public buildings in the country?

Sampling, Procedure, Size and Justification

The research adopted triangulation approach in the process of collecting and analyzing data. The triangulation approach in this research consists of three methods of data collection and analysis: survey questionnaires, semi structured interview and observation. This is due to the fact that different approaches lead to greater validity and reliability than a single methodological approach according to Denzin (1970), Dixon *et al.* (1988) and Yin (1994). The questionnaires were designed to explore the perceptions surrounding the effectiveness of the disability factor in public/commercial and domestic buildings, to ascertain whether the disability laws are enforced in the modern buildings in the country and to identify some of the problems disabled people go through in domestic and public buildings (i.e. wheelchair ramps & handrails elevators, washrooms, walkway contours, audio signals, Braille signage etc). The semi-structured face-to-face interview was designed to qualitatively analyze respondents free format comments on the main subject. Under the observations, the researcher observed residential and public/commercial buildings in Accra (New, old buildings and refurbishment as well as Tower buildings, etc). Also, architectural and structural designs for certain structures were observed and analyzed (Public buildings, designs by both architects and Engineers of estate developers, etc).

The target population consists of disabled people, architects and engineers, estate developers, law enforcing agencies as well as property owners in the Accra metropolis. This is because Accra is the place where almost all the commercial activities in Ghana take place and it is also the head of Ghana federation of the disabled. Disability in Ghana by record has a higher urban incidence, with even the national capital region (Greater Accra) dominating (Annor, 2002).

In all, 30 disabled persons responded to the questionnaire. 15 property owners: 6 architects and engineers, 4 officials from estate developing companies and 2 officials from law enforcing agencies (i.e. Town and Country Planning and Accra Metropolitan Authority. Supporting opinions were obtained from experts who are knowledgeable in this field.

A non probability sampling was used because of the difficulty in establishing the sample frame especially for the disabled at this early stage of this research due to its practicality. (Saunders *et al*, 2007). Under the non probability sampling, convenience sampling was used because the sample frame of both the interviewees and the respondents were not known. Purposive sampling was used for the Law enforcing agencies because of their expertise in that area. Accidental sampling was used for the rest. A survey was carried out in the Accra Metropolis among disables, architects and engineers, estate developers as well as property owners in the Accra metropolis. A questionnaire survey was administered among a sample of 30 disabled people and 15 property owners. Interviews were also conducted. Among those interviewed were 2 officials from the law enforcing agencies (thus Accra metropolitan Assembly and Town & Country Planning), 10 officials from Estate Developing Companies, Architects and Engineers.

The researcher adopted a survey strategy because according to Saunders *et al.* (2007), surveys are popular as they allow the collection of a large amount of data from a sizeable population in a highly economical way. Using a survey strategy gives you more control over the research process and when sampling is used, it is possible to generate findings that are representative of the whole population at a lower cost than collecting the data for the whole population (Saunders *et al*, 2007). Stroh (2000) stated that a questionnaire is used to explore a large number of people’s views. The interviews were conducted in a semi-structure format that allows respondents to express their own viewpoints (Flick, 2002).

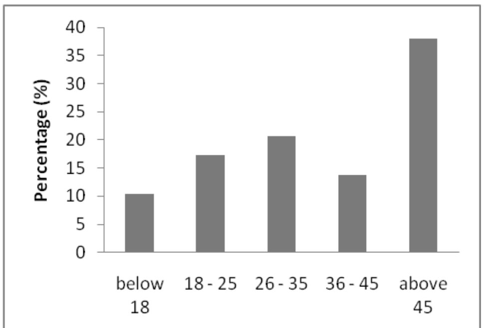


Fig 1: Age distribution

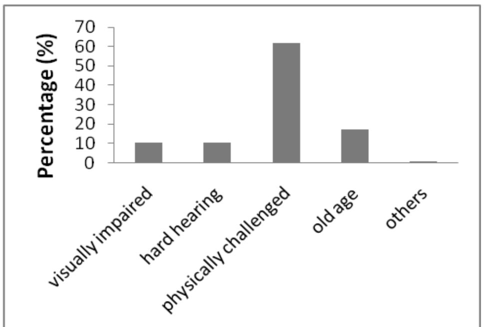


Fig 3: Type of disability

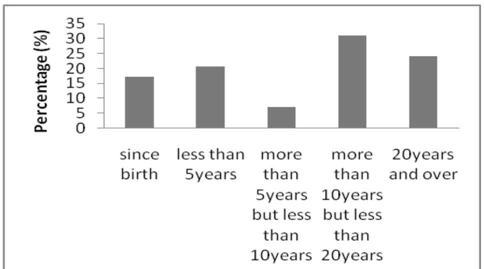


Fig 2: Period of disability

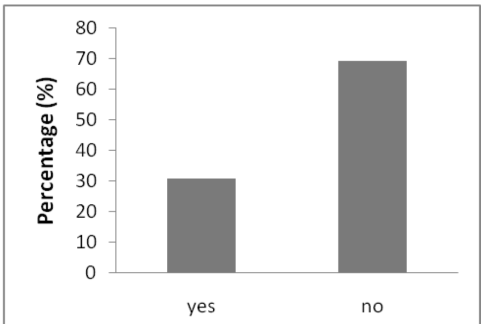


Fig 4: Disability friendly property

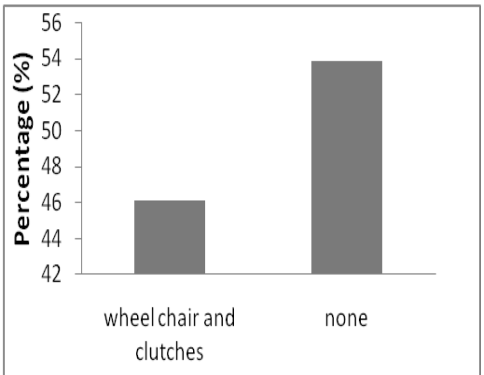


Fig 5: Disability aids use in building

RESULTS AND DISCUSSIONS

Data Analysis of People living with Disability

The data gathered from questionnaires sent to people living with Disability (disabled) and property owners were analyzed, as well as semi- structured interview for professionals. Observation aspects were used occasionally to confirm or otherwise. These presentations were as follows:

Figure 1: Age of respondents of People living with Disability

The age distribution of respondents of people living with disability as shown in Fig. 1; clearly indicates that there is no age variation or limit of becoming a disabled and therefore everybody is a potential disable. With above 45years registering almost 38%

as the highest and 26-35years closely followed with 20.69%. 18-25years and 36-45years representing 17.24% and 13.79% respectively also had a substantial percentages confirming the above assertion.

Table: 1

Question	Responden t	Percentage (%)	Responden t	Percentag e (%)	Total
a. Are you aware of the passage of the disability bill?	Yes	100	No	None	100%
b. Have changes been made after the passage of the bill (property owners)?	Yes	None	No	100	100%
c. Do you consider the disables before the passage of the bill?	Yes	90	No	10	100%
d. Do you consider the disables after the passage of the bill (builders)?	Sometimes	17.24	No	82.76	100%
e. Is there reduction of plights of disable after the passage of the bill?	Yes	100	No	None	100%
f. Was your department involved in the drafting of the bill?	Yes	None	No	100	100%
g. Do you insist on disabled friendly designs before approval for both new and refurbish buildings?	Sometimes	100	No	None	100%
h. What is the way forward?	Education	100	Rejection (drawings)	None	100%

(Source: field data- Reponses of officials from estate developing companies, law enforcing agencies officials, architects and engineers)

Figure 2: Number of years respondents have been living with disability.

The fig. 2 above explains the number of years respondents have lived with their disability. 31.03% have lived as disabled people between 10-20 years, those who have lived with it 20 years and over, represent 24.14%. Only 17.24% of the respondents were born with it. This shows that majority of the disabled were not born with it and that as one pass through life experiences he/she can become a disable even if not through mishap, age would definitely render him/her disable. Thus old age can render someone a disable.

Fig 3: Type of disability of respondents

Among those who responded to the questions were physically challenged (52.07%), old age (17.24%). Hard hearing (10.34%) and visually impaired (10.34%). This indicates that there are different types of disability and therefore builders, estate developers as well as engineers and architects have to take into consideration the above disabilities and make provisions for each of them in their designs and construction of buildings.

Figure: 4 Disability aids considered in your building

The result shown in fig. 4 indicates that majority of the property owners who responded to the questions do not consider any of the disability aids, this represents 53.85%. However, 46.15% of respondents pointed out that, they consider only wheel chairs and clutches in their building. This also discriminates against other disabled people like visually impaired and hard to hear people from using public buildings. This indicates that even the few of them who consider disabled people, think about only the physically challenged people.

Figure 5: Disabled friendly property

The results as shown on figure 5, confirm the fact that, the property owners do not make room in their buildings for people living with disability. Thus their properties are not disabled friendly. Even though 30.77% of the respondents disagreed with this assertion, 59.23% of the respondents agreed. This shows that property owners do not build to suit disabled people but rather healthy people. They always forget that everybody can become a potential disable in his or her life time especially old age.

Table 1a: Awareness of the passage of the disability bill (Property Owners)

All the property owners who responded to the questions admitted that they are aware of the passage of the disability bill. This shows that all the property owners who do not build to suit people living with disability or consider them do so, not out of ignorance but negligence and must be sanctioned.

Table 1b: Changes made to property after the passage of the bill (Property Owners)

All the respondents indicated that none of the property owners have made any form of changes in their buildings after the passage of the bill representing 100%. This confirms the assertion of the people living with disability that they are not considered by property owners.

Table 1c: Consideration of disabled people before the passage of the bill (Architects, Engineers and Estate developers)

90% of the interviewees drawn from architects, estate developers and engineers did admit that they considered disabled people before the passage of the bill while 10% of the interviewees did not consider disables. However, a close observation and interviews conducted shows that only few building in Ghana were built to suit disabled before the passage of the bill.

Table 1d: Consideration of disabled people by builders/designers after the passage of the bill (Disabled)

82.76% of the respondents were of the view that they are not considered by designers/ builders after the passage of the bill while 17.24% said they are sometimes considered after the passage of the bill. This means that the law enforcing agencies and the designers/ builders are not doing their work well and therefore have to improve upon it.

Table 1e: Reduction of plights after the passage of the bill (Architects, Engineers and Estate developers)

Though all the interviewees admitted the passage of the bill will reduce the plight of the disabled people, most of the buildings in the country are not disability friendly. This is because refurbishment and building to suit disables brings about extra cost and for that matter factoring disables in all designs/buildings, needs government intervention in terms of persuasive agenda and also taking the lead by making all government buildings disabled friendly.

Table1f: Involvement of law enforcement agencies/departments in drafting the bill

100% of the respondents admitted that their departments did not take part in the drafting of the bill. Though in further discussion, they admitted having a responsibility of making sure that all designs and buildings conform to the Disability Act, there were some sort blame game between the two enforcing agencies used, thereby creating some sort of laxity in the enforcement of the law.

Table 1g: Insistence on disabled friendly designs before approval for both new and refurbished buildings

All the law enforcement agencies respondents (that is 100%) admitted that though the law has been passed, most of the designs that come to them for approval do not conform to the disability standards and attributed this to lack of compliance and ignorance of the Act. They were of the view that the ten year compliance period is not helping because some people take advantage of that clause. Also worrisome is the lack of legislative instrument to back the Act for stronger enforcement powers. However, they try to impress upon property owners to include disable facilities.

Table 1h: On the way forward

All the respondents (that is 100%) were of the view that Seminars and fora on disabled friendly buildings must be organized regularly for professionals in the building industry especially those at the enforcing end. Also education of the general public on the Disability Act and who can be disable. This clearly demonstrates the level of ignorance especially the general public.

CONCLUSIONS

The disabled people in Ghana; be it physical, visual, hearing impairment, etc account for a recognisable size of the population and deserve the right to access and use buildings comfortably. This is long overdue because before the passage of the Disability Bill into law in June 2006, there were enough local and international conventions which made it mandatory for building professionals and clients to ensure that the disabled people were factored in the design and construction of buildings. Therefore, the only way to stop the springing up of buildings that are not disabled friendly is for the government, professional institutions within the building industry fraternity in particular and civil society, to embarked on vigorous sensitisation or education drive for all stakeholders on the need to adhere to the dictates of the Act. This would ensure that industry players do not hide under the canopy of the 10year grace period (i.e. ten year compliance period) in the Act and create a mess which would be very difficult and expensive to reverse at the tenth (10^{th}) year. Again, not until the government and civil society push for the passage of Legislative Instrument to back the implementation and enforcement of the PWDA by parliament, it would be very difficult for the enforcing agencies to insist on the introduction of facilities that make buildings disabled friendly in residential, commercial and institutional buildings to ensure compliance

REFERENCES

A Comprehensive and Practical Guide for Students, Oxford: Oxford University Press.

Akufo-Addo N. (2009). Pay serious attention to disability issues. Available: http://news.myjoyonline.com/news/200911/37625.asp (2009-11-10)
Annor, J. (2002) Implementing government policy for supporting technology use by Persons with Disability, People to People International

Denzin, N. K. (1970). The Research Act: A Theoretical Introduction to Sociological Methods. Chicago: Aldine

Disability Culture Human Rights retrieved from www.issues .takingitglobal.org

Disability Statistics DRC website (2003) available: http://www.drcgb.org/Newsroom/Key_DRC_facts_and_glossary/Number_of_disabled_people_in.aspx (2009-11-20)

Disability Statistics United Nations website (2003)

http://www.un.org/disabilities/convention/facts.shtml(2009-11-20)

Disability Statistics United States Census Bureau website (2003) available: http://www.census.gov/hhes/www/disability/sipp/disab02/awd02.html (2009-11-20)

Dixon, B. R., Bouma, G. D. and Atkinson, G. B. J. (1988). A Handbook of Social Science Research:

Flick, U. (2002). An Introduction to Qualitative Research. London: Sage Publications ltd.

Frain J. P., Carr P. H.(1996) Is the Typical Modern House Designed for Future Adaptation for Disabled Older People? Darlington Co. Durham, DL36HX

Government of Ghana (2000). National disability policy document, Accra, Government Press.

Handbook for Postgraduate Researchers. London: Sage Publications. Chapter 15.

Hart, C. (2003). Doing a Literature Review: Releasing the Social Science Research Imagination. London: Sage Publications Ltd.

Liberti-Lansing, M (undated) Building, adapting homes for disabled: Capital District Business Review. New York

Obeng, M.R. (2009). We owe a duty to people with disability. Faculty of law, KNUST Kumasi

Poverty report: Ghana's toilets are not disability accessible friendly available: www.allafrica.com (2009-12-10)

Republic of Ghana. Persons with Disability Act (2006) Act 715, Assembly press, Accra.

Sarpong, A. (1978). Ghana in retrospect, Accra, Ghana Publishing Corporation

Saunders, M., Lewis, P. and Thornhill, A. (2007). Research Methods for Business Students (4th Ed). Prentice hall

Stroh, M. (2000). 'Qualitative interviewing' in Burton, D. (Ed) Research Training for Social Scientists: Types of Disabilities available http://web.jhu.edu/disabilities/faculty/types_of_disabilities/adhd.html (2009-11-20)

Types of Disabilities available: http://www.barrierbreak.com (2009-12-02)

UNICEF (2000): The situation of Children in Ghana, Accra. UNICEF www.ssa.gov (2009-12-10)

United Nations Design Manual for a Barrier Free Environment(2009) Accessibility for the Disabled, available: www.un.org/esa/socdev/enable(2009-12-27).

DESIGNING OUT WASTE ON MASS HOUSING CONSTRUCTION SITES IN MINNA, NIGER STATE

Oluwatoyin Ayodeji Olaniyan[1]
Department of Architecture, Federal University of Technology, Minna

The need to minimize or eliminate waste in mass housing designs in order to construct quality houses and meet housing demand in Minna is unavoidably essential. The nascence of designing out waste; the smearing of design errors that compound design waste and the unawareness of construction stakeholders are issues in contention. The aim therefore is to examine construction waste caused by roof design errors complicated by improper building orientation viz a viz their remedial solutions; with a view to provide explanations on reducing construction waste on mass housing sites in Minna. Field investigations of waste routes were conducted. At the same time, the nature and extent of waste were determined. Changes in roof designs and introduction of columns in walls were critically enumerated and discussed to explicate some current and needed strategy for designing out waste in Minna. It found that waste routes originate from the structural and aesthetical objectives of architectural design. In addition to building and material complexity, immaterial complexities such as building orientation can also cause waste. Following from this, designing out waste is not only interested in reducing waste, but also in reducing environmental impacts on building and material components. Designing rightly from the onset with simple plans and building components eliminate the need to repeat work and therefore designing out waste strategies are better predefined and not post defined.

Keywords: architectural design, construction waste, design waste, mass housing.

INTRODUCTION

Amidst all the needs known to man, housing is the most crucial. Several means have therefore been devised to make shelter a reality. In the last two decades, the growing rate of urbanization in Nigeria has accentuated the need for housing quality and quantity (Ajanlekoko, 2001). Responsively, mass housing construction has intensified in Nigeria in order to mitigate housing shortage through combined efforts of public and private domains known as public private partnership (PPP) (Olayiwola et al. 2007).

The successful construction and completion of a house is contingent on a working architectural design that encompasses at least two of three fundamental objectives, viz: function, aesthetics and structure. In mass housing construction, architectural designs play the role of actuators: by which every construction stakeholder is driven, and acts upon directly or indirectly. Similarly, design links virtually every aspect of construction mobilization with a multiplied effect on man, material, machine and money. Concomitantly, fallouts such as loss of building materials are inevitable thereby resulting in various forms of construction and design waste.

[1] teewhyzee@yahoo.com

Olaniyan, O.A. (2011) Designing out waste on mass housing construction sites in Minna, Niger state *In:* Laryea, S., Leiringer, R. and Hughes, W. (Eds) *Procs West Africa Built Environment Research (WABER) Conference*, 19-21 July 2011, Accra, Ghana, 315-323.

Efforts towards identifying the sources and causes of construction waste in order to avoid, eliminate or minimize waste and erect quality houses epitomize the concept of designing out waste. Functional, aesthetical and structural design objectives now run parallel with waste reduction strategies or still are expected to incorporate waste reduction strategies. Apparently, waste minimisation through designing out waste is still in its infancy (Keys et al. 2000). Moreover, design waste is compounded by design errors and still remains unclear to most construction stakeholders.

BACKGROUND TO THE STUDY

Within the last decade, the M.I.Wushishi and Talba housing estates, comprising five hundred houses apiece have been constructed through the PPP in Minna, Niger state. The most prominent feature within these estates is a set of uniform architectural design prototypes. The Talba housing estate recorded huge building material wastes at its practical completion stage sequel to a deluge of rainstorms (fig 1). It has been claimed that the susceptibility of roofs to rainstorm destruction underscores such huge material wastes; and is caused by design errors inter alia (Jolaoso 2006; Olabintan 2006). Pohjola and Tanskanen (1997) as cited by Pongrácz et al (2004) classified such waste as things with well-defined purpose, but their performance ceased being acceptable due to errors in their structure or state.

With these in mind, the prominence of design waste may as well be less obvious in single housing units but can be quite severe in the case of mass housing construction. This is because as few designs are distributed over an entire mass housing construction site, so will a design error no matter how small, be magnified cumulatively over a wide range of housing units. If this goes unnoticed, it will inhibit the completion of such enormous projects; reduce its quality; and increase the quantity of construction waste. Aidonis et al. (2008) estimated that construction waste constitutes 30-35% of global solid municipal waste stream. It is therefore needful to highlight design errors that potentially drive construction waste generation in order to make progress with strategies for designing out waste.

Fig 1: Two and three bedroom prototypes depicting widespread building material losses resulting in enormous construction waste. Source: Author, 2011

AIM AND OBJECTIVES OF THE STUDY

This study therefore set out to examine construction waste caused by roof design errors complicated by improper building orientation viz a viz remedial solutions; with a view to provide explanations on reducing construction waste on mass housing sites in Minna. This will be explicated through the following objectives. First, the overall design scheme of the Talba housing estate will be assessed. This will be followed by outlining design waste routes through the nature and extent of material losses on the site. Lastly, the rehabilitative reconstruction work on the site will be assessed, and particularly the obvious changes made on roof designs and walls will be enumerated and discussed.

THEORETICAL FRAMEWORK

Architectural design and material waste can be viewed in different ways; therefore it is necessary to define architectural design and design waste. In Hillier (2007), architectural design can be broadly described as a process or an object that emerges from a creative-predictive design process. He stressed that the creative aspect searches for design solutions in a normative way: it defines a search-space (for example a locality) where it adopts formal and spatial properties and incorporates them into a design proposal. Thus architectural design as an object is a conglomeration of components and assemblage of various materials (Folorunso and Fadamiro, 2006). Therefore, architectural design will be considered in this study as a building (walled roofed structure) that comprises formal and spatial components.

Koskela (1992) as cited by Formoso et al. (1999) describes waste as any inefficiency that results in the superfluous use of equipment, materials, labour, or capital in the production of a building: implying that construction waste includes both the incidence of material losses and the execution of unnecessary work, with general additional cost but do not add value to the building. Sheeduzzafar and Khan (1984) as cited by Akinkurolere and Franklin (2005) divided material waste into four categories, viz: design waste, taking off and ordering waste; supply waste and contract waste. Several authors (Garas et al.2001; Akinkurolere et al.2005; Ajayi, et al. 2008) refer to design waste as material losses arising from uncompleted design, design changes, plan errors and detail errors and such definition is apposite to a study of this nature.

According to Keys et al. (2000), the concept of designing out waste rests on identifying the source of waste in the construction process which includes: materials and component complexity, building complexity, lack of co-ordination, fast tracking and lack of communication. They maintained that the solutions for designing out waste are characterized by any of four innovative strategies: which must take cognizance of the waste routes (its origins or concepts); the scheme or detail design and disciplines involved. Element of these strategies entail long and short term approaches, viz: use of prefabrication; standard component and realistic sizes; minimizing temporary works, optimizing design lives; designing for recycling and disassembly and identification of material products which create waste.

RESEARCH METHOD

This present paper is the outcome of an ongoing study on waste generation on mass housing construction sites in Minna, Niger state Nigeria. A brief description of the Talba housing estate highlights the design scheme including its building components. In order to identify design waste routes on the site, field observations were conducted to determine the nature and extent of massive loss of building materials and components accentuated by rainstorm damage. Subsequent rehabilitative works on the housing units made way for further investigations of the design changes. Together these constituted primary data and were presented using tables and photographed pictures. Secondary data which encompass discourse on architectural design, construction and design waste and rainstorm damage were sourced from cognate journals and publications. This study is however limited to design waste and only percentile analysis was carried out on the data so collected.

BRIEF DESCRIPTION OF THE TALBA HOUSING ESTATE

The area under study is a mass housing estate currently under reconstruction and located along Minna-Bida road of Niger state in Nigeria. It comprises 500 units of 2 and 3 bedroom prototype detached bungalows in a ratio of 3:2 respectively. The houses marked in red and blue represent 2 bedrooms, while houses marked in green represent 3 bedrooms (fig 2). Majority of the 2 bedrooms lie along the east-west axis while the 3 bedroom lie along the north-south axis. The irregular plan shape of the 2 bedroom represent a conglomeration of simple material components and complex planar shape; while the rectangular shape of the 3 bedroom represent a simpler design scheme (figs 3 and 4). The walling components were predominantly made of nine and six inches hollow sandcrete blocks laid in situ; while timber, corrugated aluminium roofing sheets (.35mm gauge) and asbestos ceilings constitute the roof structure.

The contract was awarded to a private developer, who concentrated on constructing 15 housing units and sub-contracted 485 units to 26 other contractors. Their agreement elapsed at the practical completion stage. Finishes, fixtures and fittings were sub contracted out separately and all together the works were executed through direct labour. The maximum number of building units awarded to other contractors was 50 while the minimum was 2. The highest frequency of building allocation was 20. The entire site measured approximately 90 hectares and each plot covered approximately 600m2.

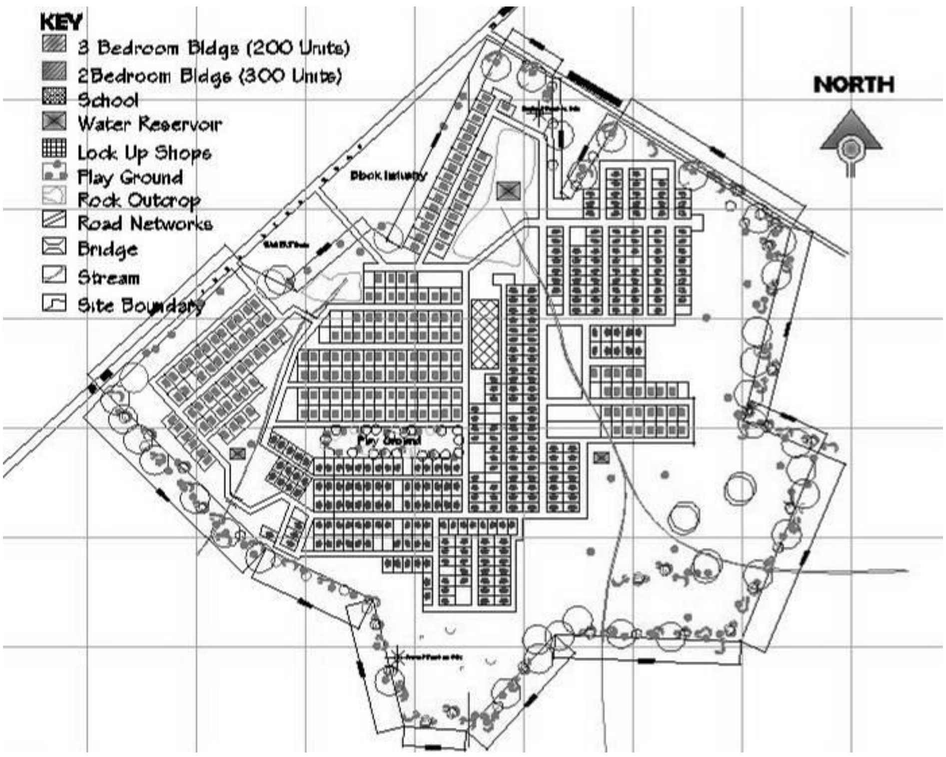


Fig 2: Schematic layout plan of the estate, showing distinctions between 2 and 3 bedroom buildings and their various orientations on site with respect to the north axis. Source: Puzzle construction

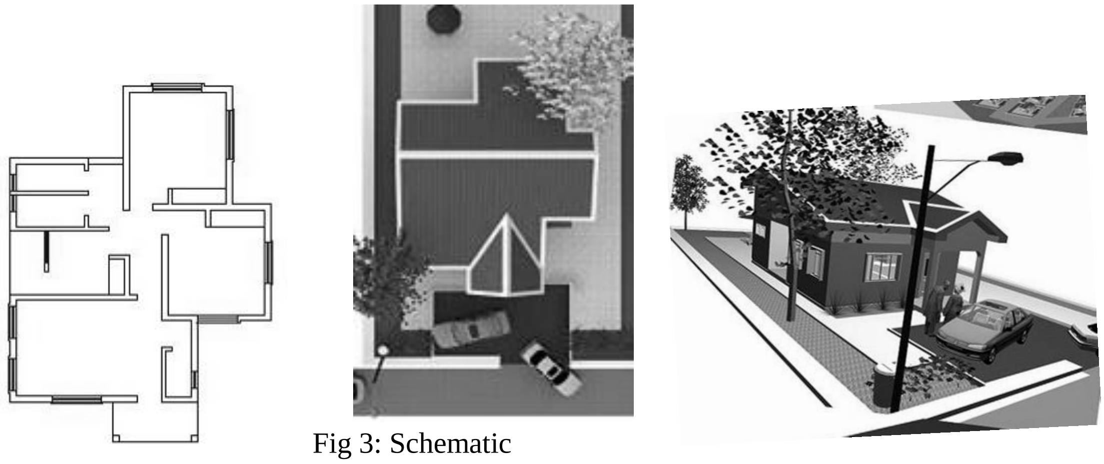
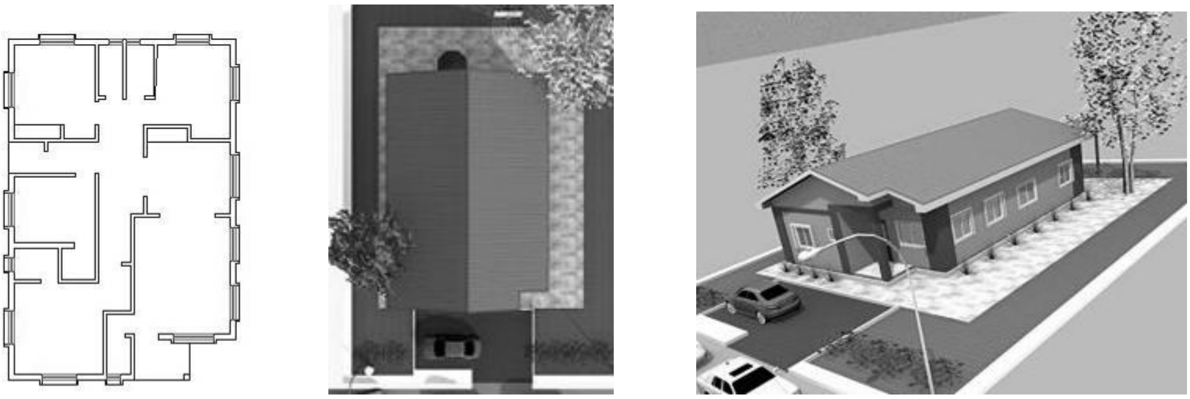


Fig 3: Schematic representation of the 2 bedroom floor plan, roof plan and 3D view. Source: Puzzle



construction

Fig 4: Schematic representation of the 3 bedroom floor plan, roof plan and 3D view. Source: Puzzle construction

RESEARCH RESULTS

Design Waste Routes

Cases of collapsed walls and exfoliated roof structure typify the bulk of component wastes. The waste constituents include sandcrete and cement rubbles, wood, aluminium sheets, nails and asbestos sheets. Following the incidence of rain storms, the material wastes encompass nearly half of the 2 bedrooms (47%) and 3 bedrooms (48%) respectively. Out of these, 30% of 2 bedroom and 29% of 3 bedroom recorded roof component losses.

Table 1: Nature and Extent of Material Waste (Damages) as at July, 2010

S/N	Description	2 Bedroom	Percentiles (%)	3 Bedroom	Percentiles (%)
1	Completed buildings	278	92.6	191	95.5
2	Affected buildings	133	47	93	48
3	buildings with damaged roofs	86	30	57	29
4	buildings with collapsed walls	47	17	36	19
5	buildings with Collapsed walls and roofs	53	19.2	42	22.2
6	Uncompleted buildings	22	7.4	9	4.5

Source: Author’s field work, 2011

The loss on walling components was slightly above a third of the entire waste material (table 1). Comparatively, similar pattern of walls and roof losses throughout the entire site correspond with similar quantity of waste between the 2 and 3 bedroom design schemes (Fig 5).

Fig 5: Views of the Talba housing estate depicting uniform pattern of material waste along the gable end owing to flawed roof design and poor building orientation. Source: Author's field work, 2011

Rehabilitative Reconstruction Works

Corrective and rehabilitative construction commenced on all the 2 and 3 bedroom buildings, to the extent that the initial architectural designs were varied substantially. The replacement of gable roof with hip roof and introduction of lateral columns on the walls are the most emphatic features of the rehabilitative reconstruction work (table 2). On one hand, the foregoing changes which necessitated the elimination of the gable end walls by the introduction of hip roofs further highlight the errors of the initial architectural designs in facilitating material waste. On the other hand, it envisions a path for designing out waste and thus warrants special attention (Fig 6).

Table 2: Nature and Extent of Design Changes as at January, 2011

S/N	Formal and spatial properties of the architectural design	Description of rehabilitative work to be done (2 Bedroom)	Description of rehabilitative work to be done (3 Bedroom)
1	Flooring and floor finish; Plastering; Painting; Ceilings and Doors and Windows	Not Available	Not Available
2	Walls	Eliminate gable end walls; introduce ring beams and lateral columns around the buildings Reconstruct broken walls	Eliminate gable end walls; introduce ring beams and lateral columns around the buildings Reconstruct broken walls
3	Roof structure	Fix ceiling members and ceilings Change roof structure from gable to hip roof and apply .55mm corrugated aluminium sheets as covering	Fix ceiling members and ceilings Change roof structure from gable to hip roof and apply .55mm corrugated aluminium sheets as covering

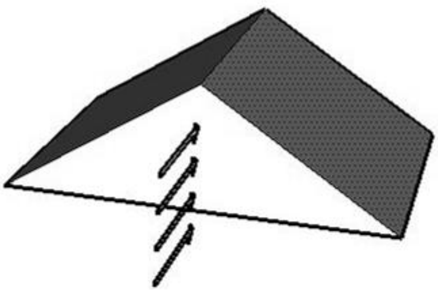
Source: Author's field work, 2011

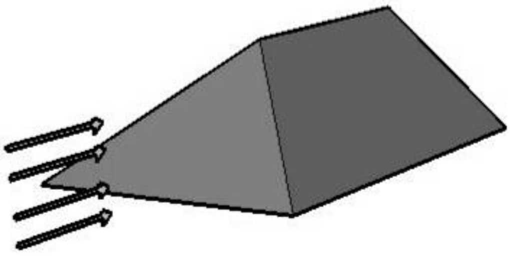

Fig 6: Views of the rehabilitative work depicting change in roof design and introduction of columns within walls. Source: Author’s field work, 2011

DISCUSSIONS

Designing out waste as the term implies is characterized by either a reduction or an elimination process: both of waste and waste prone building material components. It is active against all forms of passive waste inherent in architectural designs. In mass housing, the complexity of building shape underscores plan errors which constitute a prime target on the list for elimination and waste minimization. The decision by architects to super impose simple building elements over complex plans is as much a mismatch as it is a design error and should be avoided. Complicity with simplicity in design especially in mass housing is central to material optimization and efficiency in mobilizing man material machine and money. Apparently, because most mass houses in Minna are characterized by gable roof structures, the same choice of roof design in the case in point is normative and at first glance satisfies Hllier’s (2007) creative design process. The creativity however required for designing out waste is one that is technical: penetrating the design process via structural necessities and dovetailing into the functional and aesthetical objectives. This kind of creativity incorporates short and long term approaches of minimizing waste in design via. It also reinforces a shift towards material optimisation.

For instance, a hip roof design reflects a steep digression from the normative roof design patterns but is consistent with existing roof typologies around the immediate surroundings of the estate’s milieu. A proper design that incorporates waste minimizing strategies reflects an interdependent sensitivity to environmental impacts such as horizontal wind loads. A hip roof design, if properly constructed minimizes external area to internal volume and has a greater propensity to minimize the impact of horizontal wind loads due to its all encompassing slopes. Similarly, wind loads have maximum impact at 90^0 inclination to surfaces and lesser impact at angles lesser than 90^0. Consider the instance of wind impact on the gabled end of the roof and the slope of the hip roof (fig 5). The moment of the force in Newton on the gabled end is F (N); while moment of the force in Newton on the slope is $F\cos\Theta$ (N). The former will have a greater resistance to waste





generation.

Fig 5: Schematic representation of horizontal wind loads on gable roofs and hip roofs respectively (Author, 2011)

It may be argued that the choice of the gable roofs are cheaper alternatives; not forgetting that affordability and profitability on investment are objectives of design in Hillier (2007) and are also consistent with the construction of mass housing through the PPP. Secondly, it can also be argued that similar estates in Minna used gable roofs in the past and have recorded successes against the backdrop of design driven waste.

The backlash in these arguments is expressed in the main objective behind introducing columns to a design of this nature. The introduction of columns and beams are largely structural and in this context connote a remedial action to an irreversible design error - poor building orientation. Proper building orientations (that is ensuring that building lengths of lie along the east west axis), need little or no contraptions for lateral bracing. The portions of the building walls that received the greatest impact of wind and as a corollary, the greatest material waste were the gabled end of the roofs. However, it is less likely to achieve hundred percent successes when orienting buildings en mass. This further re-echoes the need for designs to possess an independent propensity to minimize environmental impacts.

CONCLUSIONS

With regards to construction waste generation on mass housing sites, design waste is first and foremost not to be considered as waste material as much as it is considered an agent of waste generation. The uniformity and widespread nature of roofing and walling materials waste in this study lend support to this. Various forms of design waste are passive and as such further ignorance is not a luxury that can be afforded. Designing out waste on mass housing construction sites in Minna was however not premeditated, rather it was learnt the hard way. In fact, it is not in the mobilization of man material machine and money that waste lies, but in the inability to know and do the right things from the onset.

Designing rightly from the onset eliminates the need to repeat work and therefore designing out waste strategies are better predefined and not post defined. This challenge however is characteristic of the nascence of designing out waste. It was also found that in addition to building and material complexity, immaterial complexities such as building orientation can also cause waste generation. Following from this, designing out waste is not only interested in reducing waste, but also in reducing environmental impacts on building and material components by minimizing external surfaces of building components to internal volumes.

While it is important for stake holders in the construction industry to become aware of design waste, the bulk of design waste and its domino effect starts and ends around the architect and his attendant design decisions. It is therefore very important for architects to think hard and deep over and above complex aesthetic decisions or compromising complexity of building plans with simplicity of material components. This will hitherto encourage the elimination or avoidance of design changes and plan errors.

REFERENCES

Aidonis, D., Iakovou, E., and Vlachos, D. (2008): Reverse flows optimization for construction and demolition waste. *Paper presented at BALKANTRIB 2008.* Sozopol, Bulgaria, 12-14 June, 2008. pp. 1-5. Viewed 18 May2010

Ajanlekoko, J.S. (2001): Sustainable housing development in nigeria – the financial and infrastructural implication. *Paper presented at the International Conference on Spatial Information for Sustainable Development,* Nairobi, Kenya 2–5th October, 200. Viewed 13 November 2010, http:// *www.fig.net/pub/proceedings/nairobi/ajanlekoko-CMWS1-1.pdf*

Ajayi, O. M., Koleoso, Soyingbe, A.A., and Oladiran., O. J. (2008): The practice of waste management in construction sites in Lagos State, Nigeria. *Paper presented at the construction and building research conference of the Royal Institute of Chartered Surveyors,* held at Dublin Institute of Technology, 4-5th September, 2008, Viewed 15 November 2010

Akinkurolere, O.O., and Franklin, S.O. (2005). Investigation into waste management on construction sites in south western Nigeria. *American Journal of Applied Sciences,* 2(5), pp. 980-984

Folorunso and Fadamiro, (2006): Building materials quality and architect's specifications in the Nigerian construction industry: An overview. *Archisearch international journal of architecture and environment.* 1(2). pp. 73-80

Formoso, C.T., Isatto, E.L., and Hirota, E.H. (1999): Method for waste Control in the

Building Industry. In: *Proceedings of the 7th annual conference of International Group of Lean Construction,* held at University of California, Berkeley, 26-28th July 1999, pp. 325-334

Garas, G.L., Anis, A.R., and Gammal A.E. (2001): Materials Waste in the Egyptian Construction Industry. *Ph.D. thesis,* Cairo University, Egypt, Viewed 18 May 2010

Hillier, B. (2007): *Space is the machine.* London: Space syntax publishers

Jolaoso, B.A. (2006): roof failures in residential buildings in Abeokuta, Nigeria: causes and remedies. In: Fadamiro, et al. (eds.). *Urban environmental sustainability: interventions and responses.* 1st ed. Akure: Shalom Publishers. pp. 128-140

Keys, A., Baldwin, a., and Austin, S. (2000): designing to encourage waste minimization in the construction industry. Viewed 13 November 2010 *http:// www. dspace.iboro.ac.uk*

Olabintan, O.D. (2006): Rainstorm damage to buildings in Owoand Akure, Ondo stae; causes and effects. In: Fadamiro, et al. (eds.). *Urban environmental sustainability: interventions and responses.* 1st ed. Akure: Shalom Publishers. pp. 117-127

Olayiwola, L.M., Adeleye, O., and Ogunshakin, L. (2007): Public Housing Delivery in Nigeria: Problems And Challenges. *Paper presented at the XXXIII IAHS world congress, on Housing,* 27-30th September, 2005, Pretoria, South Africa

Pongracz, P., Philips, S.P., and Keiski, R.L. (2004): Evolving the Theory of Waste Management – Implications to Waste Minimization. Paper presented at Resource Use Optimization Conference, Oulu. pp. 61-67. Viewed 13 November 2010 *http://www.oulu.fi/resopt/wasmin/pongracz5.pdf.*

DIESEL (AGO) PUMP PRICE INCREASE AND THE PRICES OF SELECTED BUILDING MATERIALS IN NIGERIA 1990 – 2009

John Ebhohimen Idiake[1]
Department Of Quantity Surveying, Federal University of Technology Minna, Niger State Nigeria

This paper investigates the effect of increase in diesel pump price on the prices of selected building materials in Nigeria. The objective is to establish the statistical relationship existing between diesel price increase and the price of selected basic building materials. Using a simple interactive polynomial method and working at 95% confidence limit a computation was made of the research variables. The result showed a significant relationship between the variables tested. Also the result revealed different degrees of relationships of the variables analyzed. Prices of cement, blocks and paint had linear, quadratic and cubic relationships respectively with increase in diesel price. Coefficients of determination of 96.04% for cement, 96.63% for blocks, 95.76% for iron rod, 94.52% for paints, 90.12% for sharp sand and 96.49% for timber were discovered for these tested variables. The results of the study indicate that the relationships were either linear or non linear in the tested variables. This reveals that diesel price increase will cause the price of building materials to rise at various degrees, thereby exerting an enormous financial pressure on the building developers as a result of its multiplier effects on haulage and production of building material. Therefore government fuel price hike policies should be implemented with caution in order to prevent rise in prices of building materials.

Keywords: building material, diesel price, energy, price hike, road haulage.

INTRODUCTION

Diesel is a refined product obtained from petroleum or crude oil which is a naturally occurring flammable liquid found in rock formation in the earth. Petroleum consists of a complex mixture of hydrocarbons of various molecular weights and other organic compounds (Hyne, 2001). The term “petroleum” was first used in the treatise *De Natural Fossilium* published in 1546 by a German Mineralogist. (Wikipaedia, 2009).

In its strictest sense, petroleum includes only Crude oil but in common usage it includes crude oil and natural gas. Both crude oil and natural gas are predominantly a mixture of hydrocarbons. The proportion of hydrocarbons in the petroleum mixture is highly variable between different oilfields and ranges from as much as 97% in weight in the lighter oils to 50% in the heavier oil and bitumen. The chemical structure of petroleum is heterogeneous, that is, it is composed of hydrocarbons chains of different lengths. As a consequence petroleum may be taken to oil refineries for the separation of the hydrocarbon chemical by distillation and further treatment by other chemical processes so as to be used for a variety of purposes. The most common distillation products of petroleum are fuels, which include ethane, diesel fuels (petro diesel), fuel

[1] idiakeje@yahoo.com

Idiake, J.E. (2011) Diesel (ago) pump price increase and the prices of selected building materials in Nigeria 1990 – 2009 *In:* Laryea, S., Leiringer, R. and Hughes, W. (Eds) *Procs West Africa Built Environment Research (WABER) Conference,* 19-21 July 2011, Accra, Ghana, 325-333.

oil, gasoline (Petrol), jet fuel, kerosene and liquefied petroleum gas, (Speight, 1999). The refined oil is moved to the end user through pipelines, by ships and by tanker trucks.

Petroleum in one form or another has been used since the ancient times, and is still very important in the economy of many nations. The rise in importance was mostly due to the invention of the internal combustion engine. More than 4000 years ago asphalt was used in the construction of walls and towers in Babylon. Great quantities of it were found around the River Euphrates (Wikipaedia, 2009). Today, about 90% of vehicular fuel needs are met by petroleum oil. Petroleum's worth as a portable, dense energy source powering the vast majority of vehicles and as the base of many industrial chemicals makes it one of the world's most important commodities. In Nigeria, petroleum industry is the largest industry and main generator of gross domestic product in the nation. Since the British discovered oil in the Niger Delta at Oloibirir in 1956, the oil industry has been marred by political and economic strife largely due to complexity of multinational corporations. Petroleum production and export play a dominant role in Nigeria's economy and account for 90%of her gross earning. Nkoro (2005) observed that increase in fuel prices has worsened the economic crisis in the Nigerian economy. He said that whenever the fuel price increases the GDP tends to decrease. His analysis showed a negative relationship between the fuel price increase and GDP.

GASOLINE AND DIESEL USAGE AND PRICING

The usage pricing of gasoline or diesel results from factors such as crude oil prices, processing and distribution costs, local demand, the strength of local currencies, local taxation and the unavailability of local sources of diesel (supply). Since the trading of fuel is globally the trade prices are similar, the price paid by consumer largely reflects national pricing policy. Some nations such as Europe and Japan impose high taxes on diesel: other, such Saudi Arabia, Venezuela and Nigeria subsidize the cost (Deutsuhe 2007.)

The Cambridge Energy Research Association reported that 2007 had been the year of peak gasoline usage in the United States and that record energy price would cause an enduring shift in energy consumption practices. Despite high demand in the United States and rising fuel costs, gasoline prices are low in the States when compared with most other Western countries. (Campoy 2008)

Other nations with subsidies on fuel include Iran, Egypt, Burma, Malaysia, Kuwait, China, Taiwan, South Korea, Trinidad and Tobago, and Brunei. The purpose of subsidies is to make transport of people and goods cheaper. This has been viewed to discourage fuel efficiency. In some of these countries, the soaring cost of crude oil since 2003 has led to these subsidies being cut, moving inflation from the government debt to the general populace, something resulting in political unrest. Pricing is a federal concern in order to ensure supply and demand is kept within limits to the consumer.

Outcome of diesel price increase on goods and services

The construction industry is a significant and productive sector that plays a vital role to stimulate growth through its linkage with other industries and professional services. Favourable energy prices have helped to mitigate the impact of declining volumes on the operating leverage of the aggregates business. Production costs in the aggregates business are also sensitive to energy prices both directly and indirectly. Production costs directly affect diesel price through consumption and indirectly by the increased cost of energy related consumables, namely steel, paint and conveyor belts. Changing diesel costs also affect transportation costs, primarily through fuel surcharges in the long-hand distribution network. (Raleigh, 2009).

In Malaysia, the negative impact of the recent price increase of fuel was viewed with concern by the Master Builders Association of Malaysia. Wong (2008) observed that the increase cost of diesel is affecting the construction contractors very deeply. Contractors are sandwiched between the need to fulfil their contractual responsibility to deliver on time at fixed tender price and on the other hand to meeting up with the rising cost of fuel which has become a tightening noose on the cash flow, financing and continuous survivability of the construction industry. Furthermore, he noted that machineries such as Bulldozers, various tower and mobile cranes and off-highway trucks are insatiable users of fuel and observed that this will definitely cut into contractors' profit margins. Kemp (2008) stated that increasing energy prices invigorated the surge in bio-fuels, leading to rise in prices for grains and ultimately boosting demands for natural gas to make fertilizers. Rising gas and energy prices have filtered back into higher costs for aluminium smelters, steelmakers and shipping companies.

Wong (2008) pinpointed that due to fuel increases, there has been a rise in cost of living. According to him transportation of workers has led to extra labour cost. This has resulted in the escalation of site labour cost in recent times. Contractors have considered the effect as a major cost item in their estimates. The increase in diesel price was also observed as having a multiplier effects on other energy sources such as power and gas used in manufacturing of construction materials, thus leading to increase in prices of materials. He further noticed that many contractors would be unable to continue in business if the increase is not kept in check.

Simonson (2008) observed that the American producer price index has gone up 6.5 percent as a result of 24 percent increase in diesel fuel cost. The consequences of this increase was a 5.5 percent rise in prices of steel reinforcement bars including other steel sections, and multiple problems on contractors using diesel to power off-road equipment and construction vehicles and also payment on fuel as result of numerous inflow and outflow of deliveries at a large job site.

Bureau for Labour Statistics (2008) reported that construction materials cost rose by 6.5 percent in the United States due to high prices of diesel fuel. Simonson (2007) stated that increase in diesel fuel has affected highway and heavy construction projects. The effect was noticed in the 2004 producer price index which rose from 5.6 to 14 percent within three years period (2001 to 2004).

PURPOSE OF THE STUDY

The purpose of this study is to examine the relationship existing between increase in price of diesel from 1990 to 2009, and prices of some selected construction material. The objectives then will be to measure statistically the relationship existing between the price of each of these construction materials (cement, 225mm block, Iron rod, sharp sand, paint and timber) with the pump price increase of diesel over the period of twenty years. Also the study further seeks to examine or compare previous analysis (Idiake 2010) carried out on the effect of increase in petrol pump price with that of current study on diesel so as to build up empirical data for policy makers, budget planners and others involved in funding and designing infrastructures.

RESEARCH METHOD

The data used for this study spanned a period of twenty years from 1990-2009, a period which covered both military and civilian administrations. The data were collected from two sources, primary and secondary sources. The data for prices of building materials used in this study were obtained through market survey from dealers in the building materials; this was also complemented by prices obtained from Building Material Price Book (2009). The data for diesel pump price were obtained from secondary sources only provided by CBN and NNPC publications. The data collected as shown in Table 1 were weighted and subjected to simple statistical analysis of polynomial modelling with graphical presentation. From these presentations, discussions and inferences were drawn out for decision making.

Scope of the Research

(i) Factors of production of selected building materials were not considered in this study.
(ii) Variations in production dynamics not taken into account in the analysis of this study.
(iii) Assessment of relationship between variables was simply based on pump price of diesel and market price of building materials.

Assumptions

The following assumptions were made for this research work;

(i) Inflation was considered to be constant throughout the period under review.
(ii) No significant lag effects existed over the period considered for the research work.

DISCUSSION OF RESULTS OF RESEARCH ANALYSIS

Figure 1 shows the graphical presentation of the relationship between increase in price of diesel and price of cement. The coefficient of determination for the analysis is 96.04% with corresponding P-value of 0.018 which is lower than 0.05 level of significance. The R-square value of 0.964 shows that 96.04% variation in the price of cement is accounted for by the increase in the price of diesel. The relationship between the variables establishes a cubic or 3rd degree polynomial model (Eqn.1).

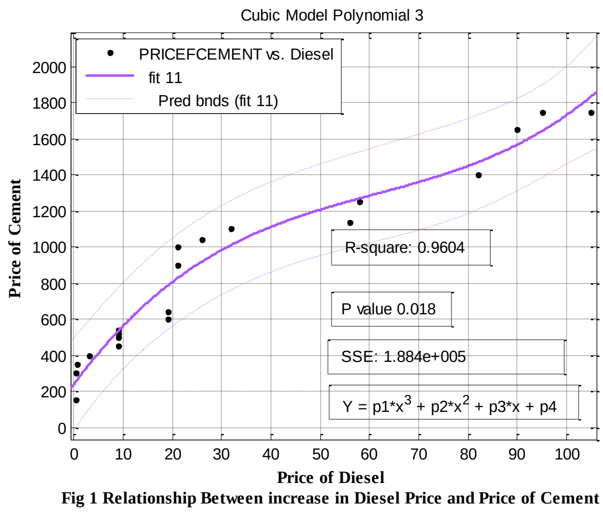


Fig 1 Relationship Between increase in Diesel Price and Price of Cement

Cement Price = $239.4 + 36.79x - 04793x^2 + 0.002605x^3$ (1)

From the equation model, the intercept on Y axis is 239.4 and for every increase of one unit of diesel there is an increase of about 36.79 in cement price. But it was observed that for every unit increase in price of diesel raised to the power of two, there is a decrease of about 0.4793 in cement price. Similarly an increase of about 0.002605 occurred for every unit increase of diesel price raised to the third power.

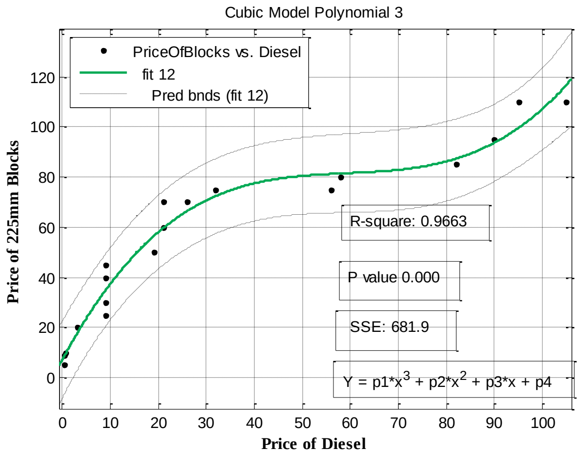


Fig 2 Relationship Between increase in Diesel Price and Price of 225mm Blocks

Figure 2 is showing the relationship between price of 225m block and increase in price of diesel. The coefficient of determination is 96.63% with a P-value of 0.000 which is less than 0.05 confidence limit set for the study. With R-square of 0.9663, it means that 96.63% variation in price of 225mm block is accounted for by the increase in price of diesel. The graphical relationship between the variables tested gives a 3rd degree polynomial model as stated in equation 2.

Blocks Price = $7.263 + 3.576x - 0.05869x^2 + 0.0003291x^3$ (2)

The model has an intercept of 7.263 on the Y axis and showed that every increase of one unit of diesel there is an increase of about 3.57 in 225mm block price. Also it was noticed that for every unit increase in the price of diesel raised to the second power a decrease of about 0.05869 was experienced. Similarly an increase of about 0.0003291 was observed for every unit increase of diesel price raised to the third degree.

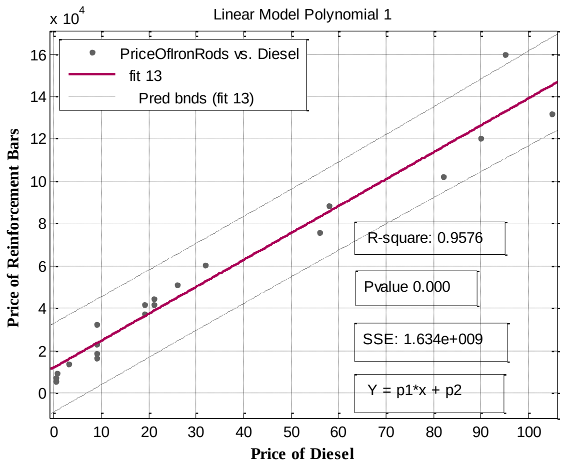


Fig 3 Relationship Between increase in Price of Dieseland Price of Reinforcement Bars

Figure 3 is the result of the analysis for the relationship between prices of iron rod and increase in pump price of diesel. The R-square for the analysis is 95.76% which is a very strong relationship. The P-square is 0.000 which is less than 0.05 level of significance, which means that the results were highly significant. The R-square result shows that 95.76% variation in price of iron rod is accounted for by the increase in price of diesel during the time under review. The variable tested gives a relationship of linear model with a straight line equation (Equation 3). This suggests that as the price of diesel changes, there is a corresponding increase in the price of Iron rod.

Iron rod = $1.201 \times 10^4 + 1269x$ (3)

The model has an intercept of 1.201×10^4 on the Y axis and for every increase of one unit of diesel there is an increase of about 1269 in the price of iron rod.

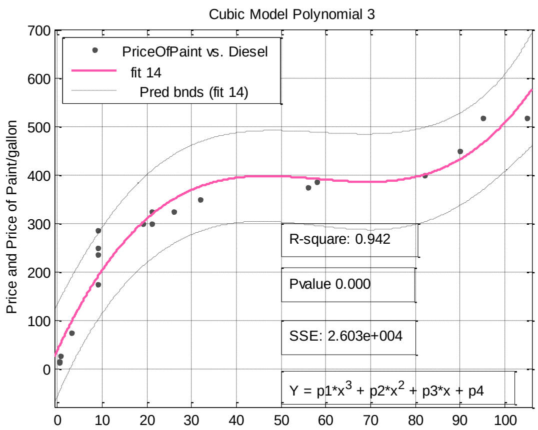


Fig 4 Relationship Between increase in Diesel Price and Price of Paint

Figure 4 shows the result of the relationship between the market price of paint and increase in pump of diesel. The coefficient of determination from the analysis is 94.2% and has P-value of 0.000 which is less than the allowable level of significance of 0.05, which depicts that the result is highly significant. The R-square of 0.942 suggest that 94.2% variation in the price of paint is accounted for by the increase in changes in price of diesel. These variables, prices of paint and diesel, maintain a 3rd degree polynomial relationship with a model equation (Equation 4)

Paint = $40.44 + 19.79x - 0.354x^2 + 0.002029x^3$ (4)

From this model the intercept on Y axis is 40.44 and for every increase of one unit of diesel there is an increase of about 19.79 in the price of paint. But it was noted that for every unit increase in price of diesel raised to the second degree there is a decrease of about 0.354 in cement price. Comparably an increase of about 0.002029 was witnessed for every unit increase of diesel price raised to the third power.

Figure 5 describes the result of the relationship between the market prevailing price of sharp sand per trip and increase in price of diesel per litre. This relationship has a coefficient of determination of 90.12% and P-value of 0.025 which is less than 0.05 level of significance. The R-square result of 0.9012 shows that 90.12% variation in the price of sharp sand is accounted for by the increase in price of diesel. The graphical relationship in this analysis has a quadratic or 2nd degree polynomial model, which is represented in the following mathematical model (Equation 5)

Sharp Sand = $294.6 + 88.39x - 0.1673x^2$ (5)

The model developed has the intercept of 294.6 on Y axis and subsequently for every increase of one unit of diesel there is an increase of about 88.39 in the price of sharp sand, but a decrease of about 0.1673 was seen in the price of sharp sand for every unit increase in the price of diesel raised to the second degree.

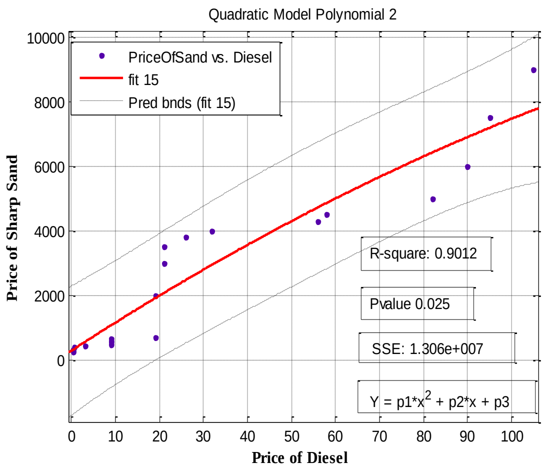


Fig 5 Relationship Between Increase in Price OF Diesel and Price of Sharp Sand

Figure 6 represents the result of regression analysis between the price of Timber and increase in price of diesel per litre. The analysis has the coefficient of determination to be 96.49% and P-value to be 0.009 which is less than 0.05 level of significance. The R-square value of 0.9649 reveals that 96.49% variation in the prevailing price of Timber in the market is accounted for by the increase in the price of diesel. The relationship between the variables shows a cubic or 3rd degree polynomial model with an equation (Equation 6)

$$\text{Timber} = 1.66 + 7.86x - 0.1036x^2 + 0.0005231x^3 \quad (6)$$

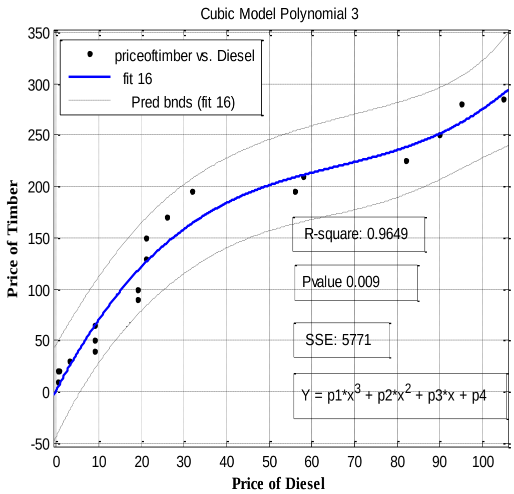


Fig 6 Relationship Between Increase in Price OF Diesel and Price of Timber

The model showed an intercept of 1.66 on Y axis and consequently for every increase of one unit of diesel there is an increase of about 7.86 in the price of timber but it was noted that for every unit increase in price of diesel raised to the second degree there is a decrease of about 0.1036 in timber price. Comparably an increase of about 0.0005231 was observed for every unit increase of diesel price raised to the third power. Table 1 shows the comparison between the regression analysis results on increase in petrol pump price and diesel pump price on prices of building materials.

Table 1. Comparative Analysis of the Effect of Petrol and Diesel Price increase on Selected Construction Materials

S/N	Building Materials	Regression Analysis Results on increase in Petrol Pump Price from Previous Study			Regression Analysis Results on increase in Diesel Pump Price from Current Study			Remarks
		R-square	P-value	Curve fitting Relationship	R-square	P-value	Curve fitting Relationship	
1	Cement per 50kg	93.92%	0.000	Linear	96.04%	0.018	3rd degree polynomial	Superior R^2 and relationship
2	225mm Sandcrete Block per unit	92.89%	0.002	2nd degree polynomial	96.63%	0.000	3rd degree polynomial	Superior R^2 and relationship
3	Iron Rod per ton	92.76%	0.000	Linear	95.76%	0.000	Linear	Same relationship with minor difference in R^2
4	Paints Per gallon	94.52%	0.002	3rd degree polynomial	94.20	0.000	3rd degree polynomial	Same relationship
5	Sharp Sand per trip	85.54%	0.000	Linear	90.12%	0.025	2nd degree polynomial	Superior R^2 and relationship
6	Timber per length	94.59%	0.015	2nd degree polynomial	96.49	0.009	3rd degree polynomial	Superior R^2 and relationship

Source: Idiake 2010, Journal of Environment Studies University of Lagos and Author's Analysis of Data 2010

It will be observed that from the previous study (Idiake 2010), about 50% of the selected building materials tested, such as cement, iron rod and sharp sand, had linear relationship, while the other 50% are polynomial in nature. In the present study, 15% of the result showed linear relationship, while the remaining 85% revealed polynomial model. The reason for this could be linked to the fact that most of the haulage vehicles are fuelled with diesel. This means that the effects of increase in petroleum products on prices of building materials could be better captured by the analysis in this study, rather than the one done in the earlier study (Idiake 2010). Moreover, the predictive power of the model in the earlier study is between 85.54% and 94.60% but ranges between 90.12% and 96.63% in this present study, which indicates that the present study gives a better predictor of the fuel-material price relationship. This is an improvement to the earlier research done. This also shows that, judging from the dynamics of market forces, the relationships between the variables tested are highly indirectly proportional to one another, indicating a multiplier effects.

CONCLUSION

The result of the study revealed that greater proportion of the relationships existing between the variable tested were non linear in nature except in the relationship between the price of iron rod and that of diesel which was linear in nature. Also the analysis showed a high level of significant relationships between the tested variables. This indicates that the relationships between the variables could be used to predict the prices of the building materials as it affect construction industry. Therefore it is suggested that government fuel price hike policies should be implemented with caution in order to prevent rise in prices of building materials. Secondly, government should stabilise and regulate prices of petroleum products. Thirdly, professional estimators (Building Planners, Quantity Surveyors, Cost Engineers, etc) should note and consider the predictive power of the model in this study in their preparation of budgets, estimates and tender bids.

REFERENCES

BLS (2008) Bureau for Labour Statistics. www.bls.gov/ppi Building and Engineering Price Book (2009) No 6 January 2009, Publisher Cosines Nigeria Limited, Lagos

Campoy . A., (2008) "Prices Curtail US. Gasoline Use." *Wall street Journal*. Pp A4

Deetsche Gesellscilaft fur Techinische Zusammennar beit, (2007) International fuel prices (PDF) htt:ll www. 2007. Palf. Retrieved 10-07-2010.

Hyne , N. J., (2001). Nontechnical Guide to Petroleum, Exploration, Drilling and Production. Penn Well Corporation. Pp. 1-4.

Idiake, J.E., (2010). The Effect of Increase in Petrol (PMS) Pump Price on the Prices of Building Construction Materials in Nigeria, 1990-2009. *Journal of Environmental studies*, University of Lagos.

Kamp, J., (2009) Easing Cost Pressures on Commodity Producer. Thomson Reuters

Raleigh, N.C., (2009) Martin Marietta Material, Inc. updates 2009 Earnings Expectations report. www.maritinrietta.com

Nkoro, E., (2005). Increase in Fuel Price: Analysis of its Effects on Nigerian Economy from Searchwarp.com/swa20448.htm Retrieved 11-09-2009

NNPC, (2000), A report of the special committee on the reviews of petroleum supply and distribution. NNPC production October.

Simonson, k., (2007). Associated General Contractor of American National Surface

Transportation Policy and Revenue Study Commission Washington, DC. www.allbusiness.com/economy.../12413775-1.html

Simonson, K., (2008). Steel, Fuel Prices Send Construction Costs Soaring. Associated Construction Publication. USA.

Speight, J. G., (1999). The Chemistry and Technology of Petroleum. Marcel Dekker. Pp. 21–216.

Wikipedia, the Free Encyclopaedia (2009) from http://en.wikipedia.org/wiki/main_page Retrieved 11-09-2009

Wong, P., (2008) Response to Fuel Price Increase and Escalation cost of building material, presented by the president of Master Builder Association, Malaysia.

DRIVERS FOR ESTIMATING CONSTRUCTION COSTS OF INSTITUTIONAL BUILDING PROJECTS IN NIGERIA

Baba Shehu Waziri[1] **and Kabir Bala**[2]
Department of Building Ahmadu Bello University Zaria, Nigeria

Central to cost based competition is the capability to accurately predict the cost of delivering a project at the early stage. Early cost estimates are important for project feasibility studies, budget allocation decision and even final project success. The accuracy and reliability of such estimates largely depend upon the selection and the use of relevant predictor variables for estimating. This study identifies and proposes through empirical means the use of relevant cost drivers for accurate and reliable cost estimating of institutional building projects in Nigeria based on 510 sets of detailed project data. Relevant cost drivers extracted from related literature were examined through a field survey. Nine cost drivers were identified by experts. They are the building height, compactness of the building, expected construction duration, external wall area, gross external floor area, number of floors, Proportion of opening in external walls, location and time indices. Backward regression analyses (linear and semi-log) were employed incorporating these relevant variables to predict construction costs. The results of the analysis revealed that the transformed regression model predicted likely construction costs of randomly selected projects with Mean Absolute Percent Error (MAPE) of 9.76%. The result also showed that the variable gross external floor area has the greatest explanatory significance with construction cost.

Keywords: cost drivers, cost estimating, institutional building, regression.

INTRODUCTION

Construction cost is a relevant success factor of building construction projects (Ogunsemi 2006, Stoy *et al*., 2007 and Stoy and Schalcher, 2008). Therefore the estimate for construction cost at the early project stage is essential for many purposes including the feasibility and budget allocation decisions (Kim et al., 2008a and 2008b; Cheng et al., 2009a and 2009b). Such early estimates allow owners and planners to evaluate project feasibility and control cost effectively in detailed project decision work. Then impact of inaccurate cost estimating on project feasibility as well as profitability is significant. Overestimated costs results a low feasibility divesting client to own new projects. On the other hand, an underestimated cost could mislead planners to a high feasibility, which causes client additional costs in the construction phase. Thus, underestimated or overestimated cost affects client’s project requiring a method to measure as accurate as possible. Due to the limited availability of information during the early project stage, construction managers usually rely on their intuition (Cheng et al 2009a and 2009b).

[1] shehuwaziri@yahoo.co.uk
[2] balakabir@yahoo.com

Waziri, B.S. and Bala, K. (2011) Drivers for estimating construction costs of institutional building projects in Nigeria *In:* Laryea, S., Leiringer, R. and Hughes, W. (Eds) *Procs West Africa Built Environment Research (WABER) Conference,* 19-21 July 2011, Accra, Ghana, 335-346.

Traditionally, cost estimating models have been developed using statistical methods which are hampered in estimating accurate project costs due to the large number of significant variables and the interactions thereof (Sonmez and Ontepelli, 2009). According to Ogunsemi (2006) a vital consideration with any method of estimating is the accuracy by which anticipated cost can be predicted. Lowe *et al.,* (1996) and Skitmore (1990) observed that while the levels of accuracy perceived by the early stage estimators were less than 10%, the accuracy achieved were greater than 20%; suggesting that estimators have an unrealistically high opinion of the quality of their estimating ability.

PROBLEM DEFINITION

In today's cost conscious project environment, project owners need a way to predict how their early decision will impact the final cost of projects (Pearce 1997, Sodikov 2005). Ashworth and Skitmore (1983) stated that a vital consideration with any method of estimating is the accuracy by which anticipated cost is predicted, because the accuracy level is one of the critical indicators of an effective estimating. The accuracy level of early estimate is usually small, since the requirements are not always clearly defined and the estimates extend over a long time period, often several months between the first cost estimate and the payment of the last bill. Shash and Ibrahim (2005) and Lowe *et al.,* (2006) have indicated that the levels of accuracy achieved by using most estimating techniques are lower than desired. Despite the odds, a precise cost estimate is almost always needed. Ogunsemi (2006) suggested that a difference of 10% between estimate and tender figure is an excellent performance. The study proposes to improve the accuracy of the cost prediction for institutional Buildings in Nigeria by looking at the relevant cost drivers for cost estimation. This study is based on regression model that shows the connection between cost drivers and building construction cost quantitatively.

STATE OF THE ART

Pearce (1997) used artificial Neural Network (ANN) in identifying potentially significant relevant cost drivers relating to construction projects. The cost drivers identified in the study includes floor to floor height, external wall area, exterior window area, number of floors among others. Bhoka and Ogunlana (1999) developed an ANN model for predicting the construction cost of building projects at the pre-design stage. They used the completed project data of 136 properties. The cost drivers used in their study are; building function, structural system, building height, exterior finishing, decorating class and site accessibility. The result of the study reveals that on the overall 42.7% of the sample were underestimated while 57.3% were overestimated. The underestimate vary from -46.5% to -6.2%. The overestimates vary from 0.1% to 136.8%. They concluded that there were relatively high errors on few samples which have extreme building features. Emsley *et al.,* (2002), worked with regression and neural networks to compare the two methods based on a data pool of 288 properties including residential buildings, up to 41 independent variables were included in the model. The cost drivers used were grouped into project strategic variables, site related variables and design related variables. The model has a MAPE of 17%. Sonmez (2004) used construction year, location index, total building area, percent health centre, commons area, number of floors and structured parking area as cost drivers to develop a construction cost models for building projects using regression and neural network. The cost data of continuing care retirement community projects were complied for the study. The regression model has a MAPE of 11.7%.

Table 1 Related Studies and their Relevant Cost drivers

Study	Data Pool	Method	Cost Drivers (extract)
Pearce (1997)	46 training Cases	Artificial Neural Network	• Floor to Floor height • External wall area • Exterior windows • Number of floors • Number of Elevators • Heating Load • Cooling Load
Bhoka and Ogunlana (1999)	136 Properties	Artificial Neural Network	• Building Function • Structural system • Building Height • Foundation Index • Decorating Class • Exterior Finishing • Site accessibility
Emsley et al., (2002)	288 Properties	Artificial Neural Network and Regression	• Project strategic drivers • Site related variable • Design related variables
Sonmez (2004)	30 Properties (Institutional)	Artificial Neural Network and Regression	• Construction year • Total Building area • Number of floors • Percent commons area
Cheng and Wu (2005)	29 Properties	Support Vector Machine	• Total floor area • Geology property • Facility class • Decorating class
Lowe et al (2006)	286 Properties	Linear regression	• Project strategic drivers • Site related variable • Design related variables
Stoy and Schalcher (2007)	290 Properties	Regression	• Median floor height • Ratio of ancillary area • Construction duration • Compactness of Building
Stoy et al (2008)	75 Properties	Regression (Semi-log, Linear)	• Compactness of Building • Number of Elevators • Absolute size • Proportion of Opening • Construction duration
Cheng et al (2009)	28 Properties	EFNIM	• Total floor area • Interior decoration • Site area • Soil condition
Feng et al (2010)	18 training samples	Genetic algorithm and Neural network	• Architecture forms • Number of piles • Doors and windows • Wall and Plane assemble

Cheng and Wu (2005) used Support Vector Machine (SVM) to develop model for construction conceptual cost estimate. They used both quantitative (total floor area, floors over ground and floors underground) and qualitative (geology property, earthquake impact, decoration class and facility class) cost drivers in the study. Lowe *et al.*, (2006) utilized 19 independent variables in the study using regression analysis to determine optimum model for cost prediction. They used among others, building function, mechanical installations, internal wall finishing, exterior wall as independent variables. The study identifies gross internal floor area, building functions, construction duration, mechanical installation and pilling as the key cost drivers. All of the models performed similarly with the best model having MAPE of 19.3%. Sonmez (2008) used a combination of regression and bootstrap techniques to integrate parametric and probabilistic estimating. The MAPE of the model was calculated to be 12%.

Cheng et *al* (2009a) and (2009b) provided new mechanisms called the Evolutionary Fuzzy Neural Inference Model (EFNIM) and the Evolutionary Fuzzy Hybrid Neural model (EFHNM) for design phase cost estimation of projects in Taiwan. The mechanisms achieved an overall estimate error of 16.07% and 10.36% respectively. The main disadvantage of the approaches is that they have very long computing time due to the use of genetic algorithm. The cost drivers used in the study includes total floor area, interior decoration, site area, soil condition and seismic zone. Feng *et al.*, (2010) presents an optimization method for construction cost estimates. The method is a hybrid of genetic algorithm and back propagation neural network (GA-BP) which adopts the algorithm that chooses the optimized dot from the multiply dot in solution space simultaneously. The GA-BP has a shortcoming. It runs a long time and the error has not attained a satisfactory degree. The review of related studies supplies a list of variables (cost drivers) that is further re-examined through a field survey. Table 1 shows extracts of some cost drivers from related literature.

RESEARCH METHOD

The study involved the survey of relevant cost drivers for estimating construction costs of institutional building projects. From related studies sixteen relevant input variables were extracted and subjected to further examination through questionnaire survey and oral interviews. The sample size for the questionnaire survey is made up of 243 professionals drawn from the offices of consultants (82), contractors (76) and building owners (85) while the expert panel for the interview is made up of 30 professionals (Boyce and Neale, 2006) comprised of 10 quantity surveyors, 7 engineers, 7 Architects and 6 Builders from the offices of consultants, contractors and building owners respectively. The professionals were mandated to add to the prepared list or crossing off of cost drivers from the list. From the survey, out of the sixteen variables, nine variables were identified to be relevant for use in cost prediction of institutional buildings (Waziri 2010). Regression analysis (back elimination) was used to further establish the significance of these variables. Linear and semi-log regression models predicting Cost/M^2 and LnCost/M^2 respectively were developed using the statistical software SPSS 16 for windows, based on 510 institutional Building projects data initiated and completed between 1999 and 2008 in Nigeria. This applies the iterative method of analysis (significance level of 5%) which is based on the fundamental of theoretically causal relationship (Stoy *et al.*, 2008). Two regression statistic the *p value* and the coefficient of determination R^2 were used for the determination of the variable to be eliminated. The performances of the models were tested from two perspectives.

i. The absolute percentage difference between the observed and the predicted costs is analysed. It is referred to as the Mean absolute Percent error (MAPE) calculated as

ii. Using a random generator the data of ten properties which are not used for developing the model but exclusively for testing the performance of the models were obtained. The construction costs of the properties were predicted on the basis of the developed models and are then compared to the actual observed data.

RESULTS AND DISCUSSION

The results of the identified input variables from the field survey reflecting relevant status from weighted values is presented in table 2.

Table 2 Relevant predictor variables

S/No	Variable	Unit
1	Building Height (X_1)	M
2	*Compactness of Building (X_2)	-
3	Construction Duration (X_3)	Month
4	External Wall Area (X_4)	M^2
5	Gross External floor area (X_5)	M^2
6	Number of Floors (X_6)	No
7	**Proportion of Opening on External walls (X_7)	%
8	Location Factor (X_8)	-
9	Time Index (X_9)	%

* Compactness of building is defined here as the external wall area divided by the gross external floor area.

** Proportion of opening on external walls here refers to the area of external doors and windows divided by external wall area ×100%.

PROPOSED REGRESSION MODEL

In this study parsimonious models were considered. The principle of parsimony is important because, in practice parsimonious models generally produce better forecasts (Sonmez 2004). The significance of the identified parameters in the data was evaluated using the backward elimination regression technique. In the backward elimination regression, all the independent variables were considered in the initial regression and the variable that is not contributing to the model is eliminated one at a time. Two regression statistics significance level (*p value*) which gives an indication of the significance of the variable and coefficient of determination (R^2) which gives a measure of the variability explained by the model were used for the determination of the variable to be eliminated.

Table 2 Summary of the Regression Models

Model	Transformation	Variables Included	R^2	R^2 Adj	F_{value}	Sig.
1	Semi-log	X_1, X_2, X_3, X_4, X_5, X_6, X_7	0.940	0.891	25.93	0.00
2	Linear	X_1, X_3, X_4, X_5,X_7	0.808	0.786	45.83	0.00

All the nine variables were included in the first two regression models predicting the LnCost/M^2 and Cost/M^2. The variables that are not contributing to the model were eliminated one after the other. The semi-log model included seven variables while the linear model included five variables. The summary of the regression analysis is presented in table 2.

Each of the regression models was tested and the model that produced the best statistical results in terms of parameter significance is the semi-log model with R^2 value of 0.940. The model included seven variables and can be represented with the following equation

Where;

X_1 is building height, X_2 is compactness of building, X_3 expected construction duration, X_4 external wall area, X_5 is gross external floor area, X_6 is Number of floors and X_7 is proportion of opening in external walls.

PERFORMANCE OF THE MODELS

a) The first method used in evaluating the performances of the two models is the absolute difference between the observed and the predicted costs. It is referred to as the MAPE. The average and maximum errors of the models are also evaluated. The result is presented in table 3.

Table 3. Errors of the Regression Models

Model	Ave Error (%)	Max. Error (%)	MAPE (%)
Linear	-4.72	22.64	12.93
Semi-log	-3.62	16.57	10.28

b) Using a random data of ten properties that were not used in the development of the models. The result of the MAPE, average and maximum error is presented in table 4.

Table 4. Prediction error of randomly selected properties

Model	Ave Error (%)	Max. Error (%)	MAPE (%)
Linear	-2.35	24.67	10.17
Semi-log	-3.47	21.35	9.76

QUANTIFICATION OF THE CAUSAL RELATIONSHIP

The causal relationships of each independent variable of the proposed model are described.

i. Gross external floor area (x_5)

The gross external floor area measured in 1000m2 is the first variable to be included in the model. It impacts negatively on the construction cost (Fig. 1). The back-transformed equation indicates that for each additional 1000m2 of gross external floor area (the variable's unit of measurement), building construction cost per m2 of gross external floor area dropped by approximately7% [ ]

The construction duration has a positive impact on the construction cost per m2 of gross external floor area. The construction duration is defined as the duration from when work begins at the construction site until the work comes to an end. The regression model shows a positive relationship between duration and construction cost. This means that building construction cost rises with increasing construction duration and decrease with a drop in construction duration (Fig. 2).

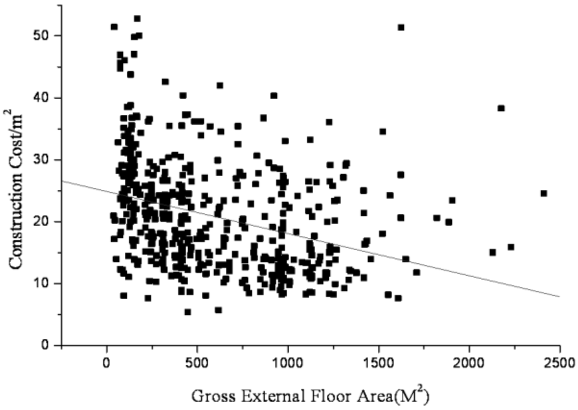


Fig. 1. Construction Cost/M^2 and Gross Floor Area

ii. Construction duration (x_3)

The building construction process passes through several phases. It begins with a concept and continuous through the preliminary studies, planning, the construction process and unto the commencement of operation. The variable deals exclusively with the construction process, in the proposed regression model, if construction duration (measured in month) increases by one month, the building construction cost (N/m^2 gross external floor area) increases by approximately 3% [ ].

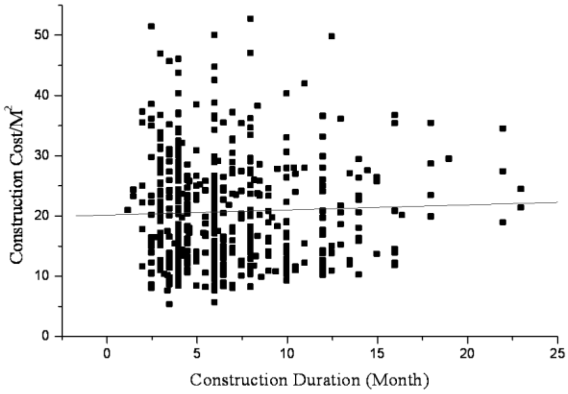


Fig. 2. Construction Cost/M^2 and Construction Duration

iii. Building height (X_1)

The third variable that is included in the regression model is the building height measured in meters. The back transformed regression shows that if building height increases by 1m the building construction cost rises approximately by 3.5%.

[ ] Conventional wisdom suggests that, for the same areas of accommodation, tall buildings are more expensive to construct than low-rise buildings. The relationship is represented in fig 3.

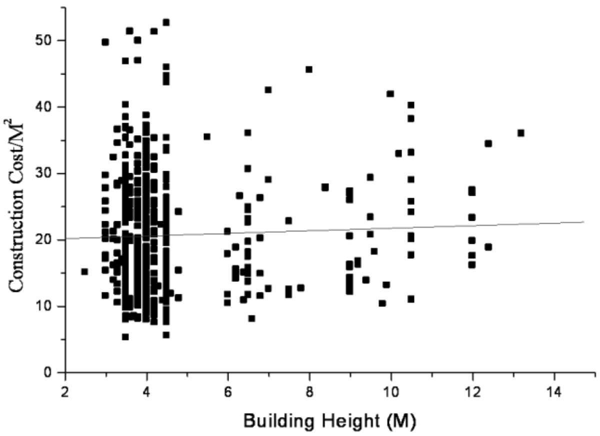
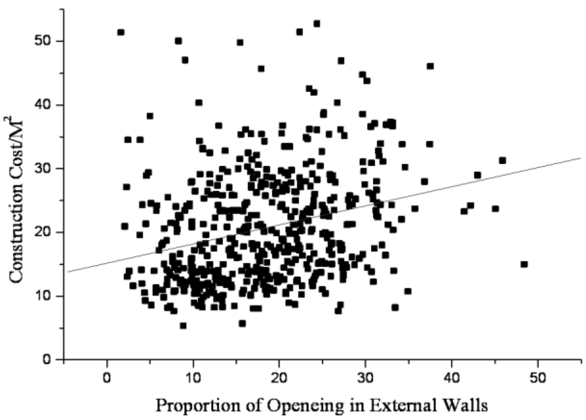


Fig. 3. Construction Cost/M^2 and Building Height

iv. Proportion of openings in external walls (x_7)

Another independent variable of the proposed regression is the proportion of doors and windows in external wall measured in %. From the back-transformed regression, it is readable that an increase of 10% in the proportion of openings makes the building construction cost to rise by approximately 7%. [ ]. The relationship is also represented in Fig. 4.The reason for this connection is the high cost of such surfaces. External door and window areas are generally substantially more complex than the basic external wall parts.



` Fig. 4. Construction Cost/M^2 and Proportion of Opening in External wall

v. Eternal wall area (x_4)

Another predictor variable that is included in the proposed model is the external wall area. The back-transformed regression model indicates that for each additional 1000m^2 of external wall area (the variables unit of measurement), building construction cost per m^2 of gross external floor area decreases by approximately 17%. This relationship is represented in figure 5.

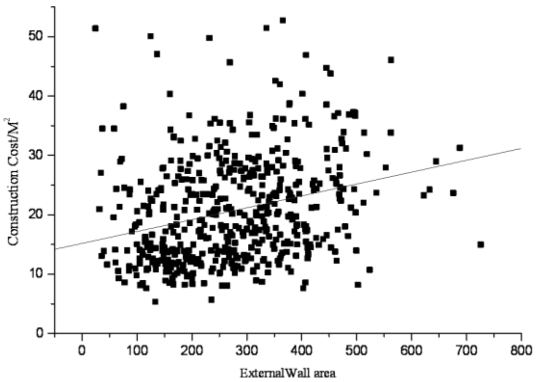


Fig. 5. Construction Cost/M^2 and External Wall Area

vi. Compactness of Building (x_2)

Another predictor variable that is included in the regression model is the compactness of the building, (external wall area/gross external floor area). It has a positive impact on construction cost (Fig. 6).The reason for this impact is particularly found in the high cost of external walls. With lower compactness of the building the cost of external walls per m^2 gross external floor area rises, largely because more m^2 of external wall area must be provided. By the model, building construction cost (N/m^2 gross external floor area) rise with an increase in units of compactness of building. If the compactness of building x_2 increases by 0.15 units, then building construction cost/m^2 rises approximately by 8.4%

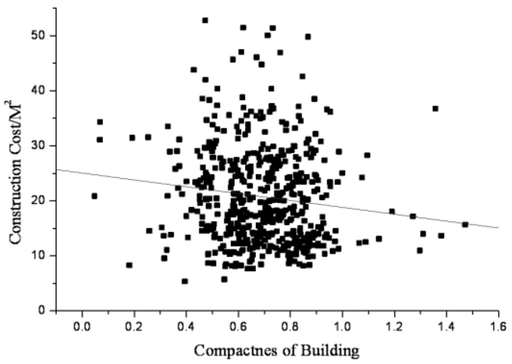


Fig. 6 Construction Cost/M^2 and Compactness of Building

vi. Number of Floors (x_6)

Number of floor also exhibits a positive cost impact. That means building construction cost (N/m^2gross external floor area) rise with an increase in additional number of floors (Fig. 7). The back-transformed regression indicates that for each additional number of floors the building construction cost per floor area will rise by about 6.3%. The regression equation reads [ ]

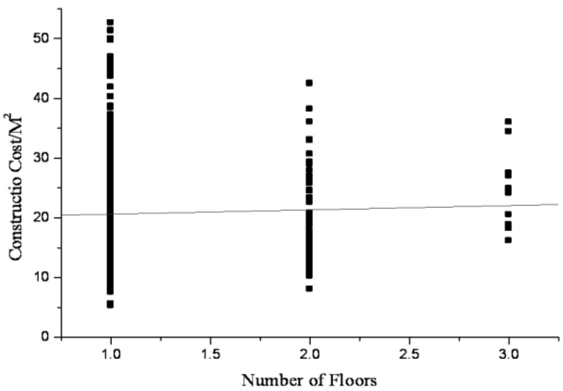


Fig. 7 Construction Cost/M^2 and Number of Floors

CONCLUSION

The main objective of the study is to identify the relevant cost drivers of institutional building projects in Nigeria to support early cost estimating. The examination of these drivers was based on identified relevant cost drivers through literature and field survey. Seven variables were included in the proposed regression model with R^2 value of 0.867 these are the building height, compactness of the building, expected construction duration, external wall area, gross external floor area, number of floors, proportion of opening in external walls. The regression model has a MAPE of 10.38%. The study revealed that the construction cost institutional properties in Nigeria can be predicted at the early stage using the identified input variables and the proposed model with high accuracy. Due to the limitation of the data set used for the study, qualitative drivers were not examined. The model is only limited to be used for institutional building projects only.

SUGGESTIONS FOR FUTURE RESEARCH

Two areas of future research can stem from this research. First, it is necessary to extend the database qualitatively. This means that, in addition to the nine variables used in this research, further cost predictive variables has to be examined which could be useful for this kind of application. Secondly, it is also recommended to study the cost variables of other building types such as residential and commercial buildings.

REFERENCES

Bhokha, S. and Ogunlana S.O. (1999). Application of Artificial Neural Network for the forecast of building cost at the pre-design stage. *Seventh East-Asia pacific Conference on Structural Engineering and Construction. Kochi, University of Kochi Japan.* 27-29 August, 1999

Boyce, C and Neale, P. (2006) Conducting In-Depth Interviews: A Guide for Designing and Conducting In-Depth interviews for Evaluation Input. *Pathfinder International Tool series May 2006.*

Cheng M.Y., Tsai, H.C and Hsieh, W.S. (2009). Web-Based Conceptual Cost estimates forConstruction Projects using Evolutionary Fuzzy Neural Inference Model. *Automation in Construction.* 18(2):164-172

Cheng M.Y., Tsai, H.C and Sudjono, E. (2009). Evolutionary Fuzzy Hybrid Neural Network for Conceptual Cost Estimates in Construction Projects. *26th International Symposium on Automation and Robotics in Construction* (ISARC2009): 512-519.

Cheng, M.Y. and Wu, Y.W. (2005). Construction conceptual cost estimates using support vector machine. *22nd international symposium on automation and robotics in construction. ISRAC* 2005, September 11-14, Ferara, Italy.

Emsley M.W, Lowe D.J, Duff A.R, Harding A, Hickson A, (2002). Data Modelling and the Application of a Neural Network Approach to the Prediction of Total Costs. *Journal of Construction Management and Economics.* 20:465-472.

Feng, W.F., Zhu, W. J. and Zhou, Y. G. (2010). The Application of Genetic Algorithm and Neural Network in Construction Cost Estimation. Proceedings of the Third International Symposium on Electronic Commerce and Security Workshop (ISEC), Guangzhou, China. 29-31 July 2010. Pp 151-155

Hinton, P.R. (2004). *Statistic Explained.* 2nd edition. Routledge Taylor and Francis group, London. Pp 375.

Kim, D. Y., Kim, B. and Han, S.N. (2008). Two staged early cost estimation for highway projects. *25th International Symposium on Automation and Robotics in Construction (ISARC).* June26-29, Held at the Institute of Internet and Intelligent technologies, Vilnius, Lithuania.

Kim, D.Y., Han, S.H. and Kim, H. (2008). Discriminant analysis of predicting international construction projects. *Journal Construction Engineering and Management.* 134(6):398-410

Lowe, D. Emsley, M. and Harding, A. (2006). Predicting Construction Cost Using Multiple Regression Techniques. *Journal of Construction Engineering and Management.* 132(7):750-758

Ogunsemi, D. R. (2006). Predicting the Final Cost of Construction in Nigeria. *The Quantity Surveyor* 54(4):3-6.

Pearce, A.R. (1997). Cost-Based Risk prediction and Identification of project Cost Drivers using Artificial Neural Network. *Final Report submitted to the Graduate Program, Georgia Institute of Technology.* AFB Tyndall, August, 1997.

Skitmore, R.M. (1990). *Developments in Contract price forecasting and building techniques. "Q*uantity Surveying Technique". New Directions. BSP Professional Books London. 75-120.

Sonmez, R. (2004). Conceptual cost Estimation of building projects with Regression analysis and neural networks .*Canadian Journal of Civil engineering.* 31:677-683

Sonmez, R. (2008). Parametric Range estimating of Building cost using Regression model and Bootstrap. *Journal of construction Engineering and Management.* 134(12)

Sonmez, R. and Ontepeli, B. (2009). Pre-Design Cost Estimating of Urban Railway Projects with Parametric Modelling. *Journal of Civil Engineering and Management* 5(4):405-409

Stoy,C. Pollalis,S. and Scalcher, H.R (2008). Drivers for cost estimating in early design: case of residential construction. *Journal of Construction Engineering and Management* 134 (1):32-39

Stoy, C. and Schalcher, H. R (2007). Residential Building Cost drivers and indicators. *Journal of Construction Engineering and Management. 133(2): 139-145*

Waziri, B.S. (2010). An artificial Neural Network Model for predicting construction cost of Institutional building projects. *In:* Laryea S., Leiringer, R. and Hughes, W. (Eds) *Procs West Africa Built Environment Research (WABER) Conference,* 27th-28th July 2010, Accra, Ghana.

DYNAMICS OF EMPOWERMENT IN PROJECTS

Enoch Sackey, Martin M. Tuuli[1] and Andy Dainty
Department of Civil and Building Engineering, Loughborough University, Loughborough, Leicestershire, LE11 3TU, UK

To better understand the implications of empowerment's multifaceted nature in a complex setting such as the project environment, we invoke complexity paradigm as a theoretical lens that is well positioned to help capture the essence of empowerment. From this theoretical framework, the true nature of how empowerment can intertwine with the complex and uncertain project context can be captured and described from the perspective of the workforce or actors engaged in the creation, execution, and closure of the project. Three preeminent questions that can aid this line of enquiry emerge from this review; how can organisations empower employees at different levels simultaneously within the same project team and still achieve goal congruence?; how does the changing nature of the project life cycle impact on employee empowerment experiences?; and what does the multidimensional perspective on empowerment add to our knowledge of empowerment in organisations? Empowerment varies depending on the targeted population, the targeted setting and also fluctuates across time. These perspectives have rarely been examined simultaneously and no theoretical framework has as yet articulated such an integrative perspective in any specific setting. The complex and dynamic nature of the project environment and the project life cycle in particular have significant implications for understanding how empowerment manifests in projects.

Keywords: empowerment, complexity theory, project life cycle.

INTRODUCTION

A dynamic perspective of empowerment with specific reference to the project lifecycle is explored in this paper. It presents the multifaceted features of empowerment including, its contextual embeddedness, its shifting nature across time and levels and its multiple forms across people. The paper extends the sparse body of knowledge on the reality of empowerment as experienced by those working within construction organisations and hence helps explain and clarify trends of empowerment experiences under conditions of uncertainty and relationship dynamics. Complexity theory is mobilised as a perspective that can help advance the study of the complex and dynamic manifestation of empowerment in project. This perspective is illuminating as it affords sense making of how different actors respond to, and cope with, the complex nature and dynamic character of project life cycle.

BACKGROUND

Empowerment as a concept exhibits three critical features with implications on how it is implemented and how it could manifest in organisations but which have received little attention in previous academic and practitioner discourse. Empowerment takes on divergent forms across people; is contextually embedded and; shifts across time

[1] M.M.Tuuli@lboro.ac.uk

Sackey, E., Tuuli, M.M. and Dainty, A. (2011) Dynamics of empowerment in projects *In:* Laryea, S., Leiringer, R. and Hughes, W. (Eds) *Procs West Africa Built Environment Research (WABER) Conference*, 19-21 July 2011, Accra, Ghana, 347-359.

(Foster-Fishman et al., 1998; Rappaport, 1984; Zimmerman, 1995). Although most empowerment researchers acknowledge these features little attention has been given to the impact they have on our capacity to understand and implement this complex phenomenon (Cloete et al., 2002; Zimmerman, 1995; Fawcett et al., 1994). There are therefore some concerns regarding significant lack of knowledge on empowerment in organisation both at the conceptual level and in practice (Huq, 2010; Logan and Ganster, 2007; Seibert et al., 2004) and the construction industry is no exemption. Greasley et al. (2004) argue that, many of the inherent challenges and flexibilities required of construction companies could be directly or indirectly managed by the appropriate use of the empowerment concept. The temporary nature of construction projects however represent a significant element that makes research on the industry of special interest, so that although others have examined empowerment from vantage point of employees (Rosenthal et al., 1997), the specific operating environment of construction warrants further examination of the complex issues surrounding empowerment.

Theoretical and empirical developments in the field of organisational culture suggest that any one setting may consist of multiple environmental paradigms (Martin, 1992; Sackman, 1992), each presenting its own contingencies for member behaviour (Mayerson and Martin, 1987). The typical nature of construction projects comprising multi-organisations with numerous highly skilled specialists present varied environmental and procedural norms that influence employee' empowerment experiences. Central to the empowerment process is a person-environment interaction (Rappaport, 1981; Zimmerman, 1995), a dynamic interplay between people's desires and contextual opportunities (Foster-Fishman and Kays, 1997). It is not simply the presence of empowering contextual elements or the presence of motivated, capable individuals that fosters the empowerment process. Zimmerman (1995) points out that, it is also the dynamic interplay between person and environment that creates the infrastructure for empowerment. When individual capabilities meet environmental demands, when supports and opportunities for control fit with individual desires, then the empowerment process is likely to succeed (Maton and Salem, 1995). Craig and Steinhoff (1990) also highlight that 'individuals or groups that do not perceive that real power has been delegated are not empowered'. It is important, therefore to understand how different contexts impact on the empowerment experiences within project setting.

While the individual facets of the empowerment features have been well presented in the literature through the investigation of context-specific questions in understanding empowerment processes and outcomes such as community organising (Kieffer, 1984), corporate work settings (Spreitzer, 1995), and human service delivery systems (Foster-Fishman and Kays, 1997), the range of empowerment experiences within a particular setting and across time have not been fully explored The linkages of the multifaceted aspects of empowerment have therefore been implicit at best.

EMPOWERMENT AS A DYNAMIC, CONTEXTUALLY EMBEDDED AND MULTILEVEL CONSTRUCT

The multifaceted nature of empowerment and the varying needs of people across time imply that, the desires for pathway towards, and manifestation of empowerment will vary significantly depending upon the population we target, the setting we examine, and the point of time we witness (Cloete, et al., 2002; Foster-Fishman et al., 1998). This perspective has rarely been examined and no theoretical framework has invoked/articulated such a perspective to understanding the meaning of empowerment in organisations. The features have largely been examined in the management literature as independent constructs. No studies have yet revealed the multifaceted nature of empowerment in any specific context. Within the construction industry context in particular, empowerment research is still piecemeal and fragmented (Tuuli and Rowlinson, 2007). Here, the multifaceted features of empowerment are simultaneously examined in order to provide clearer explanation of empowerment's dynamism within a specific context, more precisely, the construction project context. A clear knowledge of these will enable management to focus efforts in creating the conditions that enhance, and avoiding those that inhibit the prospect of the desired manifestation of empowerment.

Contextual Embeddedness of Empowerment Across Space

Employee empowerment, whether it is gaining skills, developing consciousness, or making decisions, takes place within the structural constraints of institutions and discursive practices (Rai, Parpart, and Staudt, 2007). Individuals are empowered through collective action within their organisational context, but that action is enabled or constrained by the structures and processes that manifest in those organisations across time. Thus to understand empowerment, closer attention must be paid to the specific organisational setting in order to capture the broader structures, discourses, notions, as well as laws and practices inherent in regulating the empowering experiences within that organisation. Also, empowerment is dynamic, thus, shifting organisational and environmental demands affect the empowerment experiences of employees. In the construction context for example, working under tight programme or a demanding client or significant shift in weather conditions could greatly alter daily demands and priorities placed upon employees, so that in construction organisations where time and schedule bring different constraints to the project process, empowerment is particularly bound to fluctuate over time.

Empowerment also takes on multiple forms across people. Although empowerment takes place within an organisation, it does so through the perception of individuals (Lin, 2002). As a result, personal traits such as education, gender, class, and social backgrounds exert varying degrees of influence on the way in which empowerment is perceived, thus the range of empowerment experiences within a particular setting differs across individuals. For example, in their quest to explore the multiple meanings of empowerment in a service organisation, Foster-Fishman et al. (1998) found that, the multiple forms empowerment manifest in organisations keeps changing from one individual to another. One employee for example, emphasised the importance of being creative, gaining knowledge, receiving respect, and experiencing the fulfilment of doing a job well while another employee described how having autonomy, trust and respect, and knowledge were important to feeling empowered.

Dynamics of Empowerment Across Levels

Empowerment programmes often fail as a result of lack of recognition that, empowerment is continuous variable. Spreitzer (1995) argues that, empowerment is not a global construct generalisable across different life situations and roles but rather, specific to the work domain. Indeed, empowerment is not generalisable across individuals, due to the fact that the understanding of empowerment is influenced by the individual's social-historical context (e.g. race, class, gender, age or ability), position in the organisation and the particular concerns and interests that result from his position (Foster-Fishman 1998). For example, empowerment will mean different things for a site labourer and a project manager on the same project, and the difference in understanding will reflect their individual and contextualised day to day concerns and levels of responsibility. Thus, the question that remains to be answered is, how do organisations empower employees at different levels simultaneously within the same project team or how does empowerment manifest at different levels of employees within the same organisation?

Bowen and Lawler (1992) identify three levels of empowerment across people. From least empowering, ‘controlled oriented’, to most empowering, or ‘involvement oriented’. Empowerment across levels requires individuals to pursue new directions and to acquire new knowledge and abilities. Individual empowerment involves increased control in work domains employees deem important. Such control involves having greater access to resources and or more discretionary choice in the conduct of one’s work (Spreitzer, 1995). These changes in power structure may not only redistribute control but also increase the overall amount of autonomy and influence exerted, because restructuring requires significant system and individual change. Thus, empowerment of individuals across hierarchical structures is a gradual and systematic process in which responsibilities for self-management and decision making are turned over to employees on as-ready basis (Fox, 1998). This is because, the level of empowerment that employees belief is appropriate is dependent on their perception of its use (Greasley et al., 2007). Thus, empowerment level should be appropriate to employees’ positions or responsibilities within the team. This suggests that opportunities made available for employee empowerment must fit the individual’s desire for control and influence. The assessment of employee desire for control may serve as an excellent first step in determining both the feasibility and the nature of an empowerment initiative.

Indeed, empirical research (e.g., Foster-Fishman 1997) has found that, the levels of control/power and trust/inclusion in organisations can influence the success of an empowerment endeavour. When power differences are substantial and are sustained by the organisational culture, then it is unlikely that a disempowered group will be empowered. However, when power differences are modest (e.g., between project managers, site members and site operatives in a project team) and a participatory organisational culture exists, then employee empowerment becomes more feasible (e.g., Foster-Fishman, 1997). Flexible organisations are then in a position to constantly access the needs of the individual employees across levels of responsibilities and devise strategies to meet those needs.

Dynamics of Empowerment Across Time

Empowerment experiences fluctuate overtime and within the project context, the project lifecycle provides a convenient basis for examing the dynamics of empowerment over time. Throughout the lifespan of the construction project, various changes occur which have the potency to fluctuate employees’ empowerment experiences. At the inception stage for example, very little is known about the project (Wheelwright and Clarke, 1992). As the project progresses and flows through time, it passes through transitional phases and the character changes (Winch, 1994) and uncertainty levels diminish with time (Hobday, 1998). As Winch et al., (1998) describe, “in the upstream phase the issue is to maximise the exploration of options; in the intermediate phase, the problem is to choose clearly and decisively, thereby freezing the project; and in the realisation phase, the objective is to mobilise as quickly as possible the project due to the heavy financial investment which takes place during this phase”. The question that emerges therefore is; how does the project life cycle impact on employees’ empowerment experiences? The conceptualisation of the different phases of the construction project process highlights the modulations on the overall information flow which are screened from one another by key decision points. It also shows how upstream and downstream activities are mutually dependent and the different levels are linked and affect one another in a synergistic manner. The project lifecycle also presents critical milestones for swift decision making and challenging management tasks and how uncertainty is replaced with certainty as the project progresses. (Bryman et al., (1988, cited by Dainty et al., 2002) noted that, at certain times in the course of a project’s life cycle, the workforce can be under intense pressure as a result of the need to coordinate key phases often in the face of supply and weather problems. This is exacerbated when the project is closed to completion and time is very tight. These transitional, yet, interconnected processes of the project raise the question of how empowerment manifest across the phases of the project.

In the construction project context, empowerment could be seen as a complex iterative process which can change, grow, or diminish based on unfolding events throughout the transitional phases of a project. The multifaceted dynamic nature of empowerment presented so far is often embedded within complex and dynamic project delivery arrangements, associated with increasingly demanding and ambiguous objectives due to environmental, economic and technological pressures on projects. The multiple-temporary organisation settings and site production nature are naturally uncertain. Projects are also extremely complex from an organisational and technical point of view with regards to variability and in the intensity of relationships between human-environment interactions (Mecca, 1999). The challenge therefore is to enact an integrative perspective of empowerment that explicitly blends the three empowerment characteristics to construction organisational change and development within the context of the complex, dynamic and uncertain operational realities of projects. Understanding the multifaceted nature of empowerment in project settings demands a theoretical position which illuminates the complex and interwoven set of perspectives and constraints which characterise the project environment.

To understand the complexity of empowerment and its manifestations in projects, a single disciplinary base or a certain perspective alone seems inadequate. A weakness of previous empowerment studies and the reasons for the unsatisfactory outcomes from empowerment implementations also appear to be the lack of mobilisation of a strong and credible theoretical base or lens to inform enquiry and implementation of empowerment strategies (Tuuli, 2009). In the sections that follow, a complexity paradigm is invoked as a theoretical lens that is well suited to capturing the essence of the multifaceted nature of empowerment and how it intertwines with the complex and transitional phases of the project process. Applying complexity theory as a theoretical lens could help in gaining a more realistic understanding of how the empowerment process unfolds in the complex and uncertain project environment.

COMPLEXITY PARADIGM AS A THEORETICAL LENS

The emergence of complexity theory from the natural sciences particularly biology, computer simulation, mathematics, and physics (Kauffman, 2000; Holland, 1998), has brought fresh insight into the nature and working of complex systems. Some have argued that applying this theory to social systems, albeit necessarily in adapted form, could be equally revealing and useful (Hendrick, 2009). Complexity theory serves as appropriate metaphors for understanding the nature of complex systems such as project organisations. It offers a clearer perspective that describes complex systems and how the agents within the system interact and evolve. It recognises that the world is composed of both linear and nonlinear dynamics, it does not seek prediction but understanding of the various elements of the environment and the actors involved (Yerger, 2006). The appeal of such a theoretical lens for understanding organisation concepts emerges from the ability to illuminate how order, structure, patterns, and novelty arise from extremely sophisticated, apparently chaotic systems, and conversely, how complex behaviour and structure emerges from simple underlying rules (Cook-davies et al., 2007). Here this theory is used to help us think conceptually and pragmatically about the functioning of the project environment and how the features of empowerment presented previously could be efficaciously applied in the project context.

Within a system, many independent actors interact with each other in many ways. The systemic interactions can lead to spontaneous self-organisation (Stacey, 2004). The system could represent nation states, industries, organisations, or even project teams. Projects are systems and should be addressed systemically (Remington and Pollack, 2007). They exhibit attributes of interactions, perturbation, nonlinearity, emergence, and sensitivity to initial condition, attributes which are generally useful in describing systems (Weaver, 2007) and which could well be understood through reference to complexity theory. Thus it is not out of place in adapting this theme to understanding empowerment in projects. The actors in the project sense are made up of both individual team members and any nonhuman actors (objects) required to ensuring the successful delivery of the project. The ties between the actors may be based on kinship, power structure, authority, information exchange, expertise services, or anything else that forms the basis of a relationship within the project.

The multiple nature of empowerment in projects can be likened to the various independent actors within the project team. Each have their own unique minds – differenced in identity, character and expertise from one another. As noted by Lopes (2010), ‘complex system consists of a large number of actors differenced from one another’. Thus their needs, expectations and contribution into the broader complex system vary. One therefore has to have adequate knowledge base of the divergent forms of needs across these actors before setting out empowerment strategies to meet those diverse needs. The actors within the system are in constant interactive mode. The system is always evolving and never in a fixed state (Masterpasqua and Perna, 1997), thus, emergent states are always occurring. This is congruous to the dynamic reality of empowerment. Human notion is organised not by an internalised stock of fixed reality as humans are not instinctually provided with a fixed and stable sense of social order but by the moment to moment creation and re-creation of the social world in interaction with others (Bartunek et al., 1997). In that instance, individuals attitudes then become jointly created world of meanings and reality that are shared. Attitudes are very much the creation of the socially contextualised moment, but at the same time are on a constant move. Within the system, interactions between the actors (both humans and objects), which might contain an advice, information, friendship, career or emotional support, motivation, and cooperation, can lead to very important emergent states. Emergence is a feature of complex systems. It manifests as the actors within the system feed through new knowledge as they evolve and change. Stacey (2003) defines it as a bottom-up process arising when the collective behaviour of interactive actors result in a system or part of a system adapting and creating new ordered state.

Complex systems are sensitive to initial conditions resulting in an unpredictable response to any minute initial differences or perturbation, the respond to perturbation results in self-organisation into emergent forms that cannot be predicted from an understanding of its constituent parts (Reitsma, 2001). Initial conditions may include adoption of new technology, unusual weather pattern during construction, or change in project scope. Small exogenous disturbance to complex systems can cause unexpectedly large changes (McBride, 2005). This, perhaps to a large extent, explains why two projects designed to serve a similar purpose or in the same location and size can never be achieved with the same resources. As an example, the same team delivering the same project in a different environment with different initial conditions may achieve radically different levels of performance (Remington and Pollack, 2007). The famous Lorenz's butterfly effect describes the situation where tiny differences in input can manifest as an overwhelming difference in output (Bloom, 2000). Thus, no two complex systems can be viewed to be the same because of differences in initial conditions. This concept is compatible with the contextual embedded nature of empowerment, thus, any empowerment initiatives designed to suit a particular context or system might not be effective for a different setting because at any particular point in time, the empowerment needs will be defined by the system's emergent state which is influenced by initial conditions.

Murphy (1996) noted that, the principle of unpredictable response to initial conditions defines the very nature of nonlinearity in that, minute change in a system's initial conditions may amplify exponentially as their effects unfolds so that the end result bears little resemblance to the beginning. Borrowing from the concept of GIGO, which is the acronym for the almost ancient information technology concept of garbage-in-garbage-out, the input/initial condition – output/emergence relationship amongst the actors within a complex system embraces the popular belief in GIGO, which indicates a strong positive link between input accuracy and overwhelming output accuracy. As human thoughts create reality, then, if the actors in the system are fed with discordant and destructive thought, discord and destruction will manifoldly emerge as the reality. Conversely, if the inner thoughts of the actors are full of knowledge, beauty, training, etc, that too will be reflected in reality. In this regard, the actors' disposition toward empowerment creates and is created by the pattern of interactions in which they are routinely involved. Empowerment must therefore not be treated as an abstract phenomenon, but rather as an experience that is produced in relationship to other actors in a complex system, so that if for example, the individuals' training needs are met, it will lead to a corresponding contribution back into the organisation in a more beneficial manner to the organisation.

A complex system holds a large number of actors, differenced from one another but each of which behaves to the same rules of interaction, sensitive dependence on initial condition, nonlinearity, and emergence. The combined output of the actors in the project context as a result of the interaction, is held in a resource bank described here as project network (Waver, 2007). This combined output is nonlinear because, complex systems are characterised by the whole being more than the sum of its constituent parts (Reitsma, 2001). The whole also shows emergent behaviour which cannot be predicted by studying the elements within the system. These ideas apply in the natural sciences such as shoals of fish, ant colonies and flock of birds. For example, the individual bird does not tell us much about the behaviour of the flock. The concept also applies to human social groups (Weaver, 2007). This network is encapsulated by the concept of project social network as elaborated below:

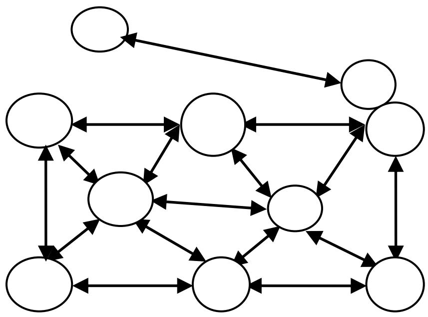


Fig. 1. A framework for project social network (Adapted from Brookes et al., 2006)

(I) A Project Actor (II) A Project Relationship (III) A Project Social Network

Fig 1 (I). A project actor is an individual participating in activities that enables the project to be executed. Each individual is an actor in a complex system; members of the project team are project actors.

Fig 1 (II) A project relationship – Each actor interact with one another to form a relationship. Each relationship can conduct information, ideas and knowledge to influence project objectives. The relationship has directional attributes (e.g. levels of trust, respect associated with it).

Fig 1 (III) A Project Social Network – The combination of many relationships forms the social network around the project and within the project. The project network can be considered as being both independent from the larger organisational network and an integral part of it.

The project network can be considered to hold social capital – the knowledge, desire, and capability needed to achieve the project outcome. The social capital contains the resources of the project actors (their knowledge and willingness to expend effort) combine through their relationships to make the achievement of the project outcomes possible (Weaver, 2007; Brookes et al., 2006). The project capital is nonlinear and can be enhanced or inhibited by the information that are fed to the individual actors within the system. The actors interact to simultaneously transfer information and ideas, negotiate social status and develop power relationships. Their intentions, choices and reactions are influenced during the interactive processes. In essence, it is people who create the project, who work on the project and close the project. Their combined knowledge becomes part of the social capital. The consequence is therefore to create a process for communicating with and influencing the actors to encourage and guide their involvement in the project and to create a jointly held objective for the team to work towards achieving.

The essence of this theoretical lens in understanding the multifaceted nature of empowerment

stem from its ability to illuminate the several important aspects to be addressed when considering the conceptualisation or implementation of empowerment or any other construct in a complex environment. In particular, it suggests how people actively understand their experience of the world as individuals who are situated in specific social-historical contexts. Their understanding of empowerment is therefore contextually embedded. The various people within the complex project setting are all different in every way. Their subjective positions become lenses through which all understanding passes. These subjective positions include their demographic characteristics such as race, gender, knowledge, experience, position in the organisation etc. These characteristics temper with the divergent form empowerment will manifest across the various actors in the complex system. The continuous interaction amongst the actors and the ability to feed on and actively integrate new information from the system causes individuals within the system or the project setting to spontaneously self-organise and adapt a new emergent form. They consistently evolve into new form through interaction, learning and adaptation. This concept is consistence with the dynamic nature of empowerment, as it explains why empowerment is on a constant shift based on unfolding events in line with the dynamic state of the project setting as opposed to a fixed state of being. The realities seen or understood at one point in time may shift within the next setting and across time. This view was reemphasised by Arthur (1999) when he stated that, complex systems are "systems that constantly evolve and unfold over time". The collective output of the individual actors is nonlinear because it cannot be understood by summing up the individual components, as demonstrated by the framework of the project social network. Any initiative fed through the actors will manifest exponentially as the reality unfolds. Thus organisational process should provide broad, meaningful direction and structure suitable to the interactive nature of the complex system – retaining adaptability and flexibility by directing actions to favourably alter the environment rather than trying to control it (Schmitt, 2007). Empowering individuals or groups that self-organise may be thought to attract certain recurrent patterns of behaviour (Dooley, Johnston, and Bush, 1995). These recurrent patterns can represent unpredictable innovation. Kreiner (1992) proposed that, project organisations should provide a way for project teams to release the creative forces within themselves rather than to plan; a way to enhance participation rather than to control. Key words like "learning", "participation", "renewal", and "innovation" ought to become as common in project management terminology as they operate in complex and uncertain environment.

DISCUSSION

The empowerment concept is very subjective. The wide range of disciplines that apply it bring differing interpretations to it (Spreitzer and Doneson, 2005; Bartunek and Spreitzer, 1999). It is thus a multidimensional concept and yet, the common connotation in most of the definitions appear to be the positive link between employee participation and job satisfaction, motivation and performance, personal commitment and corporate achievement. Changes in managerial practices perceived as empowering should therefore be seen as an antecedent of employees' feelings of self efficacy (Tuuli, 2009). Empowerment influences and reinforces the cognitive state of employees and eventually affects outcomes, providing justification for continual reinforcement of organisational practices (Tuuli and Rowlinson, 2007). Although several management scholars have discussed empowerment in various forms and currently seen as part of the lexicon of organisational practice, researchers are also concerned about the lack of publish research finding of its implementation and consequences in practice at organisational level. Thus empowerment as management practice is mainly considered as rhetoric rather than reality. Again, empowerment is considered as a contested construct and subject to different interpretation in different context.

We argue here that, the lack of clarity in conceptualisation and implementation is attributable to the lack of or weaknesses in the theoretical lenses invoked previously to studying and understanding the empowerment concept. The adoption of complexity theory as a lens to understanding empowerment in the project context suggests *inter alia* that, the creation of a successful project outcome will always be an uncertain journey but the path to success or failure can be influenced by the actions and attitudes of the actors within the complex system of the project. It is the actors who create the project, manage the project and ultimately close the project in a complex environment. The key therefore is how effective the project organisation creates a jointly held objective for the actors or mobilises the project social network to optimise the social capital (combined knowledge, expertise, effort etc of the actors in the system through interaction) needed to creating the project success. Social capital is optimised by effectively managing the multifaceted dynamics of the actors' empowerment needs in alignment with what is reasonable and feasible for the project to achieve. Managing the divergent needs of the actors takes place in a dynamic and uncertain environment and is complex because the actors are actively adapting and spontaneously self-organising into new forms through the integration of new information.

While most researchers acknowledge the dynamic and multifaceted features of empowerment, there remain a conspicuous lack of concerted research efforts to unravel a coherent perspective of the manifestation of empowerment in organisations and construction project organisation for that matter. While Tuuli (2009) and Greasley et al. (2007) examined antecedents and consequences of empowerment in project from a multilevel perspective, and employee perceptions of empowerment respectively, there is as yet no study empirically examining the dynamic manifestation of empowerment in projects across time, space and levels. The unique nature of the project setting and the spontaneous dynamism that manifest across the transitional processes of a project have the tendency to fluctuate employees empowerment experiences. Therefore, any effort aimed at capturing this phenomenon in projects is worthwhile. From the conceptual review above, three focal questions arise that have not heretofore been addressed in the empowerment literature but warrant further investigation: 1) How does the combined study of the multiplicity, dynamism and the context-specific nature of empowerment add to our knowledge of empowerment in organisations; 2) How does the fluctuation in project life cycle impact empowerment experiences? 3) How do organisations empower employees at different levels simultaneously within the same project team and still achieve goal congruence? A research agenda that cuts across these issues and aimed at capturing the dynamic and multifaceted perspectives of empowerment through the lens of complexity theory is of both theoretical and practical importance.

CONCLUSION

Empowerment is an elastic concept that takes on multiple forms across people, is contextually embedded and shifts over time. A rationale for examining this multifaceted nature of empowerment across the project life cycle from a complexity perspective is provided. Each facet provides a different lens for understanding empowerment in the workplace. The contextually embedded perspective focuses on the organisational state. The multiple nature drills down to the individual and their experiences, and the dynamic perspective focuses on the changing state of the organisation and the fluctuating individual experiences across time. Looking across these three perspectives, while each one provides different insight on empowerment, there is apparent complementarrity. The integrative perspective provides the much needed clarity to understanding empowerment, its implementation, and how it manifests in organisations. But no theoretical framework has yet invoked this line of enquiry in defining empowerment in any specific setting. This paper therefore represents a fresh departure from much of the literature on empowerment which take generalised and unitarised orientations without cognisance to its multiplicity, dynamism and contextual embeddedness. Future research will seek to empirically explore this multidimensional phenomenon of empowerment as it manifest through the transitional stages of projects.

REFERENCES

Arthur, B. W. (1999). Complexity and economy. *Science , 284*, 107-109.

Bartunek, J. M., Bradbury, H., and Boreth, C. (1997). Attending to difference: A social interpretivist apprach to empowerment. *Organisational Change and Development*, 10, 63-103.

Bartunek, J. M., and Spreitzer, G. M. (2006). The interdisciplinary career of a popular construct used in management: Empowerment in the late 20th century. *Journal of Management Inquiry , 15* (3), 255-273.

Bartunek, J. M., and Spreitzer, G. (1999). The career of a popular construct: A pluralistic journey of understandings of empowerment. *Annual Meeting of the Academy of Management.* Chicago, IL.

Bowen, D. E., and Lawler, E. E. (1992). The empowerment of service workers: What, why, how and when. *Sloan Management Review*, Spring 1992, 31.

Brookes, N. J., Morton, S. C., Dainty, A.R.J., Burns, N. D. (2006). Social processes, patterns and practices and project knowledge management: A theoretical framework and an empirical investigation. International Journal of Project Management, 474-482.

Bryman, A., Brensen, M., Beardsworth, A., and Keil, T. (1988). Qualitative research and the study of leadership. *Human Relations , 41*, 13-30.

Cloete, J. V., Crous, F., and Schepers, M. J. (2002). The construction and Evaluation of a scale of employee empowerment. *SA Journal of Industrial Psychology , 28* (2), 31-36.

Cook-Davies, T., Cicmils, S., Crawford, L. and Richardson, K., 2007. We're not in Kansas anymore, TOTO: Mapping the strange landscape of complexity theory, and its relationship to project management. *Project Management Journal*, 38 (3), 50-61.

Craig, J. G., and Steinhoff, D. A. (1990). Empowerment of women in consumer co-ops in Japan. In J. M. Bold, and L. H. Ketilson, *Empowerment through Co-operatives: Proceedings of the 1990 Meetings of the Canadian Associations for Studies in Co-operation.* Saskatchewan, Canada: The Centre for the Study of Co-operatives.

Dainty, A. R., Bryman, A., and Price, A. D. (2002). Empowerment within the UK construction sector. *Leadership and Organisation Development Journal , 23* (6), 333-342.

Dooley, K. J., Johnston, T. L., and Bush, D. H. (1995). TQM, chaos and complexity. *Human Systems Management , 14* (4), 1-16.

Fawcett, S. B., White, G. W., Balcazar, F. E., Suarez-Balcazar, Y., Mathews, R. M., Paine-Andrew, A., et al. (1994). A contextual-behavioural model of empowerment: Case studies involving people with physical disabilities. *American Journal of Community Psychology , 22*, 471-496.

Foster-Fishman, P. G., and Kays, C. B. (1997). The person/environment dynamics of employee empowerment: An organisational culture analysis. *American Journal of Community Psychology , 25*, 345-370.

Foster-Fishman, P. G., Salem, D. A., Chibnall, S., Legler, R., and Yachai, C. (1998). Empirical support for the critical assumptions of empowerment theory. *American Journal of Community Psychology , 26* (4), 507-536.

Greasley, K., Bryman, A., Dainty, A., Price, A., Naismith, N., and Soetanto, R. (2007). Understanding empowerment from an employee perspective: What does it mean and do they want it? *Team Performance Management , 14* (1/2), 39-55.

Greasley, K., Bryman, A., Dainty, A., Price, A., Soetanto, R., and King, N. (2004). Employee perceptions of empowerment. *Employees Relations , 27* (4), 354-368.

Hendrick, D. (2009, June). *Complexity Theory and conflict transformation.* Retrieved March 12, 2011, from Bradford University Web site: http://www.bradford.ac.uk/acad/confres/papers/pdfs/CCR17.pdf.

Hobday, M. (1998). Product complexity, innovation and industrial organisation. *Research Policy , 26*, 689-710.

Holland, J. (1998). *Emergence: From chaos to order.* Reading, Mass.: Addison-Wesley.

Huq, R. (2010). *Employee empowerment: The rhetoric and the reality.* London: Triarchy Press Ltd.

Kauffman, S. A. (2000). *Investigations.* USA: Oxford University Press.

Kieffer, C. H. (1984). Citizen empowerment: A developmental perspective. In J. Rappaport, C. Swift, and R. Hess, *Studies in empowerment: Steps toward understanding and action* (pp. 9-35). New York: The Haworth Press.

Kreiner, K. (1992). The postmodern epoch of organisation theory. *International Studies of Management and Organisation , 22* (2), 37-52.

Leach, D. J., Wall, T. D., and Jackson, P. R. (2003). The effect of empowerment on job knowledge: An empirical test involving operators of complex technology. *Journal of Occupation and Organisational Psychology , 76*, 27-52.

Levy, D. L. (1994). Chaos theory and strategy: Theory, application, and managerial implication. *Strategic Management Journal , 15*, 167-178.

Lin, C. Y. (2002). Empowerment in the service industry: An empirical study in Taiwan. *The Journal of Psychology , 136* (5), 555-560.

Logan, M. S., and Ganster, D. C. (2007). The effects of empowerment on attitudes and performance: The role of social support and empowerment beliefs. *Journal of Management Studies , 44* (8), 1-28.

Martin, J. (1992). *Cultures in organisations: Three perspectives.* New York: Oxford University Press.

Masterpasqua, F., and Perna, P. A. (1997). The psychological meaning of chaos: Translating theory into practice. *American Psychological Association*, 225-252.

Maton, K., and Salem, D. (1995). Organisational characteristics of empowering community setting: A multiple case study approach. *American Journal of Community Psychology , 23* (5), 631-656.

Mayerson, D., and Martin, J. (1987). Cultural change: An integration of three different views. *Journal of Management Studies , 24*, 623-647.

McBride, N. (2005). Chaos theory as a model for interpreting information systems in organisations. *Information Systems Journal*, 15, 233-254.

Lopes, E. (2010). A *grounded theory of decision-making under uncertainty and complexity*. Saarbrűcken, Germany, VDM Verlag.

Rai, M. S., Parpart, J., and Staudt, K. (2007). *(Re)defining empowerment, measuring survival.* UK: University of Warwick.

Rappaport, J. (1981). In praise of paradox: A social policy of empowerment over prevention. *American Journal of Community Psychology , 9*, 1-25.

Rappaport, J. (1984). Studies in empowerment: Introduction to the issues. *Prevention in Human Services , 3*, 1-7.

Reitsma, F. (2001). *A response to simplifying complexity: Critical review*. Elsevier Science Ltd.

Remington, K., and Pollack, J. (2007). *Tools for complex projects*. Gower Publishing, Aldershot, England.

Rosenthal, P., Hill, S., and Peccei, R. (1997). Checking out service: Evaluating excellence, HRM, and TQM in retailing. *Work, Employment and Society , 11* (3), 481-503.

Sackman, S. A. (1992). Culture and subcultures: An analysis of organisational knowledge. *Administrative Science Quarterly , 37*, 140-161.

Schmitt, J. F. (2007). Command and (out of) control: The military implications of complexity theory. In D. S. Alberts, and T. J. Czerwinski, *Complexity,Global Politics and National Security* (pp. 219-246). Washington, DC: National Defense University.

Seibert, S. E., Silver, S. R., and Randolph, W. A. (2004). Taking empowerment to the next level: A multi-level model of empowerment, performance, and satisfaction. *Academy of Management Journal , 47* (3), 332-349.

Spreitzer, G. M. (1995). Psychological empowerment in the workplace: Dimensions, measurement, and validation. *Academy of Management Journal , 38*, 1442-1465.

Spreitzer, G. M., and Doneson, D. (2005). *"Musing on the past and future of employee empowerment", in Cummings, T. (Ed.)* . CA: Sage, Thousand Oaks.

Stacey, R. (2003). *Complexity and creativity in organisations.* San Francisco, CA: Berrek-Koehler.

Tuuli, M. M. (2009). *Empowerment and control dynamics in project teams: A multilevel examination of the antecedents and job performance consequences.* The University of Hong Kong, Ph. D. Thesis.

Tuuli, M. M., and Rowlinson, S. (2007). Empowering project teams: Towards an integrative conceptualisation of empowerment. *Fourth International Conference on Construction in the 21st Century (CITC-IV) "Accelerating Innovation in Engineering, Management and Technology"*, (pp. 240-247). Gold Coast, Australia.

Weaver, P. (2007). A simple view of complexity in project management. *WPM Week, Singapore, 1-13.*

Wheelwright, S. C., and Clarke, K. B. (1992). *Revolutionising product development: Quantum leaps in speed, efficiency and quality.* New York: Free Press.

Winch, G. (1994). *Managing production: Engineering change and stability.* Oxford: Clarendon Press.

Winch, G., Usmani, A., and Edkins, A. (1998). Towards total project quality: A gap analysis approach. *Construction Management Economics , 16* (2), 193-207.

Yerger, H. R. (2006, February). *Strategic theory for the 21st century: The little book on big strategy*. Retrieved March 12, 2011, from Strategic Studies Institutes Web site: http://www.strategicstudiesinstitute.army.mil/pdffiles/pub641.pdf.

Zimmerman, M. A. (1995). Psychological empowerment: Issues and illustrations. *American Journal of Community Psychology , 23*, 581-600.

EFFECT OF OIL COATING ON STEEL BAR ON THE STRENGTH OF REINFORCED CONCRETE

Emmanuel Adukpo[1], Samuel Oteng-Seifah[2] and Patrick Manu[3]
[1]*Black Star Advisors, Ghana*
[2]*Department of Building Technology, Kwame Nkrumah University of Science and Technology, Ghana*
[3]*School of Technology, University of Wolverhampton, Wolverhampton, WV11LY, UK*

The strength of steel-reinforced concrete greatly depends on the adequacy of the bond between concrete and steel reinforcement and this can be impaired by the surface condition of reinforcing steel. Oil on the surface of steel reinforcement has been mentioned to potentially have an adverse effect on steel-concrete bonding action and consequently structural performance, but this effect remains to be buttressed empirically. This study thus considered the effect of the surface condition of deformed mild steel bar on the bond strength and the flexural strength of steel-reinforced concrete, with the surface condition being engine oil coating. Bond and flexural test involving concrete embedded with steel bars coated with engine oil and un-coated steel bars (i.e. bars not coated with engine oil) revealed that engine oil coating considerably reduces the bond and flexural strength of reinforced concrete. Steel reinforcement during storage and installation should thus be protected from contamination by oiling agents.

Keywords: bond, oil-coated rebar, reinforced concrete.

INTRODUCTION

Concrete is a composite material consisting of fine aggregate, coarse aggregate and a binding material, usually cement, and water, with or without admixtures (Marsh, 1997; Chudley et. al, 2008). It is a universal construction material that plays a key role in modern construction as a structural material. The ease with which, while plastic, it can be deposited and made to fill forms or moulds of almost any shape is one key factor that makes concrete a widely used construction material, the other key factor being its compressive strength when fully cured. Concrete however is weak in tension and fails under tensile stresses unless reinforced in the zones of tension by some materials of high tensile strength such as steel (Chudley et. al, 2008) or fibre reinforced polymer (cf. Emmons et. al., 1998; Schöck Bauteile GmbH, 2006; and Durham et. al., 2009). The performance of steel-reinforced concrete element is greatly influenced by the bond between the steel and the concrete (Turban, 1995; Bamforth, 2004), and this bond can be impaired by the surface condition of steel reinforcement. Corrosion, for instance results in loose scales on the steel surface giving rise to a weak bond and consequently reduced performance for steel-reinforced concrete (cf. Adupko et al., 2010). Apart from corrosion, grease and oil have also been mentioned as having the potential to reduce the bonding action between concrete and steel reinforcement

[1] Selorm@primroseproperties.net
[2] Sotengseifah.feds@knust.edu.gh
[3] Patrick.Manu@wlv.ac.uk

Adukpo, E., Oteng-Seifah, S., Manu, P. (2011) Effect of oil coating on steel bar on the strength of reinforced concrete *In:* Laryea, S., Leiringer, R. and Hughes, W. (Eds) *Procs West Africa Built Environment Research (WABER) Conference,* 19-21 July 2011, Accra, Ghana, 361-369.

and thus potentially resulting in reduced in-service performance of reinforced concrete elements (Turban, 1995). Unlike the effect of corrosion which has extensively been researched (cf. Everett and Treadaway, 1980; Quillin, 2001; and Cheng et al., 2005), the effect of oil coating on steel bar on the performance of steel reinforced concrete remains to be empirically examined. Given that oiling agents such as engine oil are commonplace on construction sites (due to the use of construction equipment, machinery, etc) and as such serve as potential sources of contamination of steel bars, it is important to empirically examine the effect of oil coating on steel bar on the performance of steel reinforced concrete. This study was thus undertaken with the aim of investigating empirically the effect of engine oil coating on steel bar on the bond and the flexural strength of steel-reinforced concrete. The next section discusses the importance of steel-to-concrete bonding to the strength of reinforced concrete to provide the theoretical underpinning of the research. This is followed by the research methodology, the results and its discussion and then concluding remarks.

SIGNIFICANCE OF STEEL-CONCRETE BONDING TO THE PERFORMANCE OF REINFORCED CONCRETE

Concrete, although strong in resisting compression, is weak in resisting tension and hence the need to reinforce concrete in the zone of tension by some reinforcing material (Mosley and Bungey, 1995). Conventionally steel has been used as the reinforcing material due to the high tensile capacity of steel and also due to the proximity of the coefficient of thermal expansion of steel (i.e.10 x10^{-6} per ^{0}C) and concrete (i.e. 7-12 x10^{-6} per ^{0}C) (Mosley and Bungey, 1995).

Good bonding between reinforcing steel and concrete is essential for the transfer of tensile stress and hence essential for the performance of reinforced concrete elements (Bamforth, 2004). If this bond is inadequate the reinforcing bars will just ‘slip’ out of the concrete and there will not be a composite action of the two materials resulting in under-performance of the steel-reinforced concrete (Mosley and Bungey, 1995). Bond strength is the measure of the effectiveness of the grip/anchorage between steel and concrete or the stress at which a very small slip occurs (McGregor, 1997) and this is widely noted to be influenced by the surface condition of steel bars and hence the need to protect the surface of steel bar from contamination (cf. Turban, 1995; Lu and Chung, 1998; and Chudley and Greeno, 2008).

Several surface conditions, notably corrosion has been well researched in terms of its adverse effect on the bonding action between concrete and steel and consequently the performance of steel reinforced concrete elements (cf. BRE, 2000; Quillin, 2001; Sergi and Dunster, 2004; and Adupko et al., 2010). Oil coating has similarly been mentioned as having the capability to impair steel-concrete bonding action and hence the performance of concrete elements (Turban, 1997). Unlike the effect of corrosion which has extensively been researched, this however remains to be empirically verified. Drawing therefore on the widely acknowledged phenomenon of surface treatment/condition of steel bar influencing steel-concrete bonding, and steel-concrete bonding also influencing the performance of steel-reinforced concrete, the following hypothesis were put forth to investigate the effect of engine oil coating on the bond and the flexural strength of steel-reinforced concrete:

H_1: there will be significant difference in the concrete-to-steel bond strength of engine oil coated steel bar and uncoated steel bar.

H_2: there will be significant difference in the flexural strength of concrete reinforced with engine oil coated steel bar and concrete reinforced with uncoated steel bar.

To advance the testing of the hypotheses a number of laboratory tests were conducted. These are described in the next section followed by the discussion of the results.

RESEARCH METHOD

As dictated by the nature of the research (i.e. cause and effect investigation), the research had a positivist focus (cf. Creswell, 2009). Such a focus favours the use of quantitative research design and the experiment approach was particularly appropriate as experimental research seeks to determine if a specific treatment (in this case engine oil coating on steel bar) influences an outcome (in this case bond strength and flexural strength) (Fellows and Lui, 2008; and Creswell, 2009).

Experiments consisted of bond tests (i.e. pull-out test) involving deformed 12mm mild steel bars (comprising bars which are coated with engine oil and bars which are un-coated i.e. clean bars), and flexural tests for beams reinforced with similar coated and un-coated 12 mm diameter deformed mild steel bars. Going by conventional concrete testing practice (cf. Aldajah et al. (2008), Mahoutian et al. (2008), three specimens (i.e. samples) each were used for the bond test (i.e. 3 for coated bars and 3 for uncoated bars), and two specimens (i.e. samples) each were used for the flexural test (i.e. 2 beams each reinforced with coated bar, and 2 beams each reinforced with uncoated bars). The bond test and flexural test were to determine the outcome/effect (in terms of bond strength and flexural strength) of the differences in treatment (i.e. engine oil-coated steel bar and uncoated steel bar). Therefore in the bond test, the dependent variable was the bond strength (i.e. bond stress) and the independent variable was the treatment, and in the flexural test, the dependent variable was flexural strength (i.e. failure load) and similarly the independent variable was the treatment.

In both test the control variables were concrete strength, and tensile strength of steel. This means that the same concrete grade and steel bar were used, with the only difference being the treatment to the surface of the steel bars (i.e. engine oil-coated and coated steel bar). To confirm the grade of steel bar (i.e. mild steel bar), tensile test was conducted on the deformed 12mm steel bar. The test results as shown in Table 1, confirms that the steel bar used was mild steel, the characteristic strength being greater than or equal to 250N/mm^2 but below 460N/mm^2 (see BS 8110-1:1997).

Table 1: Tensile test results

Yield strength (N/mm^2)	Characteristic strength (N/mm^2)	Ultimate strength (N/mm^2)	Failure strength (N/mm^2)
349.01	334.61	387.51	304.51

Concrete grade C25, designed in accordance with the design of normal concrete mixes (Marsh, 1997), was used. The concrete was made up of 20mm maximum size granite coarse aggregates and fine aggregate (of granite origin), obtained from pits near rivers at Aputuogya, west of Kumasi, Ghana.

The particle size distribution of the coarse aggregate is shown in Figure 1 and that of the sand is shown in Figure 2, and lies in Zone 2 of BS 882:1992.

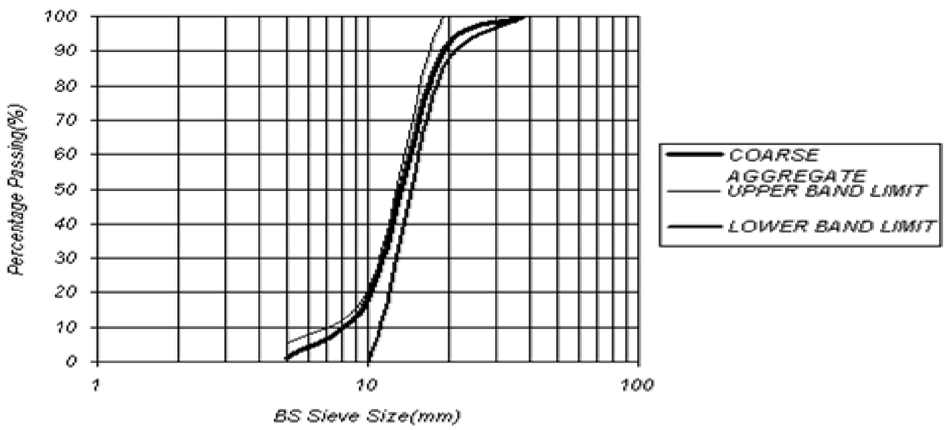


Figure 1: Particle size distribution for coarse aggregate

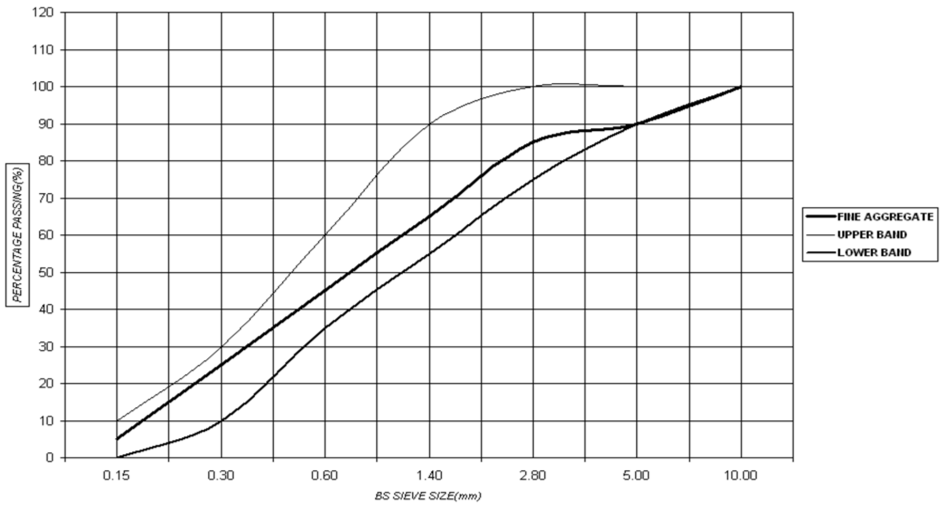


Figure 2: Particle size distribution for fine aggregate

The sand was shown by tests to have very low silt/clay content and a total sulphate/chloride content of less than 2%. Both fine and coarse aggregate were clean and were expected to produce dense concrete of good strength, when mixed with portable water and Ordinary Portland Cement (OPC).

Bond Strength Test (Pull-out Test)

Six (6) specimens of steel bar, each 555mm long, were cut from a standard piece of deformed 12mm mild steel bar, and three out of the six specimens were uniformly coated with engine oil over a length of 150mm (i.e. the bond length). Both the coated and un-coated pieces were each centrally embedded in a 150mm concrete cube (as shown in Figure 3). This thus resulted in 3 pull-out cubes, each with an embedded 12mm coated steel bar, and another 3 pull-out cubes, each with an embedded uncoated 12mm steel bar. The cubes were cured in water for 28 days. After curing, the pull-out cubes were each mounted in the electronic tension test machine and strained to failure; the failure load (i.e. pull-out load) being recorded. Three (3) 100mm concrete cube specimens were prepared from the concrete batch that was used for the pull-out concrete cubes and were cured in water for 28 days, and subsequently tested to confirm the grade of concrete (i.e. C25).

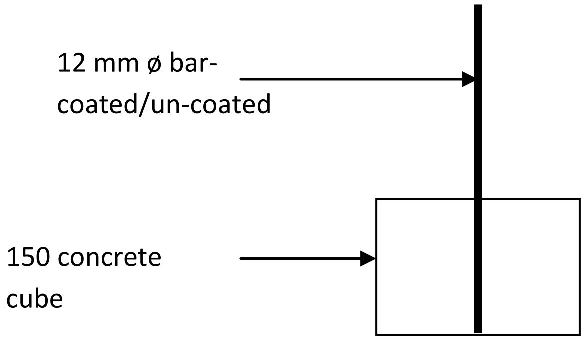


Figure 3: Bond test specimen (i.e. Pull-out cube)

Flexural Test

150x150x1600mm concrete beams were used; two (2) beams each embedded with two deformed 12mm steel bars uniformly coated with engine oil (i.e. beams C), and another two (2) beams each embedded with two (2) un-coated deformed 12mm steel bars (i.e. beams UC). The 12mm bars were used as bottom reinforcement (i.e. tension reinforcement). Two (2) 10mm mild steel bars and 6mm mild steel bars were used for top reinforcement and stirrups respectively as shown in Figure 4. The beams were cured in water for 28 days and then tested using third-point loading arrangement (shown in Figure 5) with a dial gauge placed at mid-span to record the deflections as loading took place. The third-point loading arrangement was adopted because it ensures a uniform maximum bending moment in the middle third zone, unaffected by changes in shear. As loading was increased the formation and location of cracks were noted and at failure, the failure load recorded and the widest crack measured by means of a vernier calliper. Three (3) 100mm concrete cube specimens were prepared from the concrete batch that was used for the beams and were cured in water for 28 days, and subsequently tested to confirm the grade of concrete (i.e. C25).

Analysis

To assist with the hypothesis testing, the "Data Analysis" tool in Microsoft Excel was used. As the sample size for the bond test (i.e. 3 pull-out cubes for coated and 3 pull-out cubes for uncoated bar) and the sample size for flexural test (i.e. 2 beams for coated and 2 beams for uncoated) are small (i.e. less than 30) and also the hypothesis testing concerns group comparison (i.e. differences in treatment), t-test (two-sample equal variance) was used in the hypothesis testing (cf. Middleton, 1997; and Fellows and Lui, 2008; and Creswell, 2009). For hypothesis H_1, *the null hypothesis of* equal mean bond strength for the 2 treatments/groups (i.e. coated and uncoated bar) was thus tested using two tail t-test, and for H_2 *the null hypothesis of* equal mean failure load for the 2 treatments/groups were also tested using two tail t-test.

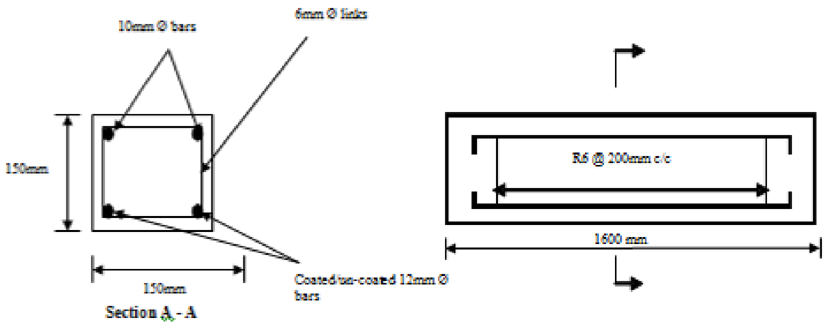


Figure 4: Arrangement of steel reinforcement in concrete beam

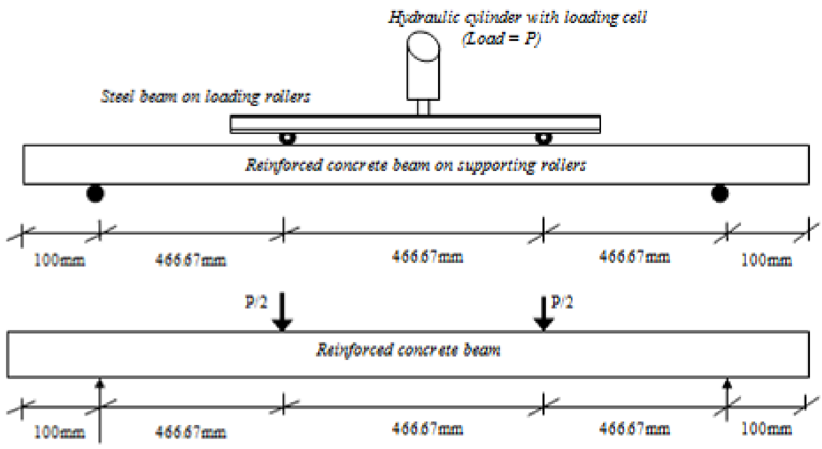


Figure 5: Experimental set up for beam subjected to third-point loading

RESULTS AND DISCUSSION

Compressive Test

As indicated in Table 2, the mean compressive strength of the concrete used for the pull-out concrete cubes (i.e. batch P) was 32.8 N/mm^2 and the mean compressive strength of the concrete used for the beams (i.e. batch B) was 34.40 N/mm^2. Both concrete batches therefore achieved the designed concrete grade C25 at 28 days as their characteristic strengths are greater than or equal to 25N/mm^2

Table 2: Compressive strength test results of 100mm concrete cubes

100mm Concrete Cubes	Density (kg/m^3)	Failure Load (KN)	Compressive Strength (N/mm^2)	Mean Compressive Strength (N/mm^2)	*s* (Standard deviation) (N/mm^2)	f_c Characteristic Strength (N/mm^2)
P1	2531	345	34.5			
P 2	2776	334	33.4	32.8	2.12	29.29
P 3	2454	304	30.4			
B 1	2529	320	32.0			
B 2	2580	350	35.0	34.4	2.16	30.85
B 3	2548	362	36.2			

Bond Test

The mean bond strength of the oil-coated 12mm diameter bar and the un-coated 12mm diameter bar were 5.63 N/mm^2 and 8.26 N/mm^2 respectively as shown in Table 3. The result of the two tail t-test for the null hypothesis of equal mean bond strength at 5% level of significance is also shown in Table 3. The computed *t Stat* is greater than the *t Critical two-tail* and so the null h*ypothesis* is rejected. The engine oil coating therefore had an adverse effect on the bonding action between the concrete and steel reinforcement. The engine oil coating acting as a layer of 'film' on the surface of the steel bar impaired the gripping/anchorage of the steel bar within the concrete and thus giving rise to the weakened bond between the concrete and the steel. This result therefore offers empirical support for Turban's (1997) assertion regarding the effect of oil coating on steel bar on bond strength and again it reinforces the need to keep the surface of reinforcing steel bars from materials that could impair concrete-to-steel bonding action (Turban, 1997).

Table 3: t-Test: Two-Sample for Bond Test

	Uncoated bar	Coated bar
Mean	8.26	5.63
Variance	0.0307	0.1323
Observations	3	3
Pooled Variance	0.0815	
Hypothesized Mean Difference	0	
df	4	
t Stat	11.28294766	
P(T<=t) one-tail	0.000175802	
t Critical one-tail	2.131846782	
P(T<=t) two-tail	0.000351604	
t Critical two-tail	2.776445105	

Flexural Test

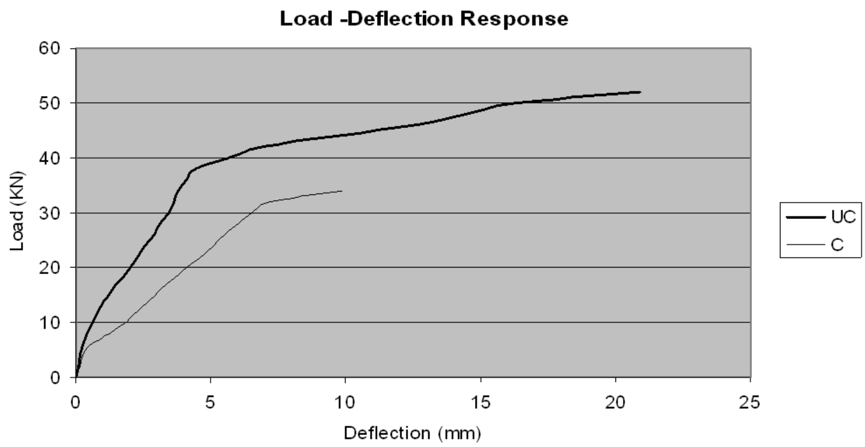


Figure 6: Load-deflection response for reinforced concrete beams

As expected, the deflection of the soffit of the beams increased with increase in applied load as indicated in Figure 6. For the same amount of applied load, the oil-coated steel-reinforced concrete beams (C) attained higher values of deflection than the un-coated steel-reinforced concrete beams (UC). Beam C failed at a mean load of 35KN with a mean central deflection of 9.88mm while beam UC failed at a mean load of 52KN with a mean central deflection of 20.87mm. Comparing the load-deflection plots in Figure 6, it is evident that beam UC performed considerably better in resisting bending than beam C. This is buttressed by the results of the two tail t-test for the null hypothesis of equal mean failure load at 5% level of significance as shown in Table 4. The computed *t Stat* is greater than the *t Critical two-tail* and so the null h*ypothesis* is rejected. The engine oil coating therefore had an adverse effect on the flexural capacity of the concrete beam.

Table 4: t-Test: Two-Sample for Flexural Test

	Uncoated bar	Coated bar
Mean	52	35
Variance	0	2
Observations	2	2
Pooled Variance	1	
Hypothesized Mean Difference	0	
df	2	
t Stat	17	
P(T<=t) one-tail	0.001721176	
t Critical one-tail	2.91998558	
P(T<=t) two-tail	0.003442351	
t Critical two-tail	4.30265273	

Again the adverse effect of the oil coating on flexural strength is confirmed by the load at which first crack occurred. Whereas Beams C developed the first crack at 8KN, beams UC developed the first crack at 20KN.

Linking the findings of the bond test to the flexural test, the research findings (taken together) provide empirical support for Turban's (1997) report. Also the findings align with the extant literature in terms of the effect of surface condition of steel bar on steel-concrete bonding and the effect of steel-concrete bonding on the performance of reinforced concrete element (cf. Lu and Chung, 1998, BRE, 2000; Quillin, 2001; Sergi and Dunster, 2004; and Adupko et al., 2010).

CONCLUSIONS AND RECOMMENDATION

The effect of the surface condition of steel reinforcement on the bond and the flexural strength of steel-reinforced concrete have been investigated in terms of engine oil coating on the surface of steel reinforcement, and from the analysis of the test results, the following conclusions can be drawn from the study:

6. Engine oil on the surface of steel reinforcement reduces the bond between concrete and steel reinforcement.
7. Engine oil on the surface of steel reinforcement reduces the flexural capacity of steel-reinforced concrete and this reduction stems from the reduction in the bond between concrete and steel reinforcement due to the oil coating on the surface of steel reinforcement.

It is thus recommended from this study and the foregoing conclusions that surfaces of steel reinforcement bars should thus be stored away from on-site oiling agents such as engine oil and in instances where steel surfaces are 'contaminated' by oiling agents, they should be cleaned prior to their installation or the placing of concrete. Also, during cutting, bending (especially where this is done mechanically), and handling of steel reinforcement, steel fixers should ensure that steel surfaces are not contaminated by engine oil.

REFERENCES

Adukpo, E., Oteng-Seifah, S., Manu, P. and Solomon-Ayeh, K. (2010) The effect of corrosion on the strength of steel reinforcement and reinforced concrete. In: Barrett, P., Amaratunga, D., Haigh, R. and Keraminiyage, K. (eds.) Proceedings of CIB 2010 World Congress, 10-13 May 2010, Salford, CIB.

Aldajah, S., Biddah, A., and Alomari, A. (2008) Experimental and FEM study of the flexural behaviour of CFRP-strengthened concrete structures. In: Dhir, R. K., Newlands, M. D., McCarthy, M. J. and Paine, K. A. (eds.), International Conference: Harnessing Fibres for Concrete Construction, 10th July 2008, University of Dundee, UK. HIS BRE Press.

Bamforth, P. B. (2004) Enhancing reinforced concrete durability: Guidance on selecting measures for minimising the risk of corrosion of reinforcement in concrete. Concrete Society Technical Report No. 61. Concrete Society.

BRE (2000) Corrosion of steel in concrete: Protection and remediation. Digest 444 Part 3. Watford: BRE.

BSI (1992) Specification for aggregate from natural sources for concrete - BS 882:1992, London: BSI.

BSI (1997) Structural use of concrete- BS 8110- 1:1997, London: BSI.

Cheng, A., Huang, R., Wu, J.K., and Chen, C.H. (2005) Effect of rebar coating on corrosion resistance and bond strength of reinforced concrete. Construction and Building Materials, 19(5), 404-412.

Chudley, R. and Greeno, R. (2008) Building construction handbook, 7 edn, Oxford: Elsevier

Creswell, J. W. (2009) Research design: Qualitative, quantitative, and mixed method approaches, 3rd Edition, California: Sage Publications.

Durham, S. A., Heymsfield, E., and Jones, J. X. (2009) Retrofitting precast bridge beams with carbon fiber-reinforced polymer strip for shear capacity. Journal of Performance of Constructed Facilities, 23 (4), 219-226.

Emmons, P. H., Baysburd, A. M., and Thomas, J. (1998) Strengthening concrete structures- Part II. Concrete International, 20(4), 56-60.

Everett, L. H. and Treadaway, K. W. J. (1980) Deterioration due to corrosion in reinforced concrete, BRE Information Paper IP 12/80, Watford: BRE.

Fellows, R. and Lui, A. (2008) Research methods for construction, 3rd Edition, West Sussex: Blackwell Publishing Ltd.

Sergi, G. and Dunster, A. (2004) Corrosion of steel in concrete: A review of the effect of humidity. Digest 491. Watford: BRE.

Lu, W., Fu, X. and Chung, D. (1998) Effects of water-cement ratio, curing age, silica fume, polymer admixtures, steel surface treatments, and corrosion on bond between concrete and steel reinforcing bars. ACI Materials Journal, 95(6)**,** 725-734.

Mahoutian, M., Libre, N. A., Emdadi, A., and Shekarchi, M. (2008) Effects of fibres on the physical properties of lightweight aggregate concrete. In: Dhir, R. K., Newlands, M. D., McCarthy, M. J. and Paine, K. A (eds.), International Conference: Harnessing Fibres for Concrete Construction, 10th July 2008, University of Dundee, UK. HIS BRE Press.

MacGregor, J. (1997) Reinforced concrete mechanics and design, 3rd Ed.. Prentice-Hall.

Marsh, B. K. (1997) Design of normal concrete, 2nd Edition. Watford: BRE.

Mosley, W. H. and Bungey, J. H. (1995) Reinforced concrete design, 4th edition. Hong Kong: Macmillan Press Ltd.

Quillin, K. (2001) Modelling degradation processes affecting concrete. Watford: BRE.

Schöck Bauteile GmbH (2006) Technical information schöck combar: reinforcement made of glass fiber reinforced polymer, Baden-Baden: Schöck Bauteile GmbH.

Tubman, J. (1995) Steel reinforcement - A handbook for young construction professionals, London: Construction Industry Research and Information Association.

EFFECT OF REPLACEMENT OF SAND WITH GRANITE FINES ON THE COMPRESSIVE AND TENSILE STRENGTHS OF PALM KERNEL SHELL CONCRETE

John Adewumi Babafemi [1] and James Babatunde Olawuyi [2]
[1]*Department of Building, Obafemi Awolowo University, Ile-Ife, Nigeria*
[2]*Department of Building, Federal University of Technology, Minna, Nigeria*

Lately, research works are being focussed on using renewable agricultural waste resources as construction materials. This is to ensure sustainability and to reduce cost of construction. Palm kernel shell concrete (PKSC) is concrete containing cement, sand and palm kernel shells wholly or partially as a coarse aggregate. This paper therefore presents results of an experimental laboratory investigation carried on PKSC by incorporating varying percentages of granite fines to replace sand in steps of 20% to study its effect on the compressive and tensile strength of PKSC. A mix proportion of 1:1.77:0.77 was used with a w/c = 0.50. Calcium Chloride ($CaCl_2$) was added as an accelerator. Results of 28-day strength test using 100 mm cubes and 150 × 300 mm cylinders revealed that the compressive and tensile splitting strengths increased with curing age and with increase in the percent granite fines content. Maximum compressive and tensile splitting strengths were obtained for PKSC containing 100% granite fines. Tensile strength obtained fall within the range of values (1.24-1.90 N/mm^2) given for grade 30 concrete.

Keywords: renewable resources; palm kernel shell; compressive strength; water absorption; palm kernel shell concrete.

INTRODUCTION

One of the major challenges facing the construction industry is the growing concern over resource depletion, hence, the need to source and utilize renewable materials. A renewable resource like the palm kernel shell (PKS) is usually not used in the construction industry but dumped as an agricultural waste. However, researches have shown that it could be used as a replacement (total or partial) for coarse aggregate in concrete (Okafor, 1988; Okpala, 1990; Mannan and Ganapathy, 2002; Mannan and Ganapathy, 2004; Teo *et al.* 2005; Teo *et al.* 2006a, b, c, d; Ramasamy *et al.* 2008).

These researches were necessitated as a result of the growing increase in the cost of building materials, the need to utilize materials seemingly regarded as agricultural waste and most importantly, the need for sustainable construction. PKS is available in Nigeria in large quantity as waste from agricultural industries, particularly in Southern Nigeria. Exploiting this waste material not only maximises the use of the oil palm, but

[1] dewunmi2001@yahoo.com
[2] babatundeolawuyi@yahoo.com

Babafemi, J.A. and Olawuyi, J.B. (2011) Effect of replacement of sand with granite fines on the compressive and tensile strengths of palm kernel shell concrete *In:* Laryea, S., Leiringer, R. and Hughes, W. (Eds) *Procs West Africa Built Environment Research (WABER) Conference,* 19-21 July 2011, Accra, Ghana, 371-378.

also helps preserve the natural resources and maintain ecological balance (Teo *et al.* 2006a).

Concrete made with PKS is a lightweight concrete. Past researches on PKSC have shown that its compressive strength is in the range of 15-25 N/mm^2 (Abdullah, 1984; Okafor, 1996, Basri *et al.* 1999; Ata *et al.* 2006). The strength of PKSC has been reported to be influenced by the aggregate-cement matrix bond (FIP Manual, 1983). The aggregate-cement bond is also generally reported to be influenced by the cement, water, sand and aggregate contents, shape, roughness and stiffness of the aggregate. Alengaram *et al.* (2008) reported that the failure of PKSC is also governed by the strength of the PKS. However, PKS usually have smooth concave and convex surfaces which produce a poorly compacted concrete and this will ultimately result in bond failure between PKS and cement matrix. To achieve PKSC of improved strength, the bond between the mortar and PKS has to be improved. Alengaram *et al.* (2008) had considered improvement of the bond of concrete by considering the influence of sand content on the mechanical properties of concrete. With all mixes super-plasticized and the addition of 10% Silica fume and 5% fly ash, Alengaram *et al.* (2008) reported that the increase in sand content has positive influence on the mechanical properties of PKSC by an increase in the density and compressive strength. Osunade (2002) had reported an increase in the compressive strength and a decrease in the tensile strength of laterized concrete with the replacement of sand with granite fines. Since sand content is a factor that influences the compressive and tensile strengths and also the bond properties of concrete, this study therefore studied and reported the influence of replacement of sand with granite fines on the workability, compressive and tensile strengths of PKSC. In this study, 2.0 % Calcium Chloride ($CaCl_2$) by weight of cement was used as an accelerator.

MATERIALS AND EXPERIMENTAL PROCEDURE

Material Procurement and Preparation

The basic components of palm kernel shell concrete are cement, sand, gravel or granite and palm kernel shell as total or partial replacement of the coarse aggregate. In this study, total replacement of the coarse aggregate was adopted while granite fines (GF) replaced sand at steps of 20% up to 100%. The sand and PKS used were purchased in Ile–Ife, Nigeria. The palm kernel shells (14 mm maximum aggregate size) obtained from a local mill along Ede road, Nigeria, was already in the cracked form, the fibrous outer parts of the nut already removed. The shells were kept outdoors under a shed for three months. This enabled the oil coating to be removed by natural weathering, which is one of the methods recommended for pre-treatment (Salam, 1982; Mohd Noor *et al.* 1990; Okafor *et al.* 1996 and Mindess *et al.*2003) among others. It was washed and dried again before use. Thereafter, it was graded in accordance with the British Standard methods of sampling, testing and sieve test of lightweight aggregates for concrete. The cement was obtained from the open market in Ile-Ife and was that produced by the West African Portland Cement Company (WAPCO) since their products are believed to conform to the requirements of BS EN 197-1 (2000) for Ordinary Portland Cement. The range of sizes of the fine aggregate used were those that passed through the 5 mm BS Sieve. The granite fine was obtained from a quarry along Ondo Road, Ile-Ife. Table1 presents some physical properties of the constituent materials. Water used for the mixing was clean water obtained from the tap.

Concrete Mixture and Testing

It has been reported by Mannan and Ganapathy (2001) that the mix design of lightweight concrete using palm kernel shell as aggregate differs widely from the procedure of mix proportioning for conventional concrete with crushed stone aggregate. This study therefore adopted the acceptable trial mix design for palm kernel shell concrete reported in the work of Mannan and Ganapathy (2001). A mix proportion of 1:1.77:0.77 (cement: sand/GF: PKS) with 2.0% $CaCl_2$ by weight of cement was used. The sand content in the mix was replaced with granite fines in gradation of 0%, 20% 40%, 60%, 80% and 100%. A water/cement ratio of 0.50 was used throughout the research.

Due to the high water absorbing nature of palm kernel shells, they were immersed in water for 1 hour (pre-soaking) before use. The absorption capacity of the shells was found to be in the range of 10-15%. Cubical specimen of 100 mm and cylindrical specimen of 150 × 300 mm were used to determine the compressive and the splitting tensile strengths of the PKSC. A total of 108 PKSC specimens, 54 apiece, were cast and tested for compressive and splitting tensile strengths respectively. Each specimen was made by filling each mould in three layers and then compacted manually by evenly distributing 25 strokes of a steel rod of 25 mm diameter across the cross-section of the mould as stipulated by the requirements of BS EN 12390–2:2000. The cast specimens were covered with polythene bags to prevent evaporation until demoulding after 24 hours of casting, thereafter the specimens were transferred into a water bath maintained at 27± 5^0C in the curing room. The compressive and tensile strengths were determined after 7, 21 and 28 days of curing.

Strength characteristics of the cube and cylindrical specimens were tested using the ELE 2000KN Compression Testing Machine. Three replicates of each specimen at the requisite curing age of 7, 21 and 28 days were brought out of the curing tank and allowed to rest for 2 hours and then crushed. The average values of the maximum loads at which each group of three specimens failed was found and then the compressive and tensile strengths were determined. This was in accordance with BS EN 12390-3 (2002). The cylindrical specimens were compressed along two diametrically opposed generators lying horizontal. To prevent multiple cracking and crushing at the point of loading, two thin plywood strips (25 mm thick) were placed between the loading platen and the specimen to distribute the load while a special appliance fabricated was used to hold the cylindrical prisms in place to avoid tilting or rolling under load. The induced stress caused the specimen to fail by splitting into two halves across the loading plane. These tests were carried out in accordance to the provision of BS EN 12390 – 6:2000.

DISCUSSION OF RESULTS

Workability

The result of the slump tests are shown in Figure 1. From Figure 1, it was observed that the slump values for each replacement level of sand with granite fines (20-100%) increased at a decreasing rate above the slump value with the mix without granite fines (control). The peak slump value, 148 mm, was obtained at 40% granite fines content. The results obtained showed that the slump increased when percentage of granite fines in the mix increased up to 40% and thereafter (60-100%), the slump value decreased. However, the result showed concretes of high workability, that is, above 50 mm. Neville (1995) stated that concrete having slump between 25 and 50 mm can be used for mass concrete foundations without vibration or lightly reinforced concrete sections with vibration. Accordingly, concrete having slump between 50 and

100 mm can be used for manually compacted flat slabs using crushed granite and also for normal reinforced concrete manually compacted and heavily reinforced sections with vibration. It can therefore be implied that, PKSC of mix proportion 1:1.77:0.77, containing 2.0% $CaCl_2$ as accelerator, with the shells at saturated surface dry (SSD) condition and a water-cement ratio of 0.5 with or without granite fines can be used for mass concrete foundations without vibration or lightly reinforced sections with vibration.

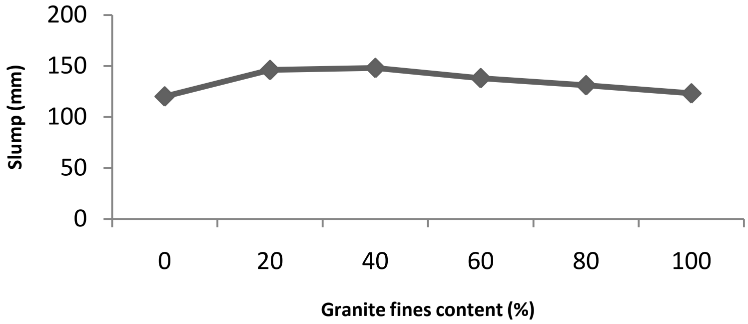


Figure 1: Variation of slump with granite fines content

Water Absorption Capacity

The water absorption capacity of the PKS was 9.03% (see Table1). This result is within the range of absorption capacity of lightweight aggregates which has been put at 5-20% (PCA, 1979). When compared with other aggregates used in this research as shown in Table 1, PKS has high water absorption. If used in the production of concrete, it would obviously absorb much of the water meant for mixing thereby requiring a high water/cement ratio to make it workable. It is because of this high water absorption characteristic of PKS that pre-soaking of the shells is necessary before use in concrete.

Table 1: Physical and mechanical properties of PKS, Granite fines and Sand

Properties	PKS	Granite fines	Sand
Maximum size	14	4.75	5.00
Specific gravity	1.58	2.4	2.55
Water absorption	9.03	3.85	3.75
Coefficient of uniformity	1.77	2.60	2.50
Coefficient of curvature	1.00	0.82	0.75
Density (g/cm^2)	1.22	2.63	2.57

Density of Concrete

The demoulded density of concrete produced in all cases of replacement (Table 2) ranges within 1900-1950 Kg/m^3. It was observed that the replacement level of the sand with GF did not impact greatly upon the density of concrete produced, though the higher the GF content, the higher the density and the higher the density, the higher the strength characteristics of PKSC. This density range falls within that of lightweight aggregate concrete (Newman, 1993; Shetty, 2002; Teo *et al.* 2006b).

Compressive Strength of PKS Concrete

The results showed that the compressive strength of PKSC increased with increase in the granite fines content (see Fig.2). Maximum compressive strength of 14.73 N/mm^2 was obtained at 28 days when the sand was completely replaced with granite fines. This indicated that palm kernel shell concrete performs better in compressive strength when sand is completely replaced by granite fines. The compressive strength also increased with increase in curing age from 7 to 28 days like normal concrete. However, compressive strength at 28-day test was only slightly higher than for 21 days at the various replacement levels of sand with granite fines. Neville (1995) posited that the knowledge of the strength-time relation is of importance when a structure is to be put into use, which is, subjected to full loading, at a later age. This is similar with the results obtained when granite dust was partially substituted for sand in laterized concrete (Osunade, 2002). It could be deduced that granite fines enhanced better bond between the mortar and palm kernel shell than when sand is used.

Table 2: Summary of Demoulded Density, Compressive and Splitting Tensile Strengths of PKSC containing Granite Fines (GF)

% GF content	Demoulded Density (Kg/m^3)	Compressive Strength (N/mm^2)			Tensile Strength (N/mm^2)		
		7 Days	14 Days	28 Days	7 Days	14 Days	28 Days
0	1900	10.90	12.47	12.63	1.24	1.42	1.63
20	1912	11.17	13.13	13.33	1.26	1.48	1.74
40	1925	11.47	13.43	13.60	1.37	1.62	1.78
60	1932	11.77	13.70	13.83	1.49	1.69	1.81
80	1942	12.03	14.07	14.33	1.54	1.77	1.86
100	1950	12.33	14.33	14.73	1.56	1.82	1.90

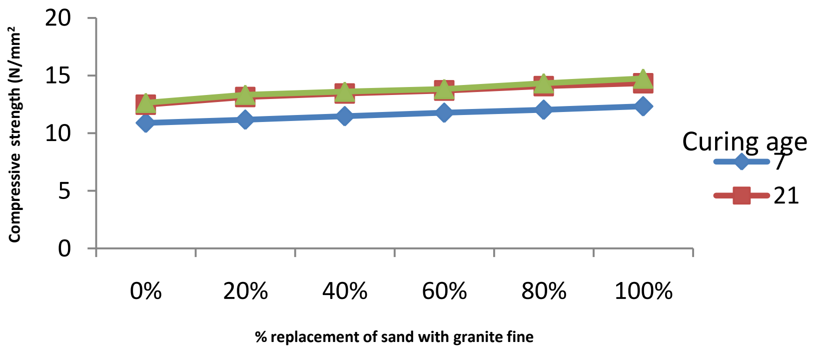


Figure 2: Variation of compressive strength with % granite fines

From the statistical analysis of the compressive strength results, Table 3, the analysis of variance (ANOVA) output showed that the independent factors; GF content and curing age and their interaction had significant effect on the compressive strength of PKS concrete at $p \leq 0.05$.

Tensile strength of PKS concrete

From Table 2 and Fig. 3, it was observed that the tensile splitting strength of the PKS concrete increased as the percentage of granite dust increased from 20% to 100%. A similar pattern of performance of compressive strength was observed for the tensile splitting strength. Total replacement of sand with granite fines (100%) at 28 days gave the optimum tensile splitting strength of 1.90 N/mm^2. Tensile strength obtained fall within the range of values (1.24-1.90 N/mm^2) given for grade 30 concrete. The tensile splitting strength also increased with curing ages from 7 to 28 days. Neville (1995) posited that although concrete is not usually designed to resist direct tension, the knowledge of tensile strength is of value to estimating the load under which cracking will develop.

Table 3: ANOVA Output

Source	Dependent Variable	Type III Sum of Squares	df	Mean Square	F	Sig.
Model	Compressive Str.	9137.800[a]	18	507.656	4.154E4	.000
	Tensile Str.	142.115[b]	18	7.895	1.254E4	.000
GF	Compressive Str.	18.933	5	3.787	309.806	.000
	Tensile Str.	.753	5	.151	239.145	.000
Curing age	Compressive Str.	49.517	2	24.759	2.026E3	.000
	Tensile Str.	1.290	2	.645	1.024E3	.000
GF * Curing age	Compressive Str.	.461	10	.046	3.770	.002
	Tensile Str.	.049	10	.005	7.827	.000
Error	Compressive Str.	.440	36	.012		
	Tensile Str.	.023	36	.001		
Total	Compressive Str.	9138.240	54			
	Tensile Str.	142.138	54			
a. R Squared = 1.000 (Adjusted R Squared = 1.000)						
b. R Squared = 1.000 (Adjusted R Squared = 1.000)						

Table 1 showed that granite content and curing ages and their interactions also have significant effect on the tensile splitting strength of PKS concrete at 95% confidence level.

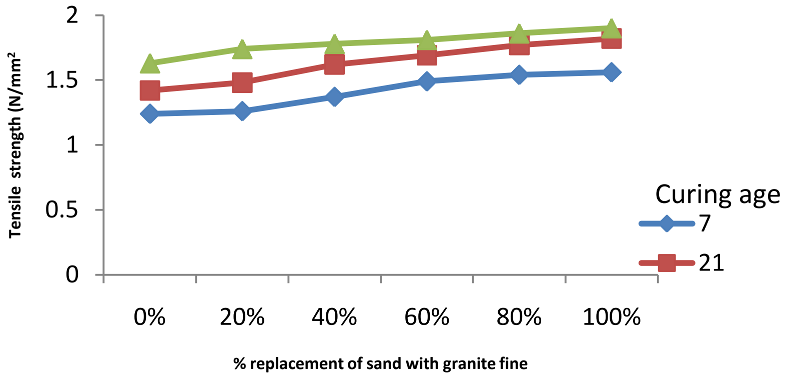


Figure 3: Variation of tensile strength with % granite fines

CONCLUSIONS

Based on the results of this research, the following conclusions can be drawn;

1. Optimum slump of concrete with PKS was obtained at 40% replacement level of granite fines with sand.
2. PKSC of mix proportion 1:1.77:0.77, containing 2.0% $CaCl_2$ as accelerator, with the shells at saturated surface dry (SSD) condition and a water-cement ratio of 0.5

with or without granite fines can be used for mass concrete foundations without vibration or lightly reinforced sections with vibration.

3. The density of PKSC is not greatly influenced by the replacement of sand with granite dust at whatever percent replacement level. At all percent replacement level, PKSC was still found to be lightweight.
4. Compressive and tensile strengths of the concrete increased with increase in percentage of granite fines in the mix and with the curing age.
5. The 28-day compressive and tensile strengths of PKSC were 14.70 N/mm^2 and 1.90 N/mm^2 respectively at 100% granite fines contents.
6. The replacement of sand with granite fines (GF) in PKSC better enhanced the bond between the mortar and the coarse aggregate.

REFERENCES

Abdullah, A.A. (1984); "Basic Strength Properties of Lightweight Concrete Using Agricultural Wastes as Aggregates", Proceedings of International Conference on Low-cost Housing for Developing Countries, Roorkee, India.

Alengaram, U.J., Jumaat, M.Z. and Mahmud, H. (2008); "Influence of Cementitious Materials and Aggregate Content on Compressive Strength of Palm Kernel Shell Concrete", Journal of Applied Science, 8: 3207-3213.

Ata, O., Olanipekun, E.A. and Olusola, K.O. (2006); "A Comparative Study of Concrete Properties Using Coconut Shell and Palm Kernel Shell as Coarse Aggregates", Building and Environment, 41: 297-301.

Basri, H.B., Mannan, M.A. and Zain, M.F.M. (1999); "Concrete Using Oil Palm Shells as Aggregate", Cement Concrete Research, 29(4): 619-622.

British Standard Institution (1985); Methods for Making Tests Cubes from Fresh Concrete, BS 1881: Part 108, British Standards Institution, London.

British Standard Institution (2000); Cement Composition, Specifications and Conformity Criteria for Common Cement, BS EN 197-1, British Standards Institution, London.

British Standard Institution (2000); Testing of Fresh Concrete, BS EN 12350-Part 2: Slump test, British Standards Institution, London.

British Standard Institution (2002); Testing Hardened Concrete, BS EN 12390-Part 3: Compressive Strength Test Specimens, British Standards Institution, London.

British Standard Institution (2000); Testing Hardened Concrete, BS EN 12390-Part-6: Tensile Splitting Strength Test Specimens, British Standards Institution, London.

FIP Manual, (1983); FIP Manual of Lightweight Aggregate Concrete, (2 ed.), London, Surrey University Press.

Mannan, M.A. and Ganapathy, C. (2001); "Mix Design for Oil Palm Shell Concrete", Cement and Concrete Research, Vol.31, pp. 1323-1325.

Mannan, M.A. and Ganapathy, C. (2002); "Engineering Properties of Concrete with Oil Palm Shell as Coarse Aggregate", Construction and Building Materials, Vol.16, pp. 29-34.

Mannan, M.A. and Ganapathy, C. (2004); "Concrete from an Agricultural Waste – Oil Palm Shell (OPS)", Building and Environment, Vol.39, pp. 441- 448.

Mindess, S., Young, J., and Darwin, D. (2003); Concrete, (2nd ed.), Pearson Education, Inc., Upper Saddle River, NJ. Ch.13, Response of Concrete to Stress, pp. 303-361.

Mohd Noor, M.J., Juosh, A. and Ghazali, A.H. (1990); "Management and Utilisation of Oil Palm Wastes - A Review", Regional Information Centre on the Management and Utilisation of Wastes, Universiti Putra Malaysia.

Newman, J. B. (1993); “Properties of Structural Lightweight Aggregate Concrete”, (In: Clarke JL, ed.), Structural Lightweight Aggregate Concrete, Blackie Academic & Professional; pp. 19–44.

Neville, A.M. (1995); Properties of Concrete, 3rd edition, Addison Wesley, England, Longman Limited,.

Okafor, F.O. 1988. “Palm kernel shell as a lightweight aggregate for concrete” Cement and Concrete Research 18, pp. 901-910.

Okafor, F.O., Eze-Uzomaka, O.J. and Eguniwe, N. (1996); “The Structural Properties and Optimum Mix Proportions of Palmnut Fibre-Reinforced Mortar Composite”, Cement and Concrete Research, 26, pp. 1045-55.

Okpala, D.C. (1990); “Palm Kernel Shell as A Lightweight Aggregate In Concrete”, Building and Environment, 25(4): 291-296.

Osunade, J.A. (2002); “Effect of Replacement of Lateritic Soils with Granite Fines on the Compressive and Tensile Strengths of Laterized Concrete”, Building and Environment, 37: 491-496.

Portland Cement Association (1979); “Design and Control of Concrete Mixtures”, Illonios: Shokie.

Ramasamy, P., Asrah, H., Mannan, M.A., Teo, D.C.L. & Neglo K. (2008); “Performance of Oil Palm Shell (OPS) and OPS Concrete under Aggressive Conditions”, Proceedings of the 2nd Engineering Conference (EnCon), 18-19 December, Kuching, Sarawak, Malaysia, pp. 93-98.

Salam, S.A. (1982); “Lightweight Concrete Made from Palm Oil Shell Aggregates and Rice Husk”, Proceedings of a Regional Seminar, Universiti Putra Malaysia, pp 177-96.

Shetty, M.S. (2002); Concrete Technology: Theory and Practice, S.Chand and Company Ltd, Ram Nagar, New Delhi.

Teo, D. C. L., Mannan, M. A., Kurian, V. J. (2006a); “Structural Concrete Using Oil Palm Shell (OPS) as Lightweight Aggregate”, Turkish Journal of Engineering and Environmental Science, 30: 251- 257.

Teo, D.C.L., Mannan, M.A., and Kurian, J.V. (2006b); “Behaviour of Reinforced Lightweight Concrete Beams Made with Oil Palm Shell”, Journal of Advanced Concrete Technology, Vol. 4, No.3, 1 -10.

Teo, D.C.L., Mannan, M.A., and Kurian, J.V. (2006c); “Structural Behaivour of Singly Reinforced OPS Beams”, Proceedings of the 6th Asia-Pacific Structural Engineering and Construction Conference (APSEC), 5th – 6th September, Kuala Lumpur, Malaysia.

Teo, D.C.L., Mannan, M.A., Kurian, J.V., Ganapathy, C. (2006d); “Lightweight Concrete Made from Oil Palm Shell (OPS): Structural Bond and Durability Properties”, Building and Environment, doi: 10.1016/j.build env.2006.06.013.

Teo, D.C.L., Mannan, M.A. and Kurian, V.J. (2005); “Utilization of Solid Waste Oil Palm Shell (OPS) in Concrete Production”, Proceedings of the International Conference on Natural Resources and Environmental Management, Kuching, Sarawak, Malaysia, pp. 135-140.

EFFECTS OF NIGERIAN RICE HUSK ASH PRODUCED USING A CHARCOAL FIRED INCINERATOR ON PROPERTIES OF CEMENT MORTAR AND CONCRETE: PRELIMINARY RESULTS

A.E. Abalaka[1], O. G. Okoli[2], M.M. Garba[3] and I.K. Zubairu[4]
[1]Building Department, Federal University of Technology, Minna, Nigeria
[2,3,4]Building Department, Ahmadu Bello University, Zaria, Nigeria

The effects of Nigerian rice husk ash (NRHA) produced in a prototype charcoal fired incinerator and milled to a specific surface of $235m^2/kg$, on properties of cement mortar and strength properties of concrete are presented in this work. Effects of NRHA on properties of cement mortar were investigated at 0-40% replacement levels at 5% intervals by weight of ordinary Portland cement (OPC). The results indicate that standard consistence water content increases linearly with the NRHA content increases. There were remarkable increases in initial and final setting times of the cement mortar that peaked at 10% NRHA replacement; above 10% content, continuous decrease in initial and final setting times were observed. There is no recorded unsoundness in the cement paste at the replacement levels investigated. The effects of the NRHA on concrete strength at different hydration periods and water/binder (w/b) ratio show that compressive strength gains are dependent on w/b ratio.

Keywords: compressive strength, concrete, rice husk ash.

INTRODUCTION

Rice husk ash (RHA) belongs to a class of materials known as pozzolan. A pozzolan may be defined as a siliceous or siliceous and aluminous material which in itself possesses little or no cementitious value but will, in finely divided form and in the presence of moisture, chemically react with calcium hydroxide at ordinary temperature to form stable insoluble compounds possessing cementitious properties (Neville, 2006; Lea, 1988).

The use of RHA in concrete could enhance known properties of concrete (Givi et al., 2010; Kartini et al., 2010; Reddy and Alvarez, 2006). Ganesan et al. (2008) and Nehdi et al. (2003b) have reported tensile strength increases in concrete resulting from cement replacement with RHA in concrete. RHA contains mainly reactive amorphous silica that reacts with calcium hydroxide liberated by cement hydration in concrete to produce dense calcium silicate hydrates (CSH) that is mainly responsible for improved concrete performance (Giannotti de Silva et al., 2008; Reddy and Alvarez 2006; Rodriguez de Sensale, 2006; Zhang and Malhotra, 1996).

[1] aabalaka@gmail.com

Abalaka *et al.* (2011) Effects of Nigerian rice husk ash produced using a charcoal fired incinerator on properties of cement mortar and concrete: Preliminary results *In:* Laryea, S., Leiringer, R. and Hughes, W. (Eds) *Procs West Africa Built Environment Research (WABER) Conference,* 19-21 July 2011, Accra, Ghana, 379-389.

RHA with high amorphous silica content could be considered as highly reactive (r-RHA). The action of RHA in concrete has two components; the chemical reaction in the lime liberated as a result of cement hydration that forms dense CSH gel and the mechanical filler effect of the fine RHA particles (Bui et al., 2005). These two components when combined together in concrete enhance its strength properties significantly.

Research results have shown that country of origin of rice husk, chemical pretreatment of rice husk and methods of incineration all affect the reactivity of RHA in concrete (Feng et al., 2004; Nehdi 2003a; Rodriguez de Sensale 2006; Salas et al., 2009).

The works of Qijun et al. (1999) and Feng et al.(2004) shows that amorphous silica in RHA reacts with Ca^{2+} and OH^{-} ions, and calcium hydroxide librated by hydrating cement to form more CSH gel and less portlandite that leads to compressive strength increase in concrete containing RHA compared to concrete without RHA.

The particle size of the RHA also plays a role in compressive strength increase in concrete (Bui et al., 2005). Most research results on the effects of RHA in concrete are based on RHA specific surface that is usually higher than that of OPC. The specific surface of the RHA used for this study is approximately half of the specific surface of OPC and the aims of this study are: to determine the effects of the RHA in concrete by testing the effects of the RHA on properties of cement mortar at standard consistence. Though these tests are not carried out on concrete directly the results in concrete are by inference; e.g. a mineral admixture that causes unsoundness in cement mortar would cause concrete expansion that can lead to subsequent deterioration. Secondly to determine the effects of the RHA with low surface area achieved by using a commercial mill rather than a laboratory mill in concrete and to determine the optimum replacement level of OPC with the RHA in concrete, by testing concrete cube specimens at different ages and water/binder ratio.

MATERIALS

The RHA used for this study was produced using a charcoal fired incinerator from rice husk sourced from a local rice mill in Minna town. Minna is a small sized state capital in Niger state; a major rice producing area in the middle belt region of Nigeria.

After production, the RHA was ground using a commercial mill. Though the level of fine particle sizes that could be attained by the commercial mill used is lower than laboratory mills, it was chosen for its affordability and accessibility and to determine the extent of cement replacement with the RHA produced. Compared to laboratory mills, commercial mills have larger outputs but produce lower specific surface milling. The use of commercial mills considerably lowers the cost of RHA milling.

A laser diffraction particle size analyzer was used to determine the particle size distribution of the raw and milled RHA. Fifty percent of the raw RHA have particles ≤303.192µm and ninety percent have particle size ≤1014.298µm. Particle sizes range from 200-600µm. When ground using a commercial mill, the ground RHA specific surface area improves to $235m^2/kg$, fifty percent of the RHA have particles ≤46.451µm. Particle sizes range from 30-100µm. The particle size distribution of the ground RHA is shown in figure 1. Ground NRHA was used for all the tests presented in this work.

In determining the composition of the NRHA, samples were subjected to X-ray diffraction (XRD) and energy dispersive X-ray spectroscopy (EDS) methods of analysis. The results of the analysis of the RHA as shown in table 1. The OPC used is a local commercial brand.

The sand used is natural river bed quartzite with specific gravity of 2.73; the coarse aggregate is crushed granite of 20mm maximum size with specific gravity of 2.63. The fine and coarse aggregates particle size distributions are given in table 2; the sand used is zone 2 type by BS 882: 1973 classification.

The concrete mix proportions are given in table 3. The concrete used for this work could be considered as high strength concrete (HSC). HSC have compressive strength higher than 50 N/mm^2 (fcu ≥50N/mm2) according to ACI Committee 363 (1998).

Table 1. Composition of RHA.

Specific surface	Loss of ignition (LOI)		Amorphous (opal-SiO_2nH_2O)	Crystalline (cristobalite SiO_2)	Quartz (SiO_2)	Langbeinite $KBaFe_2(PO_4)_3$)	Fairchild ($K_2Ca(CO_3)$) and Phosphates in trace amounts
	800°C (6 min.)	1050°C (2 hrs)					
235m^2/kg	0.77%	3.88%	90%	1%	6%	2%	1%

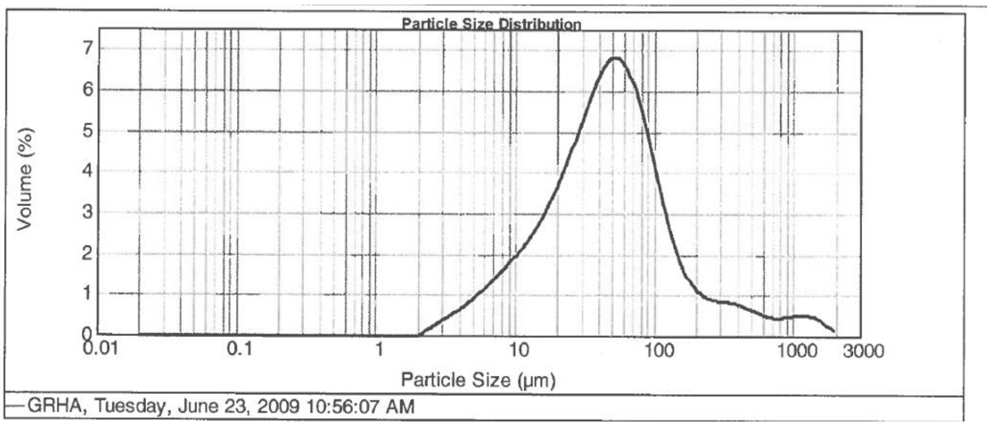


Figure 1. Particle size distribution of ground RHA.

Table 2. Particle size distribution of aggregates as percentage by weight passing sieve sizes.

Sieve size (mm)	20	10	5	2.36	1.18	0.600	0.300	0.150
Fine aggregates	-	-	96.5	94	68.60	37.40	13.80	4
Coarse aggregates	95.0	40.62	0.80	-	-	-	-	-

Table 3. Concrete mix proportions.

Cement content	Sand	Coarse aggregates	Free w/c ratio
425kg/m^3	446kg/m^3	1,419kg/m^3	0.35-0.55

METHOD

The standard consistence of the OPC and the effects of NRHA (r-RHA) on cement paste of standard consistence, initial and final setting time were measured using the Vicat apparatus using procedures complying with BS 4550: part 3 specifications. The immersion in cold and boiling water method complying with BS 4550: Part 3: Section 3.7: 1978 specifications were used in measuring soundness; vernier caliper was used to measure the separation of the Le Chatelier apparatus.

The concrete was mixed in a drum mixer for 3minutes and the cubes were cast in 100mm steel moulds and manually compacted in two layers. After 24hrs in the moulds, the cubes were removed from the moulds and cured in water at 21^{o}C; at the end of curing days the cubes were removed from water and excess surface water wiped off and crushed.

The concrete cylinders were cast in 150 mm×300mm steel moulds and de-moulded after 24hrs and cured in water at 21^{o}C; the cylinders were tested at 28 days. Three samples were cast for each parameter investigated. No water reducing admixture was used for the concrete mixes reported in this work.

The split tensile and compressive strength test of the cylinders and cubes were done using ELE ADR 3000 digital compression machine. The cubes were crushed at a loading rate of 3.00kN/s and the cylinders were split at a loading rate of 2.10kN/s.

Concrete cubes containing 0% NRHA are used as control for all the ages tested.

RESULTS AND DISCUSSION

Microstructure of RHA

The results of the BSE imaging in plates 1 and 2 show the cellular structure of the siliceous particles for the raw and ground RHA. The large surface area of the milled RHA can be seen in plate 2. The effects of the large surface area of the RHA will reflect in some of the properties of cement mortar investigated. The EDS spectra presented in plate 3 show the peak intensities of some elements in the ground RHA.

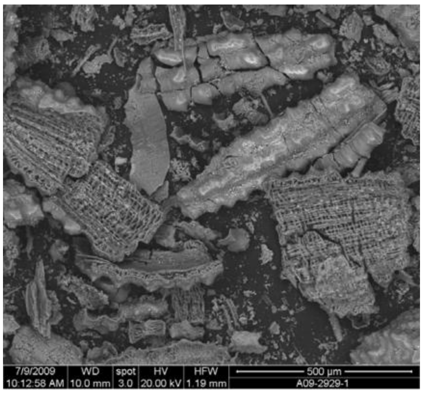


Plate1. Microstructure of raw NRHA(×250).

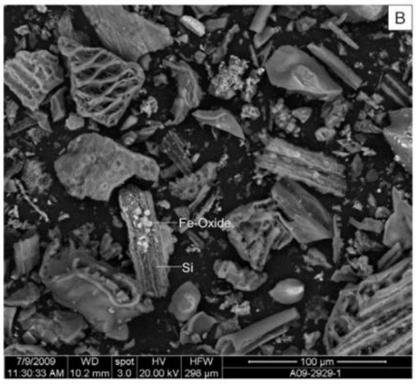


Plate 2. Microstructure of the ground NRHA (×1000).

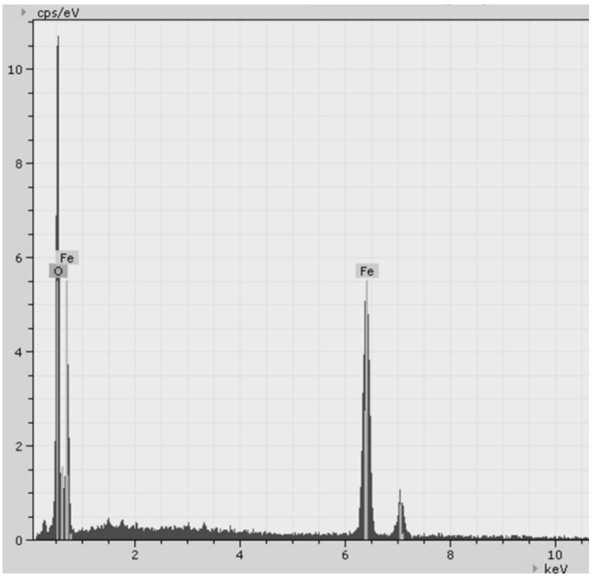


Plate 3. EDS spectra of ground NRHA.

Effects of NRHA on cement mortar

Effects of NRHA on standard consistence water of cement paste are shown in figure 2. The figure shows that the water required to achieve the same standard consistence of cement paste increases linearly with RHA increase. This is attributable to the large surface area of the ground RHA seen in plate 3. As more RHA is added to the cement paste, the water absorption by the RHA particles increases. When the percentage change in water content is plotted against the RHA content in terms of binder (cement and RHA), cement and r-RHA weights as shown in figure 3 the change in water content is most pronounced when expressed in terms of RHA weight, and it peaks at 5% RHA content.

Figure 4 shows the effect of RHA on soundness of cement paste of standard consistence. The maximum expansion of the Le-Chartelier apparatus recorded was 1.9mm at 30% RHA content. In terms of the meaning of unsoundness of cement paste as required by BS 4550: Part3: Section 3.7:1978 standard, this value is less than the maximum of 10mm. The use of RHA is therefore not expected to lead to unsoundness in cement paste.

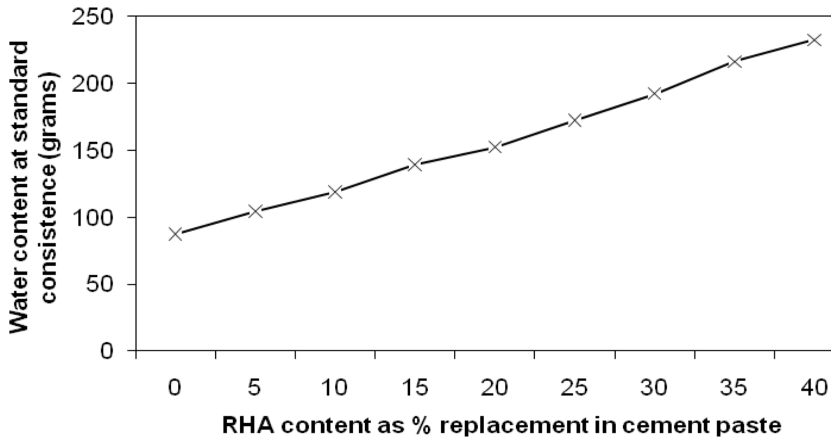


Figure 2. Effect of NRHA on standard consistence water content.

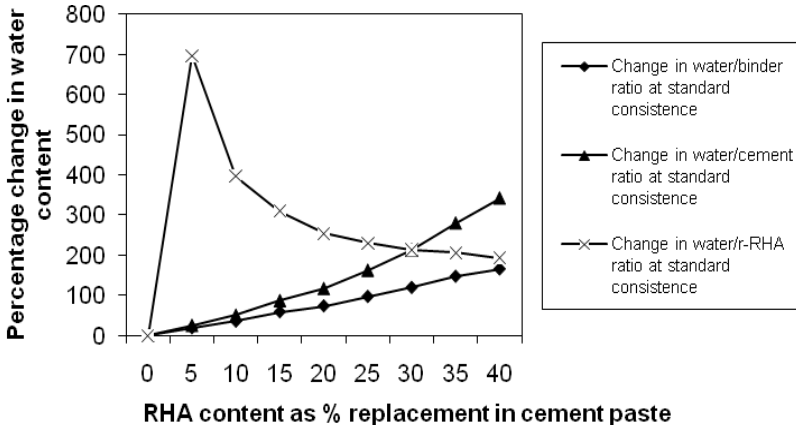


Figure 3. Effect of water in cement paste as a function of binder materials

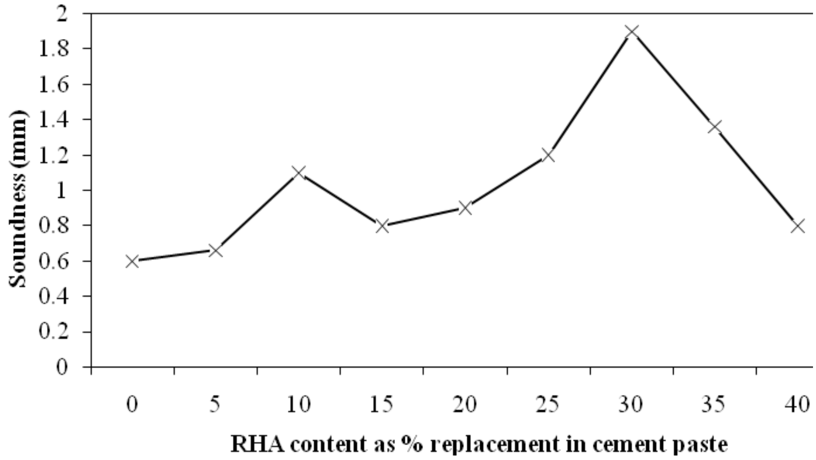


Figure 4. Effect of NRHA on soundness of cement paste

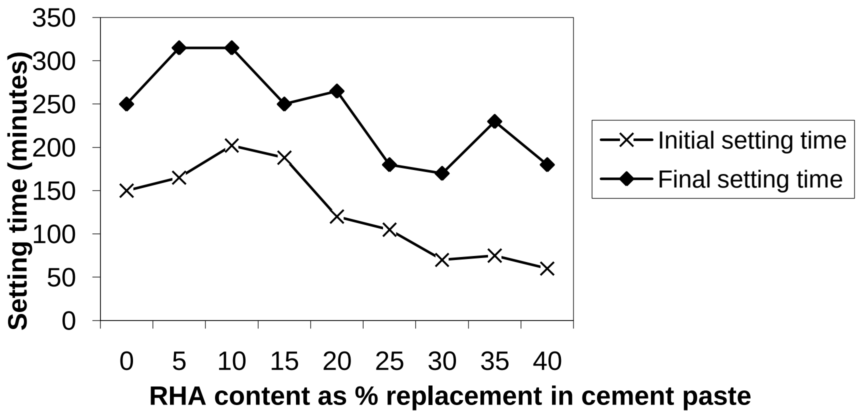


Figure 5. Effect of NRHA on setting times of cement paste.

Figure 5 shows the effects of NRHA on setting times of cement paste. Initial and final setting times increase peaks at 10% NRHA content followed by a steady decline. NRHA content from 15% is expected to lead to reduction in initial and final setting time of cement. The increased acceleration of cement setting can been attributed to the rapid consumption of $Ca(OH)_2$ formed at early stages of hydration due to the reactive RHA. Reactive RHA in cement has been reported to cause acceleration of early hydration of C_3S and production of more calcium hydroxide (Feng et al., 2004).

Effects of NRHA on high strength concrete

The results of compressive strength tests at 3, 7, 14, 21, 28 and 90 days on concrete cubes and split tensile strength tests at 28 days on cylinders at different water/binder (w/b) ratios are shown in tables 4a-e. The results represent average of three samples.

Effects of NRHA in concrete at w/b = 0.35

Table 4a shows the effect of RHA on compressive strength of HSC at w/b ratio of 0.35 at 3, 7, 14, 21, 28 and 90 days. The compressive strength of all the cubes fall below the control cubes for all the days tested. The compressive strength loss at 90 days compared to control cubes is 24.04%. Increase in split tensile strength from 3.709 N/mm2 to 3.812 N/mm^2 (2.78%) at 28 days was recorded. Since RHA particles with large surface area absorb water, at this w/b ratio available water for cement hydration would be inadequate for full strength development; un-hydrated cement has been associated with low w/c concrete mixes that are usually common with HSC (Taylor, 1997). This replacement level produces the highest demand for water absorption in cement paste from figure 3. As less water is available for hydration, the amount of $Ca(OH)_2$ (a byproduct of cement hydration) that is available to react with RHA is less, this would account for the loss in strength recorded at this low w/b ratio.

Effects of NRHA in concrete at w/b = 0.40

Table 4b shows the effect of RHA in concrete at w/b of 0.40. At this w/b ratio, more water becomes available for hydration and more $Ca(OH)_2$ become available for reaction with RHA with resultant increase in compressive strength and split tensile strength at 5% RHA content. At 5% RHA content the increase in compressive strength over control cubes was recorded for all ages. The data also shows that the RHA used can lead to 3 days early strength development in concrete. Compressive strength increase at 90 days is 11.16% above control cubes.

The compressive and split tensile strength of control cubes in table 4b are less than those in table 4a as expected because of higher w/b ratio. The exception is higher split tensile strength that is higher than that at lower w/b ratio shown in table 4a. Split tensile strength increase at 5% RHA replacement was 15.31% higher than control.

Effects of NRHA in concrete at w/b = 0.45

From the results in table 4c, there is progressive loss of compressive strength of concrete as the w/b increased to this level compared to compressive strength in tables 4a and b. The maximum compressive strength increase at 90 days is unchanged at 5% RHA replacement and represents compressive strength increase of 5.30% over control cubes. Appreciable compressive strength gain started at 28 days at 10% RHA replacement.

Split tensile strength increase of 3.53% over control was recorded at 5% RHA replacement.

Table 4a. Effects of NRHA on strength properties of HSC

	RHA replacement as %	Average compressive strength (N/mm^2)						Tensile strength (N/mm^2)
		3days	**7 days**	**14 days**	**21 days**	**28 days**	**90 days**	**28 days**
Free w/b = 0.35	0	44.40	45.51	52.13	54.24	55.63	65.11	3.709
	5	27.38	37.13	39.54	40.23	46.50	49.46	3.812

Table 4b. Effects of RHA on strength properties of HSC

	RHA replacement as %	Average compressive strength (N/mm^2)						Tensile strength (N/mm^2)
		3 days	**7 days**	**14 days**	**21 days**	**28 days**	**90 days**	**28 days**
Free w/b =0.40	0	29.28	35.35	41.71	42.78	47.93	56.14	3.553
	5	35.78	42.85	45.29	51.21	52.81	63.19	4.097
	10	33.71	38.20	44.28	44.24	49.87	53.44	3.669

Table 4c. Effects of RHA on strength properties of HSC

	RHA replacement as %	Average compressive strength (N/mm^2)						Tensile strength (N/mm^2)
		3 days	**7 days**	**14 days**	**21 days**	**28 days**	**90 days**	**28 days**
Free w/b = 0.45	0	30.18	30.16	37.73	40.59	40.71	50.04	3.517
	5	30.60	31.52	37.92	41.95	45.11	52.69	3.641
	10	26.91	30.71	37.05	39.29	44.83	49.07	3.230
	15	21.70	27.15	31.06	36.48	42.84	44.15	3.228

Table 4d. Effects of RHA on strength properties of HSC

	RHA replacement as %	Average compressive strength (N/mm^2)						Tensile strength (N/mm^2)
		3 days	**7 days**	**14 days**	**21days**	**28 days**	**90 days**	**28 days**
Free w/b = 0.50	0	23.36	26.47	34.93	33.61	37.57	39.33	2.618
	5	24.90	27.62	33.60	34.68	38.80	45.18	3.476
	10	25.17	30.53	30.01	35.86	44.90	44.00	3.389
	15	25.19	31.06	37.11	36.22	41.33	39.89	3.694
	20	19.91	26.02	29.83	37.90	32.81	36.68	3.294

Table 4e. Effects of RHA on strength properties of HSC

	RHA replacement as %	Average compressive strength (N/mm^2)						Tensile strength (N/mm^2)
		3 days	**7 days**	**14 days**	**21 days**	**28 days**	**90 days**	**28 days**
Free w/b = 0.55	0	21.24	25.75	31.47	30.71	34.86	45.70	3.297
	5	21.34	27.28	32.94	34.82	37.72	46.44	3.212
	10	19.09	29.57	29.05	34.13	35.53	38.75	2.834
	15	18.96	24.53	29.19	34.40	34.13	37.75	3.483
	20	18.07	24.06	28.33	32.73	32.84	35.81	3.182
	25	17.01	21.07	26.29	30.60	29.38	33.45	3.176

Effects of NRHA in concrete at w/b = 0.50

From the strength values shown in table 4d, increase in w/b ratio to 0.50 resulted in increases in compressive strength at RHA content of 5% at 90 days, this increase is 14.87% over control cubes; the maximum split tensile strength occurs also at this RHA content. The compressive strength increase recorded at this w/b ratio is the maximum recorded in this work. Though compressive strength increase over control cubes is recorded at 10% and 15% RHA replacement at 90 days, the maximum increase is at 5%. At 10% RHA replacement the compressive strength increase above control cubes recorded was 11.87% at 90 days, while at 15% RHA replacement compressive strength increase of 1.42% over control was recorded. At 15% RHA replacement, tensile strength increase over control was 41.10% at 28 days.

Effects of NRHA in concrete at w/b = 0.55

At w/b ratio of 0.55, the maximum compressive strength increase recorded was at 5% RHA replacement representing strength increase of 1.62% over control at 90 days. Decline in split tensile strength at 28 days was recorded at 5% and 10% RHA content compared to control; it increased at 15% RHA replacement and then declined from 20-25% RHA replacement.

From the results presented in this work, a maximum compressive strength increase of 14.87% over control was recorded in HSC used for this work at 5% RHA replacement at a w/b ratio of 0.50 at 90 days. Split tensile strength increases were recorded in concrete cylinders with RHA.

Even though the specific surface of the NRHA used for this study is low, it has none the less shown that cement replacement with RHA in concrete up to 15% at w/b of 0.50 is feasible. Though appropriate fineness of RHA could be important in compressive strength development, this work has shown that the NRHA used for this research produced by a charcoal fired incinerator is reactive in concrete and can improve compressive and tensile strength of HSC.

CONCLUSION

The results presented in this work shows that the NRHA produced in a charcoal fired incinerator at a specific surface of 235m^2/kg is reactive in cement mortar and in the concrete mix used for this study. In cement mortar the NRHA has been shown to effect water demand; higher replacement content would lead to higher water required to achieve the same slump in concrete. Furthermore, replacement content from 15% and above is expected to result in reduction in initial and final setting time of cement. The results also show that in the range of replacement content used for this study, NRHA does not cause any unsoundness in cement mortar and is therefore not expected to cause expansion in concrete.

The maximum compressive strength increase recorded occurs in concrete at 5% RHA replacement at w/b of 0.50. However, the RHA replacement can be increased to 15% at this w/b ratio without strength reduction. The results have also shown improved tensile strength of concrete containing RHA. The strength increase recorded in this work is mainly due to the pozzolanic reaction of the amorphous silica with $Ca(OH)_2$. Grinding the RHA to higher fineness should increase the filler effect of the RHA in concrete and subsequent increase in the replacement level in concrete. Though the OPC used is finer than the RHA, the results show that a commercial mill could be used to produce RHA that is reactive in concrete. This is particularly relevant considering the fact that laboratory mills usually have small milling capacity and are relatively more expensive.

The measurement of durability related properties like coefficient of water permeability, water absorption and sorptivity on these range of mix proportions are ongoing. Work on concrete mix of a lower grade to determine the effect of the RHA on normal strength concrete is currently in progress.

REFERENCES

ACI Committee 363. (1988). State-of-art report on high-strength concrete. (ACI 363.R-92/97). In: Manual of concrete practice ACI; 55p

Bui, D.D., Hu, J., Stroeven, P., (2005). Particle size effect on the strength of rice husk ash blended gap graded Portland cement concrete. Cement and concrete composites, 27,357-366.

Feng Q, Yamamichi H., Shoya M., Sugita S. (2004). Study on the pozzolanic properties of rice husk ash by hydrochloric acid pretreatment. Cement and concrete research, 34, 521-526.

Ganesan, K,Rajagopal K, Thangavel K. (2008). Rice husk ash blended cement: assessment of optimal level of replacement for strength and permeability properties of concrete. Construction and building materials, 22, 1675-1683.

Givi, A. N., Rashid, S.A., Aziz F. N. A., and Salleh M. A. M. (2010). Contribution of rice husk ash to the properties of mortar and concrete: A review. Journal of American science. -accessed 17 June 2010. Available at http://www.americanscience.org

Kartini, K. Mahmud, H.B. and Hamidah, M.S. (2010). Absorption and permeability performance of Selangor rice husk ash blended grade 30 concrete. Journal of engineering science and technology. School of engineering, Taylor's university college,5:1. -accessed 18 June 2010. Available from http://jestec.taylors.edu.my

Lea, F.M. (1988). The chemistry of cement and concrete, third edition. Arnold. London.

Nehdi M, Duquette J, El Damatty A. (2003a). Performance of rice husk ash produced using a new technology as a mineral admixture in concrete, Cement and Concrete Research,33, 1203–1210.

Nehdi M, El Damatty A, Rahimi R. (2003b).Investigation on lap-joint behaviour of GFRP plates bonded to silica fume and rice husk ash concrete. International journal of adhesion and adhesives, 23, 323-333.

Neville A.M. (2006). Properties of concrete, fourth edition, Dorling Kindersley (India)Pvt ltd, Patparganj, Delhi, India.

Qijun, Y., Sawayama, K., Sugita, S., Shoya, M., Isojima, Y., (1999). The reaction between rice husk ash and $Ca(OH)_2$ solution and the nature of its product. Cement and concrete research, 29,37-43.

Reddy D.V. and Alvarez, M. (2006). Marine durability characteristics of rice hush ash modified reinforced concrete. Fourth LACCEI international Latin American and Caribbean conference for engineering and technology (LACCET'2006). Breaking frontiers and barriers in engineering: education, research and practice. 21-23 June, Mayaguez, Puerto Rico. -accessed 18 June 2010. Available at http://laccei.eng.fau.edu/

Rodriguez de Sensale, G., (2006). Strength development of concrete with rice-husk ash. Cement and concrete composites, 28, 158-160.

Salas A, Delvasto S, Mejía de Gutierrez R, Lange D. (2009). Comparison of two processes for treating rice husk ash for use in high performance concrete. Cement and concrete research.,39, 773-778.

Taylor H.F.W. (1997). Cement chemistry. 2nd ed. London: Thomas Telford.

ENERGY GENERATION AND CONSUMPTION IN GHANA

Emmanuel A. Essah[1]
School of Construction Management and Engineering, University of Reading, Reading, RG6 6AW, UK

Electricity consumption in Ghana is estimated to be increasing by 10% per annum due to the demand from the growing population. However, current sources of production (hydro and thermal facilities) generate only 66% of the current demand. Considering current trends, it is difficult to substantiate these basic facts, because of the lack of information. As a result, research into the existing sources of generating electricity, electricity consumption and prospective projects has been performed. This was achieved using three key techniques; review of literature, empirical studies and modelling. The results presented suggest that, current annual installed capacity of energy generation (i.e. 1960 MW) must be increased to 9,405.59 MW, assuming 85% plant availability. This is then capable to coop with the growing demand and it would give access to the entire population as well as support commercial and industrial activities for the growth of the economy. The prospect of performing this research is with the expectation to present an academic research agenda for further exploration into the subject area, without which the growth of the country would be stagnant.

Keywords: energy, electricity generation, electricity consumption, Ghana.

INTRODUCTION

In today's world, the role of energy generation and consumption cannot be over emphasised. Energy consumption enhances productivity, economical growth, global networking as well as its adverse effects on climatic; climatic change. The need for additional installed capacity of energy source to meet the potential of a country has continued to be at the forefront of growing economies of many countries. However, these concepts and principles are yet to be fully harnessed in Ghana.

Electricity consumption in Ghana is estimated to be increasing by 10% per annum due to the demand from the growing population. However, current baseline production sources generate only 66% of the current demand. From this, an estimated 65% is used in the industrial and service sectors while the residential sector accounts for about 47% of total electricity consumed in the country. Though this does not add up (certainly there must be justified reason), this is what has been presented in the Energy Sector Strategy and Development Plan, 2010 (www.ghanaoilwatch.org). this lack of parity prompts research to enable the validation of available data.

Current data draws on the fact that electricity generation is primarily obtained from hydropower sources at Akosombo and Kpong Dam located in the Eastern Region of Ghana and another two thermal power plants using light crude oil at Aboadze near Second-Takoradi in the Western Region of Ghana (Gand, 2009). Additional infrastructure has been constructed to boost the capacity, bringing Ghana's installed

[1] e.a.essah@reading.ac.uk

Essah, E.A. (2011) Energy generation and consumption in Ghana *In:* Laryea, S., Leiringer, R. and Hughes, W. (Eds) *Procs West Africa Built Environment Research (WABER) Conference,* 19-21 July 2011, Accra, Ghana, 391-401.

capacity to 1960MW (i.e. 2009 figures) (www.ghanaoilwatch.org). Ghana's energy strategy and development plan by 2015 (www.ghanaoilwatch.org) predicts baseline production to rise to 80%, however it is not clear what percentage of the nation would have access to electricity. To achieve this increase, the sector raises the following challenges for additional energy generation sources:

- Developing infrastructure for the production and supply of adequate energy services to meet national requirements and for export.
- Developing the requisite infrastructure to ensure universal access as well as the efficient and reliable supply of energy services.
- Ensuring that energy is produced and supplied in a form that has no adverse health, safety and environmental impact.

These are interesting projections but current trends and statistics indicates that this may be farfetched within the 2015 targets set by the nation. This paper reviews existing data and develops detailed analysis that challenges for potential infrastructure development to meet growing energy demands. It also draws on the expectation to present an academic research agenda that is yet to be critically explored.

PROJECT RATIONALE

There is enormous potential for Ghana to address the "pressures" of its energy demand by investigating ways in which similar or other technologies could be viably adopted to supplement and provide energy to meet the needs of the growing population. However, without detailed research and commitment to implement its findings, this potential would not be realised The fact that there are variations in data regarding the current percentage of the population that has access to electricity raises concerns and debate regarding the authenticity of data available to the public. Depending on the source from which information is obtained, values of those who have access are quoted between 50-70% (www.ghanaoilwatch.org; http://www.modernghana.com). From this, it is estimated that the access to electricity in the urban areas is 70 % and that to rural areas is approximately 30% (http://www.modernghana.com). These figures are yet to be substantiated with facts backed by research.

Undoubtedly, it is clear from the constant *"blackouts"* that the current national grid lacks security because of the unpredictable variation in energy sources (www.ghanaoilwatch.org) or insufficient wholesale electricity supply (excluding indirect cost) eventually costing the nation between $320 million and $924 million annually or 2 - 6% of Gross Domestic Product (GDP) (www.adomonline.com). As a result, the current energy strategy policy of the country (2010) identifies the need for research to develop additional strategies to improve and modernise transmission and, distribution infrastructure. This is aimed at developing a non-congested transmission system by 2015 (www.ghanaoilwatch.org).

STUDY APPROACH

To understand the lapses in data presented and the challenges that face the Energy Sector, this paper present research that was performed using three effective stages:

Stage 1: Understanding the potential of the current grid infrastructure and its capability to meet the growing demands: a literature survey.

Stage 2: Empirical studies to investigate the countries energy requirements, installed capacity and energy consumption.

Stage 3: Modelling a photovoltaic system with grid integration as a possible source of energy generation.

Based on these stages, several recommendations are made with a view to initiate a rigorous research engagement into the subject area by leading researchers and academic institutions in Ghana.

IMPACT OF GROWTH: URBAN AND RURAL

Ghana's 2010 census reported a population of 24.3 million people out of which an estimated 29% of the population are identified to live in rural areas (http://unstats.un.org; Yanga and Di Sirio, 2011). Even though rural electrification has grown substantially (GRIDCo, 2010a), it goes without saying that the urban population consumes the most. Over the last decade, Ghana experienced annual growth in peak electricity demand of about 1.4%, from a baseline of 1,258 MW in 2000 to 1,960 MW in 2009, with a corresponding cumulative growth in energy demand of 3.3% annually from 7,539 GWh in 2000 to 10,116 GWh in 2010 (projected) (GRIDCo, 2010a).The growth rates have been driven largely by three trends (GRIDCo, 2010a):

- **Economic growth:** Ghana's GDP grew at an average of 5.5% per annum between 2000 and 2009.
- **Rapid urbanization:** Ghana's urban population share increased from 44% to 52% between 2000 and 2010.
- **VALCO's demand curtailment:** VALCO's operations have been interrupted several times over the last 10 years due to the unpredictable nature of the grid distribution.

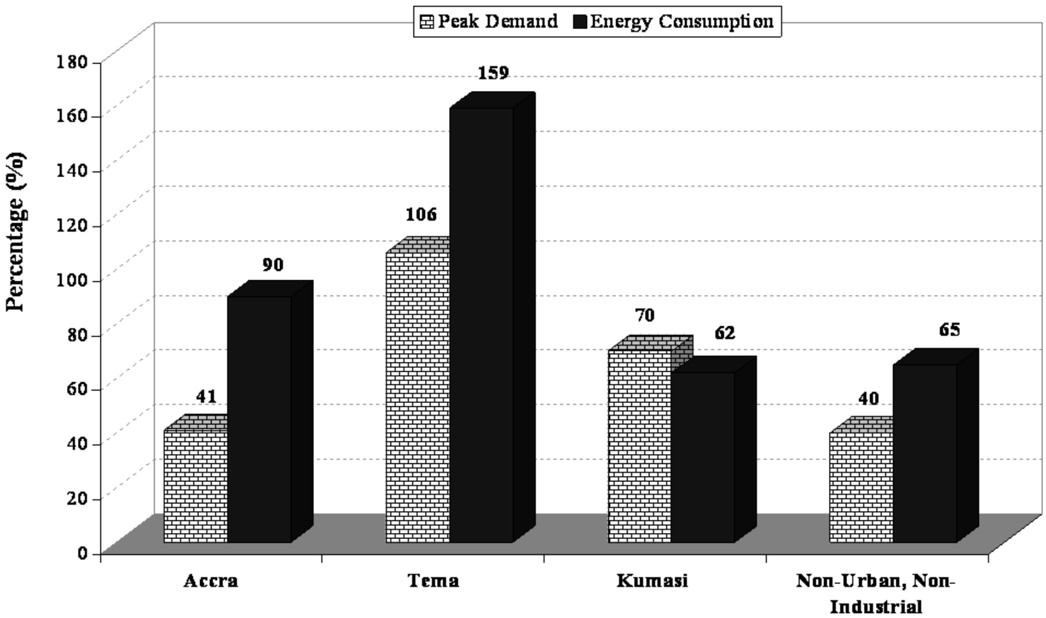


Figure 1. Peak Demand and Energy Consumption for key Urban areas; 2000-2009 *(Source:GRIDCo,2010a)*

Significantly, Ghana's three largest cities; Accra, Tema, and Kumasi, have been the key drivers in increased urban electricity usage, because of the impact of urbanisation. The total peak electricity demand for these cities rose from 48% in 2000 to 52% in 2009 with a corresponding steady growth of electricity consumption at just over 50%. The most significant growth was in Tema, where peak demand grew more than 106% over the 10 year period and energy consumption grew more than 159% (see Figure 1) (GRIDCo, 2010a; GRIDCo, 2010b).

To sustain this growth, significant development of additional infrastructure is required. Unless this is developed, the existing infrastructure would not be able to sustain and/or coop with the prospective demand, as a result the need for research and investment in this area.

EXISTING INFRASTRUCTURE

Statistics of electricity generation in Ghana as illustrated in Tables 1 and 2 shows the possible potential of electricity generation even though percentage availability varies significantly. Since 2007, five additional generation plants have been commissioned to boost the capacity of the existing structure. As stated earlier, despite this development, only between 50-70% of the population have access to electricity (www.ghanaoilwatch.org; http://www.modernghana.com). This is rather low, since the growth of any country depends on the availability and affordability of electricity to the entire population.

To meet the growing consumption rates, the projected yearly energy consumption is estimated by GRIDCo (2010) to be 10,305 GWh. It is anticipated that with the current construction of additional infrastructure (i.e. to be completed by 2014), hydro would contribute 6,360 GWh, with the remaining 3,945 GWh generated from thermal plants. This implies running almost five thermal plants continuously throughout the year. Hence, with the current low levels of units' availability (Table 1), a supply deficit of close to 1000 GWh is likely to be experienced (GRIDCo, 2010a).

Table 1: Electricity generated by plant (GWh)

	Hydro			**Thermal**								
Plant	**AKOS**	**KPO**	**Total**	**TAPCO**	**TICO**	**TT1**	**TRPP**	**ERPP**	**KRPP**	**MRPP**	**Total**	**Total**
2000	5557	1052	6610	345	268	-	-	-	-	-	613	7223
2001	5524	1085	6609	740	510	-	-	-	-	-	1251	7859
2002	4178	858	5036	874	1363	-	-	-	-	-	2237	7273
2003	3210	675	3885	1328	668	-	-	-	-	-	1997	5882
2004	4404	876	5281	536	222	-	-	-	-	-	758	6039
2005	4718	911	5629	831	328	-	-	-	-	-	1159	6788
2006	4690	929	5619	1416	1395	-	-	-	-	-	2810	8429
2007	3104	623	3727	1521	1417	-	162	80	33	38	3251	6978
2008	5254	941	6196	874	1063	-	85	45	16	46	2128	8323
2009	5842	1035	6877	453	1040	570	-	-	-	18	2081	8958
% availability	98.97	99.01	-	27.71	90.5	98.25	-	-	-	76	-	-

Where AKOS = Akosombo Hydro Power Plant
ERPP = Emergency Reserve Power Plant MRPP = Mines Reserve Power Plant TRPP = Tema Reserve Power Plant
KRPP = Kumasi Reserve Power Plant
KPO = Kpone Hydro Power Plant
TT1 = Tema Thermal 1 Plant
TICO = Aboadze Tico Thermal Power Plant
TAPCO = Takoradi Thermal Power Plant

Source: Energy Statistics (http://new.energycom.gov.gh)

From Table 3, there is a steady growth in electricity consumption by the residential sector while a corresponding decline is observed from the industrial sector. This is only possible because of the reduced activity of VALCO while the construction of residential properties connected to the grid is on the increase. Within the scheme of events, electricity exports are also on the increase (Table 3).

Table 2: Grid Electricity available for domestic sales (GWh)

Year	Electricity Generated (GWh)				Generation and Substation use	Transmission Loses	Export	Available for Domestic sale
	Hydro	Thermal	Import	Total				
2000	6610	613	864	8087	23	229	392	7835
2001	6608	1251	462	8321	32	259	302	8030
2002	5036	2260	1146	8442	45	368	612	8029
2003	3885	2015	940	6840	45	333	604	6462
2004	5281	758	878	6917	31	205	665	6681
2005	5629	1159	815	7603	42	249	639	7312
2006	5619	2810	629	9058	51	318	754	8689
2007	3727	3251	435	7413	47	230	246	7136
2008	6196	2128	275	8599	51	303	538	8245
2009	6877	2081	198	9156	25	339	752	8792

Source: http://new.energycom.gov.gh

To date, electricity exports have provided an important source of foreign exchange earnings for the country. Ghana exports power to the neighbouring countries including Togo, Benin, and Burkina Faso. It must be noted that when necessary, Ghana also imports power from La Cote D'Ivoire. Becoming a major exporter of electricity is a major objective to achieve the vision of the energy sector. In addition, the opportunity exists for Ghana to expand its electricity exports under the West African Power Pool (WAPP) Project (www.ghanaoilwatch.org). This is significant as it promotes investment in the sector.

Table 3: Electricity Consumption by Sector (GWh)*

Sector	Industrial	Non Residential	Residential	Total
2000	4306	536	1494	6336
2001	4335	579	1612	6526
2002	3900	602	1671	6173
2003	2205	620	1727	4552
2004	2085	661	1782	4528
2005	2543	698	1915	5156
2006	3593	791	2129	6513
2007	2697	803	2095	5594
2008	2966	928	2269	6163
2009	2943	878	2408	6229

**data does not include commercial and technical losses (Source: VRA, GRIDCo)*

ESTIMATED ELECTRICITY CONSUMPTION

Ideally, based on the population of a country, the basic energy needs of each individual must be met through the installed capacity of the generated sources. This forms the basic requirements of all developed countries; in fact, it must form the basis of any country that seeks development. From this analogue, this section develops simple equations to analyse the actual demand and deficit of electricity supply required to meet the needs of the current population of Ghana. Assuming all the electricity consumption requirements of Ghana are met,

Basic Equations

These equations are developed to assess the consumption of household appliances, assuming every individual has access to a range of basic appliances as would be in any home.

$$D_a P_W C_{ons}\ (Wh/day) = AR\ (W) \times quantity \times hours/day \quad \textbf{(1)}$$

$$A_{nn} P_w C_{ons}\ (kWh/year) = \frac{D_a P_w C_{ons} \times Days\ of\ the\ year}{1000} \quad \textbf{(2)}$$

Where $D_a P_w C_{ons}$ = Power Consumption/day; Wh/day
$A_{nn} P_w C_{ons}$ = Annual Power Consumption; kWh/year
AR = Appliance Ratings; W

Note:
These equations do not take into account losses due to inefficient appliances and or transmission losses.

From the carbon independent review of UK, annual average electricity consumption is 4,800 kWh per 4 person household. A smaller than average household (2 person household) is taken arbitrarily to be 3,000 kWh, and a larger than average household (5^+ person household) accounts for about 7,000 kWh (www.carbonindependent.org). Since similar statistics is not available through the statistics division of Ghana, a simple empirical study was carried out to estimate average energy consumption of a household (4 persons).

The study collates data within a domestic (residential) sector (Table 4) and non residential sector (using a virtual commercial office) as a case study (Table 5). Tables 4 and 5 were developed using Equations 1 and 2. From the study (Table 4) it was estimated that an average household of 4 persons consumes at least 1795.1 kWh/year of electricity. This is approximately $1/4^{th}$ the limits consumed in UK. It must be noted that most of the data used to generate the results in Table 4 were based on updates from general review appliances reported by Energy Foundation, Ghana (www. ghanaef.org) in comparison with the researcher's current domestic appliances and other relevant sites. Generally, comparing the yearly household (residential) values of 2408 GWh in 2009 (Table 3) the country requires additional electricity generation plants that would contribute to ~ 4.5 times more than the current annual average; 2408 GWh. This would then agree with the estimated residential electricity consumption of 10,771 GWh (Table 4).

The total energy required (estimated in Table 4 and 5) for the domestic and commercial sector is 94,036.1 GWh. From Table 3, the industrial sector requires an additional 35% (on average) of the residential sector. This implies that to address the electricity consumption required by the population and for economic growth, the annual total energy required is 97,805.76 GWh. This is ~ 11 times more than the current available electricity for domestic sale (Table 2) and ~ 9.5 times more than the projected electricity consumption estimated at 10,305 GWh.

Table 4: Estimated energy consumption for a domestic residence

Appliances	Rating (W)	Quantity	Hours (per day)	Power (kWh/year)
Hi-Fi radio	20	1	2	14.6
Mobile Phone(Charging 3 times/ week)*	-	1	3	0.7
Television (14 inch)	60	1	3	65.7
Computer with LCD screen	150	1	2	109.5
Ceiling Fan (max speed)	45	1	0.5	8.2
Telephone **	3.6	1	24	6.3
Refrig./freezer(22 cf***)	1200	1	-	292.0
Electric Stove	5500	1	-	876.0
Kettle	1200	1	0.2	73.1
Microwave	1000	1	0.2	73.0
Blender	700	1	0.1	25.6
Lights:				
11W compact fluorescent	11	3	2	24.1
Incandescent	40	4	3	175.2
Iron	1000	1	0.14	51.1
Total				1795.1
Total Demand (assume 4 person household of population) GWh				10,770.5

* *Mobile Phone Charger (http://www.willsmith.org/climatechange/domestic.html)*
*** Charges a DC researchable battery (6v 600mA)*
*** cf - cubic foot (*www.PVSyst.com*)

Table 5: Estimated energy consumption for a Commercial Offices (non residential)

Appliances	**Rating (W)**	**Quantity**	**Hours (per day)**	**Power (kWh/year)**
LCD Monitors(in Common areas)	90	3	6	591.3
Desk top computer (per Staff)	200	1	8	584.0
Telephone**	3.6	1	24	6.3
Refrig./freezer(22 cf***)	1200	1	-	292.0
Air Conditioning (efficient)****	1200	1	-	894.0
Toaster	800	1	0.15	43.8
Kettle	2200	1	0.15	120.5
microwave	700	1	0.25	63.9
Multifunctional printers - copiers	4500	1	24	2365.2
Lights:				
25W compact fluorescent	28	20	4	817.6
Fluorescent Lamps++	40	60	3	2628.0
Utility (security…)	500	6	0.08	87.6
Vacuum Cleaner	780	3	0.21	179.4
Total				**8673.5**
Total Demand***** **GWh**				**83,265.5**

***** http://www.sust-it.net/energy_saving.php?id=75#nogo*
****** assuming only 35% of the population work in commercial buildings based on facts from (www.theodora.com)*

To investigate the amount required to generate 97,805.76 GWh of electricity by plant, an empirical calculation based on the assumption that the required average transmission losses (*TLosses*), export and substation (*Sbs*) usage (Table 2) are known and accounted for.

Assuming 100% annual plant efficiency and yearly losses (Table 2),

then for the estimated available supply for domestic sale (DS)

$$\begin{aligned} \textit{Electricity available for DS}\ (GWh) &= \textit{Estimated Value}(GWh) - (TLosses + Export + Sbs)\,GWh \\ &= 97{,}805.76 - (284 + 550 + 39)\ GWh \\ &= 96{,}932.86\ GWh \end{aligned} \qquad \textbf{(3)}$$

Therefore from the estimated demand assuming 85% plant efficiency (based on current efficiencies Table 1), the required plant power is

= 9,405.59 MW ***(4)***

That is if $1MW\ (plant\ power) = 8.76GWh\ (power\ produced)$

Considering the fact that to date Ghana has an installed capacity of 1960 MW (www.ghanaoilwatch.org), based on the estimated values in Equation 4, there is a deficit of ***6320.59 MW*** of plant power that is required to be installed (this does not include a possible 20% generation loss).

PROSPECTIVE INFRASTRUCTURE

There are several projects (Table 5) that are being built to meet the possible demand and strategic goal set out by the government to increase the existing facility to 5000 MW by 2015 (www.ghanaoilwatch.org). However, this is ~ 53 % less than the estimated capacity that is required to be installed, to enable every individual function and attain a substantial level of electricity usage.

Table 5: Summary of potential projects to meet the 2015 targets

Name of Project	Unit Type	Installed Capacity (MW)	Time Frame	Investment Cost $/kW*
Bui	Hydropower	400	2013	1660
Hemang	Hydropower	60	-	1860
Juale	Hydropower	93	-	3300
Pwalugu	Hydropower	50	-	3600
Tema Thermal Power	Gas Turbine**	120	2010	-
Takoradi Thermal Power	Gas Turbine***	132	2013	-
Kpone Thermal Power	Gas Turbine***	220	2011	-
Wind Power Projects	Renewable	50	2014	-
Total (MW)		**1125**		
Deficit (MW)		**6320.59**		

** Karlsson,2006 (http://esa.un.org/un-energy/pdf/Ghana.pdf)*
*** Essandoh-Yeddu, 2010 (http://new.energycom.gov.gh)*
**** Energy Sector strategy plan (www.ghanaoilwatch.org)*

Amongst all these projects, the potential of photovoltaic systems is yet to be explored.

In this light it is envisaged that solar energy systems, will increase the national energy mix to ensure production and use. With an estimated 1.0MW of existing Photovoltaic (PV) installation (i.e. mainly standalone systems for rural electrification) supplying approximately 0.01% of the total electricity supply (http://www.areed.org), the potential of the sun through PV systems is still not harnessed.

Ghana, like all other countries in the sub-Saharan region, is blessed with year round intense and abundant sunshine with daily solar irradiation of between 4-6 kWh/m^2. While integrated photovoltaic (PV) technology is not new, the uptake of the technology has been slow and patchy. This can be attributed to a whole range of economical and technical reasons (Essah, 2010).

Using version 5.3 of PVSyst: a modelling software (*www.PVSyst.com*), the potential of using building integration photovoltaic (BIPV) technology to offset the deficit has been investigated, a summary of which is illustrated in Table 6. In this study only two types of PV technology was considered because of their relatively high efficiencies (η). These technologies are:

Polycrystalline Modules (η = 12 - 15%)

Monocrystalline Modules (η = 16 - 19%)

Table 6: Summary of possible electricity generation using photovoltaic modules

PARAMETERS	POLYCRYSTALLINE MODULES		MONOCRYSTALLINE MODULES	
Installed Capacity (MW)	5	10	5	10
Annual Energy Output (GWh)	6.72	13.55	6.72	13.55
Percentage of Demand (Eq. 3); %	0.007	0.014	0.007	0.014
Area required (m^2)	47,619	95,238	41,667	83,333
Percentage of Ghana's total area (%)	$2.00 * 10^{-5}$	$3.99 * 10^{-5}$	$1.75 * 10^{-5}$	$3.49 * 10^{-5}$
Cost on Investment ($)	41,100,378	81,466,248	40,053,320	79,367,932

From this study (Table 6), the potential of using PV to offset the demand for electricity generation sounds promising but comes with its own difficulties. Most of these short comings are the cost intensity and the vast land required (in this case roof space). For the percentage that would be offset, it is not currently viable, however with future reduction in PV module cost, this technology has a huge potential for the future. Payback time of the systems above was estimated at 20 years.

CONCLUSIONS

This paper has explored significant areas of energy generation and consumption. It is envisaged that the findings would stimulate debate and research in this field. The following deductions and suggestions are made:

From the estimates in Tables 3-5, the values of 50 -70% access to electricity consumption seems rather overstated. From this study, values presented indicate that it is rather < 30% and not as documented.

Though there are plans to increase the installed capacity, access to electricity would still be less than 40% of the population even though values quoted are above 70%.

Despite the abundance of yearly solar irradiance levels at present, the cost implications, payback periods and vast use of land, does not make the uptake of BIPV systems a viable source of generation and supplying electricity to the country.

It is rather interesting that one of the challenges proposed by the Energy Strategy Plans is *"Ensuring that energy is produced and supplied in a form that has no adverse health, safety and environmental impact".* The constant generation of power, by thermal plants (that uses light crude oil for fuel) defeats this purpose as it contributes significantly to CO_2 emissions, and hence global warming.

It is evident that there is very little or no research, in this area hence the variation in information that has been made available through the net amongst others.

Suggestions

It would be beneficial if such statistics are made available to the public to ensure wider knowledge of the field.

Ideally data for domestic homes across that country must be made available. Possible investigation into the energy consumption of typical houses with 2, 4, 6 person household, throughout all regions.

Similar research and data collection for commercial buildings, educational establishments must also be considered.

Possible development of a carbon footprint for the country can be investigated.

The results presented in this research paper enhance the understanding of varying parameters associated with energy generation and consumption in Ghana. This study is designed to develop an essence of recognising the lack of information in this field to the general public and the need to research and invest in the subject area.

REFERENCES

Electrical Power in Ghana - Overview
Available at: http://www.mbendi.com/indy/powr/af/gh/p0005.htm
[Cited: May 2011]

Energy Foundation: Cost of Using Appliances
Available at: http://www.ghanaef.org/energyinghana/costofusingappliances.htm
[Cited: May 2011]

Energy Statistics (2000 – 2009)
Available at: http://new.energycom.gov.gh/downloads/statistics2000-2009.pdf
[Cited: May 2011]

Erratic electricity costs Ghana 924 million dollars (source Daily Graphic)
Available at:
http://adomonline.com/index.php?option=com_content&view=article&id=530:erratic-electricity-costs-ghana-924-million-dollars
[Cited: May 2011]

Essah, E.A. (2010) Building integration photovoltaic module with reference to Ghana: using triple junction amorphous silicon. Proceedings of the West Africa Built Environment Research (WABER) Conference, 27-28 July 2010, Accra, Ghana, 203-214.

Essandoh-Yeddu, J.K., (2010). Energy Commission, Ghana. 2010 Energy (Supply And Demand) Outlook for Ghana
Available at: http://new.energycom.gov.gh/downloads/2010Energy_Outlook.pdf
[Cited: January 2011]

Gand, E.K. (2009), Country profile for Ghana
Available at: http://www.setatwork.eu/downloads/SETatWork_Ghana_Profile_0910.pdf
[Cited: May 2011]

Ghana Overview
Available at: http://www.areed.org/country/ghana/ghana.pdf)
[Cited: November 2010]

Ghana People 2011
Source: 2011 CIA World Factbook and Other Sources
Available at: http://www.theodora.com/wfbcurrent/ghana/ghana_people.html
[Cited: November 2010]

Ghana wholesale power reliability assessment 2010 (GRIDCo), Final Report, March 2010b
Available at:
http://www.gridcogh.com/site/downloads/27a623e256c7d94a7dce43d5ef82d3e3GridCoReportFinal.pdf
[Cited: May 2011]

Home energy source
Available at: http://www.carbonindependent.org/sources_home_energy.htm
[Cited: May 2011]
Karlsson.M., (2006). Assessing Policy Options For Increasing the Use Of Renewable Energy for Sustainable Development: Modelling Energy Scenarios for Ghana (A UN-Energy Demonstration Study)
Available at: http://esa.un.org/un-energy/pdf/Ghana.pdf
[Cited: January 2011]
Ministry of Energy, National Energy Policy (2010), Republic of Ghana
Available at:
http://www.ghanaoilwatch.org/images/laws/national_energy_policy.pdf
[Cited: January 2011]
Ministry of Energy. Energy Sector Strategy and Development Plan, Republic Of Ghana
Available at: http://www.ghanaoilwatch.org/images/laws/energy_strategy.pdf
[Cited: January 2011]
PVsyst: Software for Photovoltaic Systems
Available at: www.PVsyst.com
[Cited: January 2011]
2010 Electricity Supply Plan, Ghana Grid Company Limited (GRIDCo), 2010a
Available at: http://www.gridcogh.com/site/downloads/a22932efb1446463338be7d7f793dc6d2010-Electricity-Supply-Plan.pdf
[Cited: May 2011]
2010 Population and Housing Census. Provisional Results Ghana Statistical Service (February, 2011)
Available at: http://unstats.un.org/unsd/demographic/sources/census/2010_PHC/Ghana/Provisional_results.pdf
[Cited: January 2011]
VRA to increase electricity supply
Available at: http://www.modernghana.com/news/326464/1/vra-to-increase-electricity-supply.html
[Cited: May 2011]
Yanga.T and Di Sirio. P.(2011). Draft Country Programme Ghana 200247 (2012–2016
Available at: http://one.wfp.org/eb/docs/2011/wfp234689~1.pdf
[Cited: May 2011].

ENHANCING THE IMAGE OF TRANSPORT TERMINALS IN GHANA

Peter P. Yalley[1], Gloria Osei Poku[2] and Harold Adjarko[3]
[1]*School of Engineering, Department of Civil Engineering, Takoradi Polytechnic, Takoradi, Ghana*
[2,3]*School of Engineering, Department of Building Technology, Takoradi Polytechnic, Takoradi, Ghana*

A study was conducted with the aim of exploring and understanding intra-city transport terminals and their impacts on users. The research specifically studied the Old Tafo Lorry Park in Kumasi, Kaneshie Station in Accra, and Anaji *trotro* Lorry Park in Takoradi, examined their location and management problems and level of congestion. A literature review focused on exploring transport terminals, interviews, questionnaires and personal observations were used in the study. The study discovered that the terminals at Old Tafo and Kaneshie in Kumasi and Accra respectively are sited next to markets, where various economic activities including vibrant buying and selling occur, while, the Anaji *trotro* terminal in Takoradi is found within residential areas located in streets, clearly suggesting that no consideration was given to the development of public transport terminals. Seventy four percent of the respondents described the facilities at the terminal as poor yet they are of the view that the location of the terminals be maintained due to their proximity to markets. The large number of vehicles that use the terminals in the morning and evening peak hours result in congestion at the terminals. The study concluded that the vehicular-pedestrian conflicts at the terminals could be controlled if adequate infrastructure and services are provided at the terminals. The study increased awareness of the managers of the terminals on the need to provide security at the terminals, comfort to patrons and to reduce vehicular and pedestrian conflict.

Keywords: commuters, Ghana, intra-city, terminals, transport.

INTRODUCTION

Road transport is Ghana's main means of travelling, accounting for about 45% of the nation's socio-economic growth (Agyemfra, 2003). Majority of daily commuters in Ghana do not have personal vehicles. Available statistics indicates that only 35% of road users use private cars, the other 65% travel on foot or make use of public transport (mass transit system) to meet their travelling requirements (MRT 2006b).

Urbanik (2007) defines public transport as "transportation service that is available to the general public and carries passengers to common destinations for a fee". Public transport systems require spaces to operate. The spaces allow people and vehicles to assemble and disperse. These spaces are known as terminals. A transport terminal is a facility or location where freight and passengers assemble and disperse on a journey. It is any point of interchange involving some mode of transport (Rodrigue et al., 2006). The main functions of all terminals are to provide spaces for convergence and dispersal; however, the mode of movement and the type of cargo handled there define

[1] ppyalley@gmail.com
[2] gloriaoseipoku@yahoo.com
[3] haroldadjarko@yahoo.com

Yalley, P.P., Poku, G.O. and Adjarko, H. (2011) Enhancing the image of transport terminals in Ghana *In:* Laryea, S., Leiringer, R. and Hughes, W. (Eds) *Procs West Africa Built Environment Research (WABER) Conference*, 19-21 July 2011, Accra, Ghana, 403-412.

the differences. The focus of this study is on road transport and intra-city movement of people from bus terminals. These bus terminals in Ghana are known as lorry parks, lorry stations or simply 'stations'. A lorry park is a bus terminal involving different kinds of vehicles including taxicabs, minibuses (known locally as 'trotro') and Metro Mass Transit (MMT) buses.

In Ghana, most settlements are developed without the necessary provisions of certain social services like public transport terminals. In cases where such provisions are made, developers violate Town and Country Planning regulations in that, the terminals may be sited without compliance to regulations. Many of these sites are no longer suitable for use as terminals because of the changing trends in road construction and population growth. Prospective users are repelled by the problems of location, lack of facilities, poor management and unsafe working environment. They therefore resort boarding vehicles at unauthorised places along the length of the roads. (This is often referred to as 'hit-and-run' or in the local Twi dialect as *"waa-waa"*)

The aim of this study is to explore and understand intra-city transport terminals and their impact on users. The research will specifically study the Old Tafo Lorry Park in Kumasi, Kaneshie Station in Accra, and Anaji *trotro* Lorry Park in Takoradi, examining their location, facilities and security issues. Old Tafo transport terminal is located outside Kumasi central business area and is a satellite station that serves a large number of commuters from Mampong and surrounding communities and therefore needs the attention of the local authorities on the need to upgrade the place. Kaneshie station which is the satellite station for travellers from the Western and Central Regions of Ghana also serve a large concentration of people and aid in commercial activities that take place at the terminal's market area. This station also needs the attention of the local authorities to be upgraded for smooth running of the market. Stations located on roads are common in the Sekondi-Takoradi Metropolis and Anaji Trotro Station is one them. Anaji Trotro station was selected because among the stations located on the road it is the station with most commuters and has no room for expansion hence increasing the awareness of the need to relocate the station is important. The study intends to find out the level of congestion, based on traffic generated on a daily basis at the terminals. The research would examine as well the infrastructure and services provided at these stations and asses how adequate or otherwise they are. Safety of passengers and how security issues are handled at the stations would also be examined.

Finally, the study will propose solutions to the identified problems with the aim of enhancing the image of the road transport terminals in the study areas and how best the solutions can be adjusted and applied to other intra-city terminals in Ghana.

ROAD TRANSPORTATION

Road transport is the principal mode of transport in Ghana for both freight and passengers; be it public or private transport systems, carting on the average 98% of people and 95% of goods (MRT, 2006a). Other modes such as rail, air and water are also in use albeit at a lower scale. Ghana therefore has a large road network linking major cities and towns as well as small villages in hinterlands. The planning, construction and maintenance of roads and road infrastructure is handled by the Ministry of Transportation through three main branch departments. These are the Ghana Highway Authority (GHA), the Department of Urban Roads (DUR) and the Department of Feeder Roads (DFR) (MRT, 2006c). Improving urban public transport systems and developing road infrastructure will result in increased mobility and access to employment, markets, as well as job opportunities, and this is important for both the populace and the image of the nation.

PUBLIC TRANSPORT IN GHANA

Private car ownership was not very common in Ghana in times past. The history of public transport in Ghana dates back to 1927 when the first public bus company, the Omnibus Services Authority (OSA) started. It was government owned and contributed a lot to the society until its decline in the 1980's. This caused the privately owned public transport industry to boom. The assets of OSA were put into divestiture in 1995. In 1961, the Government of Ghana introduced a bus company, the Government Transport, to link people in the country. The company's name changed to State Transport Corporation (STC) in 1966. The company was diversified in 2000 and finally privatised. It is now known as Intercity STC with Social Security and National Insurance Trust (SSNIT) as its main shareholder (MMT 2006a). Present day public transport systems operating on intra-city basis are taxis (shared taxis), minibuses (*trotro*) and metro mass transit buses (MMT 2006b). Taxis have a seating capacity of four passengers and *trotro* range in size from 12 to 30 seats (Kwakye et al., 1997). These vehicles offer a range of services such as chartering, point-to-point (dropping) and fixed route sharing or joining. The vehicles are not metered, but fares for normal journeys are fixed (Grieco et al., 1996). This strategic change in the transport sector has increased the number of lorry stations, which has made accessibility to transport terminal easier than before. However, facilities at these terminals do not merit the status of a modern transport terminal. This calls for the need to upgrade most terminals especially in the cities to a befitting status.

LOCATION OF TERMINALS AND LEVEL OF TRAFFIC CONGESTION

Transport terminals are defined by their spatial as well as a functional character. By virtue of where they are found, their functions are specific going a long way to influence the environment in which they are located. The major factor influencing the location of a transport terminal is that it must serve a large concentration of population and/or industrial activities which forms the terminal's market area (Rodrigue et al., 2006). It also serves as a focal point for clusters of other specialized services including brisk trading.

Traffic congestion (known colloquially as traffic jam) refers to the situation where long queues of vehicles result in slower speeds of vehicles and longer travel times (Strickland and Berman, 1995). In Ghana, the legal seating capacity of taxis is four passengers while *trotro* range in size from twelve (12) to thirty (30) seats (Kwakye et al., 1997). Multiplying these figures with the number of available vehicles and taking into consideration other people who come to the terminals for other activities give an idea of the number of people who can be at a particular terminal at a given time.

The various activities that go on and thus draw people to a terminal include boarding and disembarking from the following types of vehicles – Metro Mass Transit (MMT) buses, minibuses (*trotro*), taxis and private cars, and carrying of goods and luggage either personally or with the assistance of porters to or from vehicles. Other activities performed are queuing to purchase tickets, if needed; waiting in sheltered areas and lounges if vehicles are not ready for departure or expected ones have not yet arrived and trading; i.e. buying and selling of food, snacks and newspapers. Vehicles in queue awaiting passengers during off-peak hours and interaction between members of the community as they move around also take place at terminals. These activities cause terminals to become crowded with people and congested with vehicles.

Some notable negative effects congestion can have on the facility are delays in the movement of people and goods. This is the result of vehicles not being able to enter or exit the terminal, leaving passengers stranded. The few people who manage to get vehicles to board within the terminal go through a whole lot of delays and frustrations before they are able to embark on their journeys. Llittering and filth creation is another result of overcrowding of terminals as are chaos and high crime rate such as pick pocketing. Congestion is therefore not a good phenomenon and as such should be discouraged.

FACILITIES PROVIDED AT TERMINALS

Considerations are to be made when facilities especially infrastructure are being provided for terminals. This is because, aside the need for facilities and services to be able to cater for current traffic, future projections and trends are equally important. Facilities that are provided in terminals include lanes for arrival and departure, parking areas for the vehicles, areas for cargo-vehicle interchange – handling, storing and processing of the cargo. Other facilities are traffic control facilities, administration units, operations, maintenance, safety and security areas; parking areas for the personnel of the terminal, customers and visitors as well as vehicle servicing areas. The facilities at terminals are to aid in achieving the main function of a terminal which is to handle and cart freight and people. They can be sub-grouped under headings such as shelter, logistics and technology.

THE SAFETY AND SECURITY IN TERMINALS

A major concern when managing terminals is about safety and security of the people and goods that are handled there on daily basis. Rodrigue et al., (2006) identified crowd control and safety issues as the priority matters bothering managers of railway terminals and airports due to the dense numbers of passengers there. They advanced a proposition that accesses to terminals be well monitored and controlled while movement of passengers is channelled along pathways that provide safe access to and from platforms and gates (Rodrigue et al., 2006). Safety and security of goods and passengers in road transport terminals is also of major importance. In places where dark alleyways and obscure corners abound, crime rate is higher and safety of users can be compromised.

After the September 11th, 2001, terrorists' attacks in the US, new and improved systems of monitoring airports have been put in place. They include restricted accesses to airports and freight terminals, presence of more security personnel and fortifying cockpits of aeroplanes. Extensive screening of passengers both manually and with electronic gadgets as well as rigorous inspection of their luggage are some of the means employed at ensuring safety in airports (Nolan, 2007). These same systems if incorporated into road transport terminals will go a long way in helping with the safety and security of the users. In addition to monitoring systems, planning arrangements done in such a way as to minimise obscure and dark areas are necessary to ensure safe and secure terminals.

Worker safety and theft are also of primary concern at terminals. There arises the need to put in stricter measures to ensure that terminal workers are safe and secure while on duty. However, these stricter safety measures have their negative consequences. Cost of installing high-tech security devices and paying of more security personnel are some problems managers of terminals have to deal with. In addition, when tighter security measures are employed, it becomes an inconvenience, which delays the movement of people and goods (Rodrigue et al., 2006).

RESEARCH METHOD

Both primary and secondary sources of data collection were used in this study. The primary sources used were interviews, questionnaires and personal observations. Literature review of publications, books, journals and magazines from libraries and the internet were used as a secondary source of information.

Interviews and Questionnaires

A study of this nature required the collection and analysis of quantitative data. This survey was carried out using self-administered questionnaires that had open-ended and closed questions. The population involved in this survey (i.e. the stakeholders in the transport terminal) is heterogeneous – different people from different backgrounds with different purposes. Due to the busy nature of the terminals and the nature of the population, the stratified random sampling method was used in selecting the people to be interviewed and to be served with questionnaires. The sample size was 500 people drawn from the population in Accra, Kumasi and Takoradi. The population was divided into three subgroups. These are:

Patrons of the terminal. This category includes the administrative body working at the terminal, drivers, conductors, passengers, vendors, porters, shop owners as well as hawkers (Group A).

Managers of terminals in the cities and statutory bodies managing the three cities, that is, Accra, Kumasi and Sekondi-Takoradi Metropolitan Assemblies, Town and Country Planning Department and the Department of Urban Roads, in the three regions (Group B).

The management of Greater Accra, Ashanti and Western Regional Secretariats of the Ghana Private Road Transport Union (GPRTU) as an agency operating vehicles that make use of transport terminals in the region (Group C).

The interviews that took place at the Kaneshie Station in Accra, Old Tafo Lorry Park in Kumasi and Anaji trotro station in Takoradi were done over a period of two months. Between December 2010 and February 2011, the terminals were visited daily for the first two weeks. This was reduced to once a week for the rest of the period.

Personal Observation and Photographs

Extensive personal observations of the situation on ground at various terminals were undertaken as a data source for this project. The observation focused on the general layout of the structures in relation to other facilities around, the activities that go on at the terminal, circulation patterns of humans and vehicles, fabric, structure and aesthetics of any building, safety and security as well as ground treatment. Relevant pictures of the terminals and daily activities that go on there were taken and used as a source of information.

Traffic Density

Traffic density (both human and vehicular) was measured during the study months through traffic counts at regular intervals during peak and off-peak hours to determine congestion levels and their impact on the activities at the terminals. Traffic counts were taken between the hours of 6:00 a.m. and 10:00 a.m. for morning peak densities and between 4:00 p.m. and 8:00 p.m. for the evening peak densities. It was also done during the daytime off-peak hours between 11:00 a.m. and 2:00 p.m. The results were used in the analysis.

RESULTS AND DISCUSSION

Respondent Rate

Averages of 100 persons from each of the three terminals were interviewed in a one-on-one manner and 70 people from each terminal were served with questionnaires. Out of the 500 people who were either interviewed or served with questionnaires in the survey, 350 (Accra=150, Kumasi=112 Takoradi=88) valid responses were received, representing a response rate of 70%. This is because some respondents did not return the questionnaires; some did not fill them while others did not answer all the questions asked during the interview. Out of the 350 received responses, 250 people representing 70% were interviewed in a one-on-one manner. Most of those interviewed belonged to subgroup A. This is because the drivers, conductors, hawkers and porters were busy going about their duties, majority of them were not literate enough, and thus they did not like the idea of filling questionnaires but preferred to answer the questions in a one-on-one-dialogue manner. Sixty and forty valid questionnaires were received from people from subgroup B and subgroup C respectively.

Location of the terminal

When asked about their opinions of the location of the station, some patrons responded it was easy to access the facility and do not wish for it to be relocated. Table 1 shows the distribution of the responses.

Table 1: Commuters response to location of the terminal

Commuters' Opinion	No. of People KS	OT	AT	Total	Percentage of respondents
Good – should be maintained	110	100	0	210	60
Not good – should be relocated	34	1	88	123	35
Location is not important	16	1	0	17	5
Total	150	112	88	350	100

Out of 350 respondents, 210 answered that the location should be maintained with reasons that it was easily accessible while 123 respondents mostly from Takoradi suggested that the terminal be relocated if it must to be developed into a satellite terminal with improved facilities that would bring in more people and vehicles to the terminals while 17% mostly commuters were indifferent to the location of the terminal.

Level of traffic generation

In determining the traffic densities of vehicles and people at the terminal, traffic counts were conducted between the hours of 6:00 a.m. and 10:00 a.m. To determine morning rush hour densities and between 4:00 p.m. and 8:00 p.m. for the evening peak densities. It was also done during the daytime off-peak hours between 11:00 a.m. and 2:00 p.m. Table 2 shows average vehicular densities recorded at each of the three terminals.

Table 2: Average number of vehicles using the terminal daily

Type of vehicle	Morning (6:00 a.m. – 10:00 a.m.)				Afternoon (11:00 a.m. – 2:00 p.m.)				Evening (4:00 p.m. – 8:00 p.m.)			
	KS	OT	AT	Av	KS	OT	AT	Av	KS	OT	AT	Av
Mini buses (trotro)	110	52	38	67	71	28	24	41	113	65	55	78
Taxis	38	26	11	25	26	20	17	21	36	31	26	31
Private cars	14	11	5	10	12	10	8	10	10	8	3	7
Total	162	89	54	103	109	58	49	72	155	99	84	116

KS- Keneshe, OT- Old Tafo, AT-Anaji Trotro

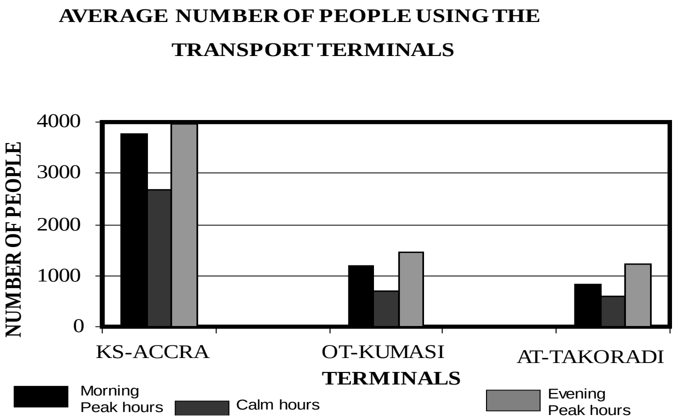


Figure 1 Number of people using the terminals

An average of 103 vehicles use the lorry parks between morning hours of 6:00 a.m. and 10:00 a.m. Out of these vehicles 25 were taxis, 65 were buses and 10 were private vehicles. The private vehicles consist of all non-commercial saloon vehicles that use the terminal. The capacities of each vehicle (i.e. maximum) are 4 for saloon cars – taxis and private cars, an average of 20 for minibuses. It was determined that the average total number of people that use the terminals were 10412, 3322 and 2620 for Kaneshie, Old Tafo and Anaji trotro respectively as indicated in Figure 1and Table 3 . The following formula was used to determine the average number of people who use the terminals: Number of Vehicle type multiplied by Capacity

Table 3: Number of people using the terminals

	KS	OT	AT	Average
Morning peak hour	3776	1186	824	1928
afternoon	2672	680	580	1310
Evening peak hour	3964	1456	1216	2212
Total vehicle	10412	3322	2620	5450

Facilities at the terminal

All the people interviewed complained about lack of shelter especially during the rainy season when using the terminal is most inconvenient. Two hundred and ninety four out of the 350 respondents laid emphasis on the deplorable state of the inadequate facilities available. The facilities available were described as bad by 74% of the people interviewed while 18% described the facilities at the terminal as average.

It was also discovered that some passengers wait for sometime before having access to vehicles, especially in the evenings. Again, it was observed that there were few snack bars and local restaurants at the terminals. Facilities like waiting room for passage, common room for drivers were not available at case study terminals. Basic services in the form of electricity and regular water supply were found to be inadequate at the terminals. Also there were few refuse disposal bins. As could be seen in Figure 2 ground treatment was very poor. Table 4 display the responses patrons to the terminal gave about the facilities provided.

[Please note that Figures have been omitted from the proceedings and can be obtained directly from the authors]

Table 4: Commuters response to facilities provided at the terminal

Facilities provided	No. of People				% of respondents
	KS	OT	AT	TOTAL	
Very bad	101	70	88	259	74.0
Bad	49	14	0	63	18.0
Average	0	28	0	28	8.0
Good	0	0	0	0	0.0
Very good	0	0	0	0	0.0
Total	150	112	88	80	100

Preferred Means of Public Transport

From 250 commuters randomly selected and interviewed from the station, 200 of them representing 80% use public transport as their daily means of travel. Of the remaining 50, it is either they do not travel every day or because they own private cars and prefer to travel in them.

Table 5: Commuters public transport preference

Type of vehicle	No. of People	% of commuters
Taxis	85	34
Minibuses	137	55
MMT buses	80	11
Total	250	100

A list of the three kinds of public transport systems, namely taxi, minibus (trotro) and Metro Mass Transit (MMT) bus were presented to commuters to indicate their preferences and reasons (Table 5). Of the respondents, 85 use taxis daily because that was the only means of public transport to the areas they were going. Given a choice, 55% (representing 137 people) preferred minibuses since they considered taxis as expensive. Only 28 of the commuters preferred to board MMT buses because they felt safer travelling aboard bigger vehicles.

DISCUSSION

The findings from the research calls for the need to address the short falls relating to location, facilities, as well as safety and security issues at the transport terminals in the study areas and in Ghana as a whole.

Location of the terminal

In this study, it was clear that, 60% of the respondents preferred that the locations of Old Tafo and Kaneshie transport terminals be maintained at their present locations but with improved facilities. The preference of the locations by majority of the respondents might be due to the fact that these terminals are located at vantage points and this makes them able to serve a large concentration of population, which is in line with the submission of Rodrigue et al. (2006). Kaneshie and Old Tafo terminals with upgraded facilities would serve as a focal point for clusters of other specialized services including brisk trading. A modern satellite transport terminals at the current location, would also help patrons to and from the Kaneshie and Old Tafo markets have easy means of transportation for themselves as well as their goods.

On the contrary, almost all the respondents from Takoradi were of the view that Anaji Trotro and other stations in Takoradi which are located on the road should be relocated. Relocation of the Anaji and other stations in the Sekondi Takoradi Metropolis would ease traffic congestion on roads used as lorry station and also minimize vehicular pedestrian conflict.

Facilities provided at the terminal

Information from literature revealed that standard terminal should have basic infrastructures like, ticket booths, arrival and offloading bays, and vehicle boarding bays. Others are sheltered waiting areas for passengers (both open and enclosed) and washrooms. None of the above mentioned facilities were found at any of the terminals under study. There was also inadequate lighting system and poor sanitary facilities at these terminals.

Inadequate lighting, absence of sheltered waiting areas for passengers and rest rooms for drivers at the terminals, compel passengers to stand in the open (sun or rain) or in the dark in the evenings while waiting to board a vehicle. These expose passengers to all forms of harm, such as pick pocketing, snatching of mobile phones, hand bags, etc. To prevent these vices there must be the need to provide facilities such as waiting room where passengers, could rest while waiting for Lorries to their various destinations.

The authors observed in all the three terminals that drivers rest in their lorries, while waiting for their turn to load, which in effect make drivers restless and look tired. Provision of rest room for drivers would reduce the incident of accidents due to tiredness on our roads, since driving tired can cause accident.

Again it was observed that there were inadequate waste disposal bins at these terminals. This makes users of the terminals indiscriminately litter waste and create filth on the untreated ground, making it difficult for cleaner to tidy up the place, since sweeping is always accompany with dust causing dust pollution..

The Safety and Security at the terminal

From the study, it was observed that there were no safety and security facilities provided. Because, the terminals are close to markets, there is movement of people between the markets and the terminals during the day. This evokes a sense of security in users during the day. This then implies that, in the late evenings and night, criminal activities at the terminals are increased, since there are less or no activities at the market during those times, hence less people moving between the markets and the terminals making the dark terminals insecure. Maximum security at night is of paramount importance. This could be achieved by providing security lights around the terminals at Kaneshie and Old Tafo, while streetlights are to be provided around the terminal periphery for full night lighting at the Anaji Trotro station. Besides secondary security systems such as closed circuit cameras and televisions (CCTV) monitoring activities all over the facility and alarm systems should be employed. Fire hydrants are to be located at vantage points of the terminals for easy access by fire engines, since none was found there.

CONCLUSIONS

This study explored intra-city transport terminals and their impact on users in Accra, Kumasi and Takoradi, using Kaneshie, Old Tafo and Anaji Trotro terminals as case study areas. From the findings and their implications it can be concluded that

Poor lorry park location of Anaji trotro affects optimum use of public transport systems, as people do not wish to patronise badly located terminals.

Lack of facilities like security light, engineered waiting areas, washrooms, fire hydrants and inadequate waste disposal bins at the terminals, expose users to robbery especially during the night and insanitary conditions.

The practical implication of this research was that awareness of the managers of the terminals was increase on the need to provide security at the terminals, comfort to patrons and to reduce vehicular and pedestrian conflict. The study recommends that Anaji and other stations in the Sekondi-Takoradi Metropolis be relocation to ease traffic congestion on roads used as lorry parks and also to minimize vehicular pedestrian conflict. Also enough lightening, waiting rooms for passengers, rest rooms for drivers and proper sanitary facilities must be provided at the terminals to enhance the image of the terminals under this study.

REFERENCES

Agyemfra, D. D. (2003). Transport Terminal - Kronom, Kumasi. Unpublished Postgraduate Design Thesis, KNUST, Kumasi.

Grieco, M., Apt, N., Dankwa, Y. and Turner, J., (1996). At Christmas and on rainy days: transport, travel and the female traders of Accra. Avebury, Aldersh

Kwakye, E. A., Fouracre, P. R. and Ofosu-Dorte, D., (1997). Developing Strategiesto Meet the Transport Needs of the Urban Poor in Ghana, *PA3330/98* World *Transport Policy and Practice, Vol. 3, No 1.*

Metro Mass Transit Limited, Ghana (2006a). The Establishment of MMThttp://metromass.com/establish_mmt..htm [Accessed 2006, December 19]

Metro Mass Transit Limited, Ghana (2006b). Background Information http://metromass.com/back_fies_journalists.htm [accessed 2006, December 19]

Ministry of Roads and Transport, Ghana (2006a). Road Transport Services and Safety, http:www.mrt.gov.gh/images/log02. [Accessed 2006, December 21]

Ministry of Roads and Transport, Ghana (2006b). Public Transport in Ghana http:www.metromass.com/pub_trans_gh.htm [Accessed 2006, December 21]

Ministry of Roads and Transport, Ghana (2006c). Departments and Agencies http://www.mrt.gov.gh/lists.asp?page_Id=73&expandable=2 [Accessed 2006, December 19]

Nolan, Michael S. "Airport." Microsoft® Student 2008 [DVD]. Redmond, WA: Microsoft Corporation, 2007.

ESTABLISHING A MAINTENANCE COST PROFILE OF RESIDENTIAL BUILDINGS

D. O. Mac-Barango[1] **and I. I. Kakulu**

Quantity Surveying Dept, Rivers State University of Science & Technology, Port – Harcourt (Nigeria)

Regular maintenance ensures restoration of building components. It is a sinequanon to longevity of building fabrics. The work attempts to establish a maintenance cost profile. It appraises the existing relationship between maintenance cost and the variables of gross floor area, the age of building, population densities of residential buildings in Warri Metropolis (an oil rich city in the Niger Delta region of Nigeria). The work obtains data for the variables through primary source. It uses the statistical tool of regression in the analysis of data. It concludes that the variables of floor area, population, population density do not significantly impact on maintenance cost. Whilst the variable of age, impact significantly on maintenance cost. It recommends that in planning of maintenance schedule cognizance should be given to age of building; the frequency should increase as the age increases.

Keywords: maintenance, maintenance cost variable, maintenance management.

BACKGROUND

Buildings have a substantial life in the order of 40 to 80 years. The lives of existing buildings are difficult to assess as all properties have from the date of their erection, been the subject of varying amounts and standards of maintenance, besides being constructed to different standards. Physical life is often much greater but they may be demolished before the end of this period to permit a more profitable use of the site. (Seeley 1976b). Holmes and Droop (1982): have established that the cost of maintenance increases with age, revealing further that costs are shown to increase significantly during the first 20 years and then assume a slow-growth pattern. It would seem reasonable to suggest that maintenance costs continue to rise for the economic life of the dwelling. It will be appreciated that any (strictly hypothetical) building entirely composed of elements which are supposed to need repairing or replacing only every sixty years will not require much attention for the first twenty or thirty years, but after sixty years the annual repair bill will be substantial. Specific dwelling types, have different maintenance cost. There is little evidence to support the view that size of dwelling should be taken into account in the maintenance equation. It was assumed social status of estates would affect maintenance costs, those areas or estates enjoying a good reputation would require less maintenance than those estates which were less desirable. The assumption was wrong. Infact the area with the highest reputation, had the highest maintenance cost per dwelling and areas which were less desirable had lower maintenance costs. Slater (1982a), opines that costs are generally of a “random” nature and do not appear to significantly influenced by the size of the hospital, in terms of number of bed, volume of floor area. The unit cost of

[1] dumomac@yahoo.com

Mac-Barango, D.O. and Kakulu, I.I. (2011) Establishing a maintenance cost profile of residential buildings *In:* Laryea, S., Leiringer, R. and Hughes, W. (Eds) *Procs West Africa Built Environment Research (WABER) Conference*, 19-21 July 2011, Accra, Ghana, 413-425.

hospitals performing the same medical functions, did not relate to size, no detectable pattern could be seen. The total maintenance cost related to the number of beds (and therefore patients) the examination of maintenance cots per bed did not reveal any clear pattern, except that correlation between costs and bed numbers appeared to improve slightly when smaller hospitals were ignored. The pattern is certainly too vague to enable predictions to be made. It was apparent that no pattern existed between maintenance costs (per unit) and size. Whilst the age of a building can be a factor in determining maintenance expenditure, it will also depend on the standard of maintenance which the building has received over the years. Disparities exist between actual costs of maintenance, when compared with the previously estimated costs of maintenance. It was observed that in 14 cases, out of the 18, the estimates were greater than the actual amounts spent sometimes by over 300%. The effectiveness of maintenance spending was decreasing, because of the disparities.

The research establishes a maintenance cost profile with a view of being used as a management tool that addresses maintenance problems associated with residential buildings. It investigates existing relationships between maintenance cost and the variables of size (gross floor area), population, age and population densities of the buildings making inferences from the outcomes of relationship and using these outcome of analysis between variables to inform and predict future relationships. It also digests the concept of maintenance and management of residential buildings.

The boundary and limits of the study are as follows:

(i) Location – Warri Metropolis (in the Niger Delta region of Nigeria). (ii) Building Types – Two floors (Duplexes) and Bungalows. (iii) Parameter Coverage – Demographic variables, affecting cost of maintenance in residential buildings.

Location: Warri metropolis in the oil rich Niger Delta region of Nigeria. Nigeria lies between latitude $5^0$31'N and $5^0$45'E of Nigeria. (http.www.travemath.com/city/warri). It lies latitudes $5^0$300 and $5^0$350N and longitudes $5^0$290 and $5^0$480E within the Niger Delta region (http:www.springlink.com). The activities of multi-national oil companies have enhanced economic activities and increased the inflow of population, this has increased the demand housing stock and its maintenance.

This research will assist designers and builders appreciate problems associated with maintenance and its applicability in subsequent designs, subsequently improve the environmental scenario of the city on the long run. Also, assist in budget control and management of maintenance. Warri is an oil rich city with rapid increase in population, the demand for housing stock has also increased. Maintenance enhances the longevity of building fabrics and cost data profile, in turn enhances maintenance management.

The outcome of research findings are hinged on the premises that data given by the Landlords and tenants are true reflections of expenditure incurred, the models are developed from these raw data. Economic, climatic and other variables that influence building maintenance, do not impact on the outcome of results. The study attempts to provide answers to the followings: (i) Has the lack of maintenance cost data and profile, necessitated the rapid deterioration and decadence of buildings. (ii) Are there problems of maintenance and lack of maintenance culture Warri metropolis. (iii) What underlying factors are responsible for maintenance problems. (iv) What relationships exist between the various independent and dependent variables. (v) How does the demographic variables of age of building, seize of building, population and population density influence maintenance cost. (vi) Are there existing cost data, maintenance cost profile. (vii) How can a maintenance cost profile be built. The study Hypothesis that a linear model exists between the variables of maintenance cost and the demographic variables of total floor area, age, population of occupants and the population densities of occupants of the sampled housing stock.

THE ESSENCE OF MAINTENANCE

Maintaining a building is to retain the value of the investment; to maintain the building in a condition in which it continues to satisfactory fulfill its function and to present a good appearance to the public. (Seeley 1983a). Maintenance is a combination of any actions carried out to retain an item in, or restore it to an acceptable condition. Retailing implies work carried out in anticipation of failure and restoring which implies work carried out after failure. (Igwe, 1989a). According to Oguike (1997), opines that building maintenance services include maintenance, structure and fabric maintenance, services maintenance, finishes maintenance, external area maintenance, security, telecommunications, energy maintenance, environmental survey and health and safety.

Total neglect of maintenance inputs significantly influences the state of disrepair of infrastructural facilities and the built environment. There is also inadequate funding set aside for maintenance works. Natural resources are depleted because of the frequent use of building materials for new construction, which ordinarily would have being reserved and conserved. New buildings are always springing up along side with some existing old almost dilapidated and yet inhabited ones. Some have stayed over 100 years. The craze is always to build new houses and caring little for the existing ones. The governments of the Federation have spend billions of Naira providing housing estates that are very poorly maintained. (Onwuka, 1989a). According to Onwuka (1989b), no matter how well a building or construction project is executed by a good contractor, it must require constant routine checks to maintain it properly. A close examination of the life span of some building components will reveal the need for proper maintenance of the building as the life span of some components expires. There is a need for proper maintenance of building and replacement of some worn out components. Ashworth (1988), observes that the expenditure of money in time and materials on building maintenance is extensive, and growing due to the necessity of having to maintain an ever-increasing stock of older properties. The petroleum trust fund (PTF), is a classical example of an interventionist body set up in the mid-nineties (1994-1998) to address problems of maintenance neglect. Most projects executed indicated that maintenance and rehabilitation costs were twice as high as their initial cost of construction, the infrastructure were and have been neglected for large span of periods, due mainly to backlog of outstanding rehabilitation and maintenance. (Ahmad 1997). Maintenance related work, account for less than 20% of the total work load of the construction industry in Nigeria. The neglect has manifested in the sorry state of most infrastructure in both public and private sectors. Findings of the outcome of (20) twenty organizations indicate the absence of a maintenance culture, policies and practices. Most glaring was the absence of any planned maintenance system. (Ikupolati, et-al 2004).

Maintenance seek to preserve a building in its initial state so that it continues to serve its purpose as an essential component in the life cycle of a building. Building work will be a discredit to the designer, if its usefulness and convenience is permitted to fall below accepted standard. Accepted standard recognizes three categories which serve to illustrate some of the complexities of maintenance. Functional performance, quality and reliability which relate to user needs. Structural, electrical, fire and other safety aspects for which maintenance personnel are generally responsible. The preservation of the asset and its amenities, in which the owner has the primary interest. (Seeley 1983b).

Types of Maintenance: Seeley (1976b), categories maintenance into three, components, servicing, rectification and replacement. Servicing is essentially a cleaning operation undertaken at regular intervals of varying frequency and is sometimes termed day to day maintenance. Rectification work usually occurs fairly early in the life of the building and arises from shortcomings in design, inherent faults in or unsuitability of components, damage of goods in transit or installation and incorrect assembly. Repayment is inevitable because service conditions cause materials to decay at different rates. Much replacement works seems not so much from physical breakdown of the materials or element as from deterioration of appearance. Maintenance can also embrace renovations which consist of work done to restore a structure, service and equipment by a major overhaul to the original design and specification, or to improve on the original design. This may include limited additions and extensions to the original building. BS 3811, breaks maintenance work into there classes. Planned preventive running maintenance work which can be done while the facility is in service. Planned preventive or corrective shut down maintenance work which can only be done when the facility is, or is taken, out of service. Planned corrective breakdown maintenance. Work which is carried out after a failure, but for which advance provision has been made in the form of spares, materials, labour and equipment. (Seeley 1983d). Igwe (1989b) has opined hat a building will definitely need regular maintenance to ensure a useful and economical life. It is therefore essential that planned approach be adopted for this work and that maintenance planning should start at the design stage of any building project and should continues throughout the life of that building, all buildings start to deteriorate from the moment they are completed and from that time they begin to need maintenance in order to keep them in good condition. The adequacy of the building design and the suitability of material specified, the standard of workmanship in initial construction determine the extent to which the designer has anticipated future maintenance needs.

MAINTENANCE COST VARIABLES (TECHNICAL)

Maintenance work is generated by a whole range of factors, including weathering, corrosion, dirt, structural and thermal movement, wear, low initial expenditure, passage of time, incorrect specification, inferior design, poor detailing and damage by users. Some of the major maintenance problems stem from the use of new materials and techniques, workmanship, the intensity of exposure and the efficiency of maintenance organization. (Seeley 1983c). Generally, the more adaptable the design, the longer the period of use of the building resulting in higher total maintenance costs but lower new construction costs. A direct relationship exists between the design of a building and its eventual overall cost. In this regard the economics of maintenance demands that a proper balance be struck between first costs and subsequent maintenance and running costs. Okechukwu, (1988a), postulates that the use to which these facilities are put also determines the frequency and extent of maintenance required. Quite often these facilities are stretched beyond designed limits The design's team ability to take into account the continuing technical and economic consequences of design decisions and how these influence future operating cost is required. The availability of replacement parts for building components, machinery and equipment when they have reached the inevitable end of their useful life, is important. It does not make sense, from maintenance point of view, to incorporate in a building design items that cannot be easily replaced due to scarcity of vital parts. (Igwe 1989b).

Mosaku (1990), has observed a basis for rational specification writing and opines that materials and components specification for building requires careful consideration and informed judgment if premature decay of our building stock as well as a reduction in maintenance costs are to be accomplished. It is obviously not going to be possible to write specification that will eradicate maintenance problem. Mosaku and Kuroshi (2002), have concluded that systematic analysis, in-depth study and creative thinking that border on the factors of climatic conditions, design considerations, social and ergonomic implication, can influence and affects the scale of maintenance.

DEMOGRAPHIC VARIABLES INFLUENCING MAINTENANCE COST (AGE)

There is some relationship generally between maintenance costs and the age of a building. Evidence collected showed an increasing maintenance cost trend with age. The cycle of redecoration depends upon many factors such as user requirements, the type of finish exposure, etc. During the early years of a building's life, no costs will be allocated to these elements of costs-in-use. (Ashworth 1988b).

Some Other Variables influencing maintenance cost (Economic and Environmental):

Okechukwu (1988b), has opined that weather affects will still take its toll on facilities. Wind, sun etc, will definitely manifest themselves on the components of finishing's. Deterioration due to age, whether induced by pollution of time will still remain an issue to contend with.

MAINTENANCE MANAGEMENT

Planning, budgeting and controlling the cost of maintenance work are essential operations if buildings are to be maintained effectively within available funds. Budget limits will be established after inspection, critical analyses and estimates that provide the essential supporting data, aimed at controlling the use of resources in order to achieve objectives of programmes of maintenance. Analysis of maintenance cost information services gives details of the type, owner/occupier, location, age, accommodation, dimensions, construction, budget procedure and maintenance organization relating to the particular building. (Seeley 1976c). In a similar vein, Holme and Droop (1982b) have contended and stated that it is by no means a simple matter to estimate accurately the capital cost of new construction but the estimating of capital cost is a much more predictable business than estimating maintenance expenditure. The equation becomes complex and it is extremely difficult to predict what influence each variable is likely to have from year to year.

The running of an efficient and effective maintenance management programme borders on management information service system, that derives its basis from building records of defects, faults replacement preventive as well as on refurbishment and renovation works. Visa viz maintenance cost records for budgetary planning, management control and design cost control. A good maintenance management system derive its basis from a good planned maintenance system that involves a frame of activities; details of jobs to be executed, their frequencies, a master book of maintenance statement that is reviewed periodically, to reach the optimum total cost, through a preventive maintenance policy. The number of breakdowns and the frequency of preventive maintenance are inversely related, whilst with a repair only maintenance policy number of breakdowns remains stationary for a while, then began to increase. The "optimal policy", is the policy with a specified among of preventive maintenance that results in the minimum total cost of maintenance, plus downtime. The attainment of this state, involves several iterations between maintenance and cost. It becomes critical to determine the level of preventive maintenance that ensures the total minimum. This makes imperative budgetary control that integrates cost data and analysis that identify areas of excessive costs and to investigate the reason why. (Shields et-al 1975a). The above assertions relate particularly to a preventive maintenance system for machinery maintenance, the approach can however be adopted, when dealing with structural maintenance for building works.

Okechukwu (1988c), has postulated and avers that if we want to enjoy these facilities and services then we must be ready to tackle the challenges of preservation by cultivating the right attitude towards maintenance and repairs. The availability of funds and staff resources dictate the volume of maintenance and repair work that could be undertaken at any given period. While we can conveniently boast of adequate staff resources in the industry we cannot do the same for funds. Igwe (1989d), has stressed that it is maintenance It is the responsibility of the owner/user to provide realistic maintenance budget for the regular servicing of his building. The designer can assist him in routine maintenance by providing a maintenance manual on completion of construction works.

RESEARCH METHOD

The research conducts field survey, using questionnaire in the form of a checklist that outlines parameters of interest. The dependent variable, maintenance cost, data are obtained through primary source. The data for the independent variables are also obtained, by taking physical measurement of the buildings for the parameters. literature; include journals, magazines, periodicals, newspapers and internet browsing. A sample population of 30 buildings, duplexes and bungalows were obtained. The selection for the parameters of gross floor area, whilst data for the variables of age, population of occupants and its derivate, population densities are obtained through interactive interviews. The selection of buildings were done randomly in clusters within some estates. The mean values of the raw data (the demographic parameters) is used for the analysis of data. The unit cost of maintenance (cost per m^2), is used in the analysis of data; this allows for commonality of raw data values for maintenance cost obtained from duplexes or bungalow buildings. Also as a further check to the reliability of the data and the outcome of research findings, the ages of building within the same age brackets are grouped together to ascertain how varying building age segments impact on maintenance cost.

The study uses the statistical tool of regression analysis, to determine the relationship between variables. The equation is put as Y = abx, where a and b are the regression co-efficient (parameters). The co-efficient of determination R^2 is employed to determine the extent of the relationship existing between the maintenance cost and the demographic parameters. Graphs and Charts are used for the descriptive analysis of data. Statistical computer package, (SPSS), is used for the data analysis. The level of significance, between variables is put at 5%. The decision rule to accept the Null hypothesis is determine by the outcome of the Fcal, Ftab and P values of the statistic calculated. Hypothesis Testing; the following hypotheses are set and tested. Null Hypothesis: (Ho), there is no significant relationship between two or more parameters (when Ho equals zero); we reject the null hypothesis. Alternative Hypothesis (Hi), there is significant relationship between two or more parameters. (When Hi, is not equal to zero, we accept the alternative hypothesis (i.e. Ho: U = O, Hi: U = 0). The validity of the outcome of the hypothesis is restricted to some bounds, that is limited and scope within which results hold. From the outcome of research findings, the dependent variables of (total floor area, population of occupants, the population density and ages of the buildings), are used to predict the independent variable of maintenance cost; for the sampled buildings.

PRESENTATION, ANALYSIS AND DISCUSSION OF RESULTS

Segment investigates the existing relationships between the parameters of maintenance cost and the demographic variables.

Summary of Correlation Analysis between Parameters:

Anal No	Variables X	Variables Y	Type of Model	Observations: Regression Equation	R^2	F_{cal}	F_{tab}	P_{value}	Inferences: Strength of Relationship	Rmk	Action on hyp
1	TFA	MC	Linear	MC = 46920.06 + 253.79 TFA	12.2%	3.891	4.17	0.058	Very Weak	NS	Accept Ho
2	TFA	MC M2	Linear	MCM2 = 555.58 – 0.433TFA	2.40%	0.701	4.17	0.409	Very Weak	NS	Accept Ho
3	Age	MC	Linear	MC = 20336.64 + 10035.49 Age	73.8%	78.852	4.17	0.000	Strong	SS	Reject Ho
4	Age	MC M2	Linear	MCM2 = 189.43 + 27.13 Age	37.2%	16.565	4.17	0.000	Weak	SS	Reject Ho
5	Popn	MC	Linear	MC = 100889.3 + 1383.84 Popn	1.30%	0.363	4.17	0.552	Very Weak	NS	Accept Ho
6	Popn	MC M2	Linear	MCM2 = 480.81 – 4.23 Popn	0.80%	0.233	4.17	0.633	Very Weak	NS	Accept Ho
7	Popn Densitv	MC	Linear	MC = 135041.5 – 577699 Popn Density	3.00%	0.880	4.17	0.356	Very Weak	NS	Accept Ho
8	Popn Densitv	MCM2	Linear	MCM2 = 476.155 – 929.23 Popn Density	0.50%	0.153	4.17	0.699	Very Weak	NS	Accept Ho

S/No.	Details of Analysis		Statistics of ANOVA			Remarks
1	Ranges of floor areas of blog	Average Maintenance Cost (N)	Ftab	Fcal	P value	
a	(150 – 190)m^2	78,750				
b	(191 – 255)m^2	105,714	2.975	2.122	0.122	NS
c	(256 – 332.5)m^2	141,250				
d	(333 – 400)m^2	130,000				
2.	Age Brackets					
a	(2 – 5) yrs	63,000				
b	(6 – 9) yrs	75,000	2.975	16.362	0.000	SS
c	(10 – 13) yrs	138,571				
d	(14 – 18) yrs	178,571				
3.	Population of Occupants					
a	(2 – 5) persons	(107,500)				
b	(6 – 9) persons	(110,000)	2.975	0.098	0.960	NS
c	(10 – 13) persons	(115,714)				
d	(14 – 18) persons	(122,857)				
4.	Population densities					
a	(persons per m^2)	(114,667)				
b	– 0.03)	(125,000)	3.354	0.707	0.502	SS
c	– 0.05)	(88,000)				
	– 0.07)					

Analysis of Variance of Building Maintenance Cost for the Parameters of (i) Floor Area (ii) Age (iii) Population (iv) Population densities. The set of transpositions of the initial linear models to exponential format (square roots), did not result to any significant departure from the initial linear analysis. The P values and the significance showed the same trend.

Descriptive Analysis of Data: The descriptive charts show the pattern and trends between variables. Fig. 1: It indicates that building have floor areas between 256-352 square metres recorded the highest maintenance cost. Floor areas between (333-400) square meters, though highest recorded lower maintenance values than those having (256 – 352 square meters).

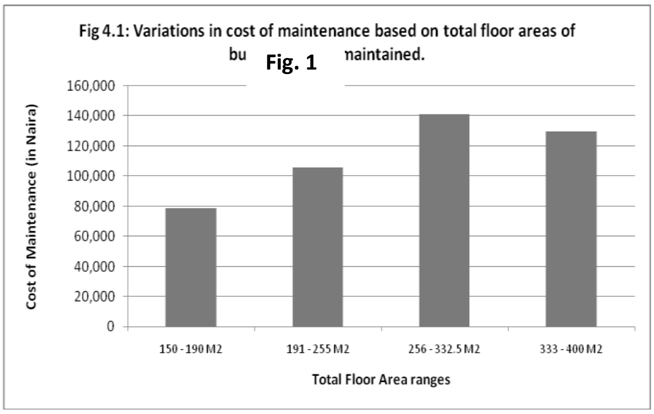


Fig. 2: Variations in cost of maintenance based on ages of buildings being maintained. The charts show progressive increases in cost of maintenance according to the age brackets of the building. Building that have lower age brackets show lower maintenance costs.

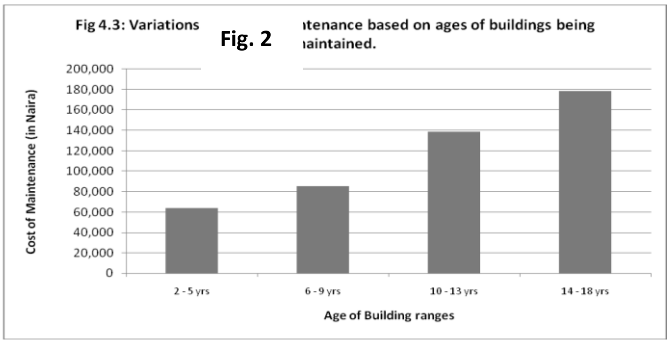


Fig. 3: Variations in cost of maintenance based on population of occupants of buildings being maintained. The charts show progressive increases in maintenance cost according to number of occupants in buildings.

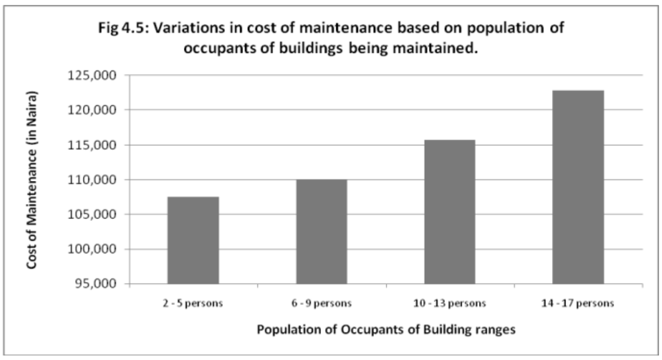
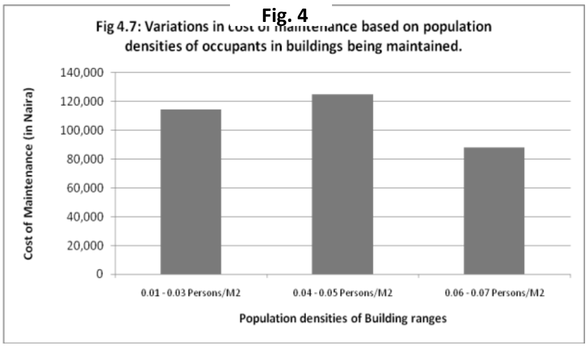


Fig. 4: Variations in cost of maintenance based on population densities of occupants of buildings. The chart did not exhibit any systematic trend. Building having 0.01 – 0.03 persons per square meters recorded the lowest, whilst buildings having population densities of 0.06 – 0.07 person per square

metres recorded the least. Densities of between 0.04-0.05 per square metres recorded the highest maintenance cost.

Fig. 4



DISCUSSIONS OF RESULTS:

Research findings establish as follows: **(1)** Total floor area, has a weak positive relationship with maintenance cost. The model is of the form MC = 46920.06 + 253.79TFA, R^2 value = 12.12%, Fcal = 3.891, Ftab = 4.17. The statistics of the analysis between the parameters of the mean values of the maintenance cost and the floor areas of buildings showed that both variables increase in the same direction, (a positive relationship). The correlation between the variables is a weak one, acceptance establishing an R^2 value of 12%. The outcome of the statistics Fcal, Ftab and P values led to the acceptance of the Null hypothesis. There is no significant relationship between the variables of maintenance cost and the total floor areas of buildings. **(2)** The ages of building however establish a strong positive relationship with maintenance cost. The model is of the form MC = 20336.64 + 10035.49 Age, R^2 value = 73.8%, Fcal = 78.852, Ftab = 4.17. The statistics of the analysis between the parameters of maintenance cost and Age showed that both variables increase in the same directions (a positive relationship). The correlation between variables is a strong one, with an R^2 value of 73.8%. The outcome of the statistics, Fcal, Ftab and P values led to the rejection of the Null hypothesis. There is a significant relationship between the variables of maintenance cost and the ages of the tested buildings. **(3)** Also, population of occupants, has a weak positive relationship with maintenance cost. The model is of the form MC = 100889.3 + 1383.84 population, R^2 value = 1.3%, Fcal = 0.363, Ftab = 4.17. The statistics of the analysis between maintenance cost and the population of building occupants showed that both variables increase in the same directions, (a positive relationship). The correlation between the variables is a weak one, with an R^2 value of 1.3%. The outcome of the statistics, Fcal, Ftab and P values led to the acceptance of the Null hypothesis. There is no significant relationship between the variables of maintenance and population. **(4)** Population densities of the buildings have weak negative relationship with maintenance cost. The model is of the form MC = 135041.5 – 577699 population density, R^2 value = 3.0%, Fcal = 0.888, Ftab = 4.17. The statistics of the analysis between maintenance cost and the population densities showed that both variables increase in the same direction, (a positive relationship). The correlation between the variables is a weak one, establishing an R^2 value of 3.0%. The outcome of the Fcal, Ftab and P values statistics led to the acceptance of the Null hypothesis. There is no significant relationship between the variables of maintenance cost and the population densities.

Discussion of Research Findings (ANOVA)

The ANOVA for maintenance cost of buildings having different ranges of total floor area. ***Observation:*** The observations of the floor areas range between (150-190), (191-225), (256-332.50) and (333-400)m^2. ***Interpretation:*** The null hypothesis is not rejected. The result is summarized as follows. There is no significant difference in the mean values of the maintenance cost of buildings for different floor area ranges. **(2)** The ANOVA for maintenance cost of buildings having different ranges of age brackets. ***Observations:*** The age brackets of building (2-5), (6-9), (10-13) and (14-18) years old. The statics: Fcal = 16.362, Ftab = 2.975, P = 0.000. ***Interpretation:*** The null hypothesis is rejected. The result is summarized as follows: There is significant difference in the mean values of maintenance cost for building having different age brackets. **(3)** The ANOVA for maintenance cost of buildings having different ranges of population of occupants. ***Observations:*** The observations of the population of occupants range between (2-5), (6-9), (10-13) and (16-18) persons. The statistics Fcal = 0.098, Ftab = 2.975, P = 0.960. ***Interpretations:*** The null hypothesis is not rejected. The result is summarized as follows. There is no significant different in the ranges of population of occupants. **(4)** The ANOVA for maintenance cost of buildings having different ranges of population densities. ***Observations:*** The ranges of population densities (0.01 – 0.03) (0.04 – 0.05) (0.06 – 0.07) per m^2. The statistics, Fcal = 0.707, Ftab = 3.354, P = 0.502. ***Interpretation:*** The Null hypothesis is not rejected. The result is summarized as follows. There is no significant difference in the mean values of maintenance cost for buildings having different ranges of population densities.

Implications of Research Findings: (Correlation Analysis)

Analysis No. 1: Total floor area and maintenance cost. The positive relationship between the variables, indicate that increases in the total floor areas, might necessitate a corresponding increase in maintenance cost, however the impact of the total floor area on the cost maintenance is negligible. **Analysis No. 2:** Age of building and maintenance cost. The positive relationship between the variables is indicative that increases in the age of building would necessitate a corresponding increase in maintenance cost. Variations in the age of buildings can be used to predict the outcome of maintenance cost. The trend of the descriptive chart between these variables, further supports the outcome. **Analysis No. 3:** Population of Occupants and maintenance cost. Increases in the population of occupants might necessitate a corresponding increase in maintenance cost, however the impact of occupants population on maintenance cost is negligible, having R^2 values less than 2%. Variations, in the maintenance cost of buildings cannot be safely attributable to population changes. Such variations in maintenance cost would be explainable by other factors – the frequency of usage by the occupants and some other technical variables (Quality of construction and supervision, etc). **Analysis No. 4:** Population densities of occupants and maintenance cost. Decreases in the dependent variables (population densities) would necessitate a corresponding increase in maintenance cost. However, the influence of population densities of buildings on maintenance would be negligible, establishing an R^2 value that is not greater than 3%. Maintenance cost, cannot be adequately predicated from population densities. The outcome of this result is in tandem with that of occupants' population, after all population density is a derivate of occupants population. The outcome of the descriptive analysis, (between maintenance cost and population densities – a non systemic trend further explains the outcome of the inferential statistic between the variables).

Implications of Research Finding (ANOVA):

The implication of the outcome of the ANOVA test for different ranges of floor areas show that maintenance costs of building do not increase in same proportion to increase in floor areas. The result has shown that for the ranges of floor areas studied, there were no differences in their maintenance cost.

The ANOVA test for maintenance cost of different age brackets of building shows that each age bracket has a different maintenance cost. Therefore for age bracket studied, each had a different maintenance cost.

The ANOVA test for maintenance cost of different buildings with the occupancy rates did not establish differences in maintenance cost for the different population ranges of occupants.

The ANOVA test for maintenance cost of different ranges of population densities did not establish differences, in the categories of population densities (0.01 - 0.03) (0.04 – 0.05) (0.06 – 0.07) per m^2.

CONCLUSION

Periodic maintenance of buildings, enhances longevity, it restores the building fabric and adds value to property. A computerized cost information service facilitates an efficient and effective maintenance management. A computerized management information system on maintenance captions all variables influencing maintenance cost and establish inter relationships between them. Research findings establish that the impact of total floor area, the population of occupants and population densities of occupants on maintenance cost are negligible. The predictability of maintenance cost from these variables can not be ascertained. The variable of age, however impacts significantly on maintenance costs; the variable can be used adequately to predict maintenance cost. Corollary to the above conclusion are that (i) maintenance cost for buildings will not change for floor area between (150 – 400) sq.m (ii) maintenance cost for buildings constantly change for building, within the bracket (2 – 18) yrs (iii) maintenance cost will not be influenced by occupancy population within the range (2 – 18) persons (iv) it will not also be influenced by population densities within the range (0.01 – 0.07) per m^2. Changes in maintenance costs, within the stated categorization are likely to be explainable by other factors outside the tested variables which influence the maintenance cost.

Recommendation: Residential building owners should make maintenance an integral part of the construction process even at the initial design stage of construction. This sandwiched with quality supervision and right choice of material reduces the frequencies of maintenance during the life cycle of the buildings. The frequencies of maintenance, even when all other variables are taken care should be stepped up as the ages of buildings increase. Maintenance cost profile compilation and management should be imbibed by all stakeholders in the real estate business. Further research works to study the impact of economic and climatic variables on maintenance cost, maintenance cost profile for commercial and institutionalized buildings..

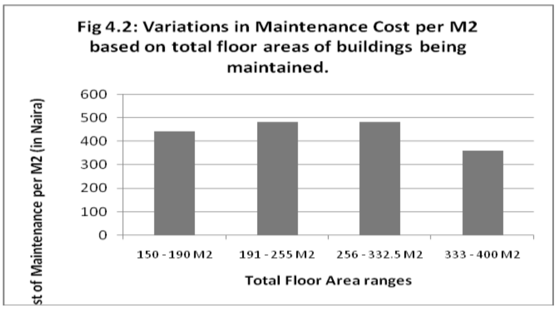
REFERENCES

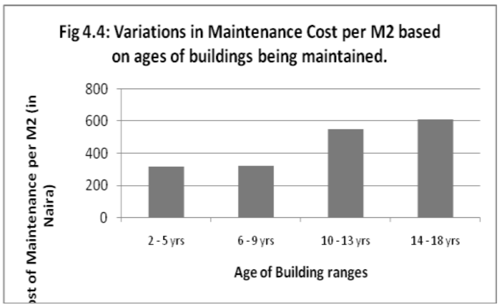
Ahmad, S. (1997): Facility management: The Petroleum (special) Trust Fund Approach to National Rehabilitation of infrastructure. Paper presented on the occasion of the 2-Day National Seminar on Facilities Management and Maintenance programme. Organized by the Nigerian Institute of Quantity Surveyors, Lagos. P(2 and 3).

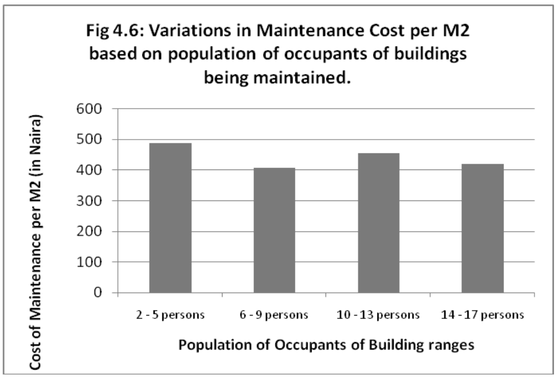
Ashworth, A. (1988a): “Cost studies of Buildings” Longman Group UK limited. London p(229)
Ashworth, A. (1988b): “Cost studies of Buildings” Longman Group UK limited. London p(229-230)
Holmes, R and Droop, C (1982a): Factors affecting maintenance costs in Local Authority Housing. In (Ed) Brandon P. S. “Building Cost Techniques. New Directions pp (399-408)
Holmes, R and Droop, C (1982b): Factors affecting maintenance costs in Local Authority Housing. In (Ed) Brandon P. S. “Building Cost Techniques. New Directions pp (418-419)
Igwe, J. M. (1989a): The designer’s Role in Building maintenance management. Paper in “Lagos Q. S. Digest” Journal of the Nigerian Institute of Quantity Surveyors. Vol. 3:1:5
Igwe, J. M. (1989b): The designer’s Role in Building maintenance management. Paper in “Lagos Q. S. Digest” Journal of the Nigerian Institute of Quantity Surveyors. Vol. 3:1:5-7.
Igwe, J. M. (1989c): The designer’s Role in Building maintenance management. Paper in “Lagos Q. S. Digest” Journal of the Nigerian Institute of Quantity Surveyors. Vol. 3:1:6.
Igwe, J. M. (1989d): The designer’s Role in Building maintenance management. Paper in “Lagos Q. S. Digest” Journal of the Nigerian Institute of Quantity Surveyors. Vol. 3:1:7.
Ikupolati, A. O., Apochi J. O. and Ene G. U. (2004): Maintenance organization and practice of selected public organizations in Kaduna State. Paper in “Nigerian Journal of Construction Technology and Management. University of Jos, Nigeria. Vol. 2:1:36
Mosaku, T. O. (1990): Specification of Building components as a means of reducing maintenance costs. Paper in “the Nigerian Quantity Surveyors” Journal of the NIQS, Lagos. Nigeria pp (13-14)
Mosaku, T. O. (2002): Evaluating performance specification factor in Building maintenance cost minimization. Paper in “Nigerian journal of Construction Technology and Management Department of Building. University of Jos. Vol. 4:1:117.
Oguike, L. M. (1997): Facilities management in Nigerian Economy: - Emergent Business Opportunities for Nigerian professionals. Paper on Seminar “Evolving a maintenance culture in Nigeria. The Role of facilities management”. Organized by the NIQS, Lagos. Nigeria p(6)
Okechukwu, C (1988a): Maintenance and repairs in the construction industry – A sadly neglected line. Paper in “Lagos Q. S. Digest” Journal of the Nigerian Institute of Quantity Surveyors. Lagos Nigeria. Vol. 2:3:9.
Okechukwu, C (1988b): Maintenance and repairs in the construction industry – A sadly neglected line. Paper in “Lagos Q. S. Digest” Journal of the Nigerian Institute of Quantity Surveyors. Lagos Nigeria. Vol. 2:3:11.
Okechukwu, C (1988c): Maintenance and repairs in the construction industry – A sadly neglected line. Paper in “Lagos Q. S. Digest” Journal of the Nigerian Institute of Quantity Surveyors. Lagos Nigeria. Vol. 2:3:11-23.
Onwuka, E. E. (1989a). Maintenance in Building and Construction Works: Paper in “Lagos Q. S. Digest” Journal of the Nigerian Institute of Quantity Surveyors. Lagos chapter. Vol. 3:1:3.
Onwuka, E. E. (1989b). Maintenance in Building and Construction Works: Paper in “Lagos Q. S. Digest” Journal of the Nigerian Institute of Quantity Surveyors. Lagos chapter. Vol. 3:1:3.
Seeley, I. H. (1976a): Building Maintenance. Macmillan. London & Basingstoke. Pp(10-11)
Seeley, I. H. (1976b): Building Maintenance. Macmillan. London & Basingstoke. P(8-9)
Seeley, I. H. (1976c): Building Maintenance. Macmillan. London & Basingstoke. Pp(214, 232)

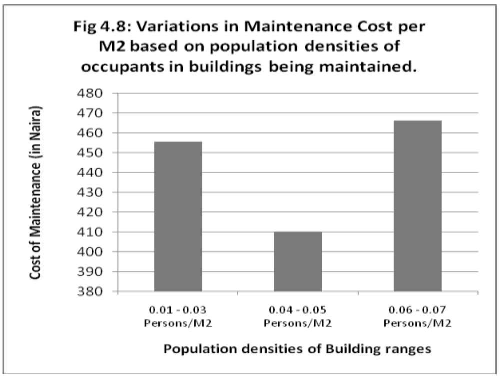
Seeley, I. H. (1983a): Building Economics third edition. Macmillan publishers Ltd. London & Basingstoke. P(209)
Seeley, I. H. (1983b): Building Economics third edition. Macmillan publishers Ltd. London & Basingstoke. Pp(209-210)
Seeley, I. H. (1983c): Building Economics third edition. Macmillan publishers Ltd. London & Basingstoke. Pp(210).
Seeley, I. H. (1983d): Building Economics third edition. Macmillan publishers Ltd. London & Basingstoke. Pp(209).
Shields, S, Sparshott, K. J. and Cameron, E.A (1975a): Ship maintenance a Quantitative Approach. Marine Media Management Ltd. London pp(22, 25, 26, 31, 32, 47 and 48)
Slater, K (1982a): An Investigation into hospital maintenance expenditure in the North West Regional Health Authority. In (Ed) Brandon, P.S. "Building Cost Techniques new directions" pp(411-417)
The Spatial distribution of particular matter (pm 10) in Warri metropolis, Nigeria.
Warri, Nigeria, Latitude/Longitude: Accessed from http:www.travelmath.com/city/warri on 23rd March, 2011.

APPENDICES









ESTABLISHING THE COMPRESSIVE STRENGTH OF SANDCRETE BLOCKS PRODUCED IN THE CENTRAL REGION, GHANA

Emmanuel Bamfo-Agyei[1]
Department of Building Technology, Cape Coast Polytechnic, Cape Coast, Ghana

Sandcrete block is one of the common materials used in constructing buildings as walling units in Ghana. Most of these sandcrete blocks are produced by local block moulders. The quality of blocks produced, however, differs from each manufacturer due to the different methods employed in the production and the properties of the constituent materials. This research therefore, examines the methods of production and determines the strength of the sandcrete block in the Central Region of Ghana. Sandcrete blocks were taken from suppliers and tested for compressive strength, bulk density, water absorption, and dimension tolerances. Fine aggregate samples were also taken from the suppliers and tested for grading, silt, and organic matter content. The study confirmed that mix ratio, quality, and mixing of the constituent materials affected the quality of sandcrete blocks. The research findings revealed that sandcrete blocks producers that the research were conducted 30.40% of the standard crushing strength of sandcrete blocks. No factory where the research was conducted were able to scientifically state their strength of sandcrete blocks. The study confirmed that mix ratio, quality, and mixing of the constituent materials affected the quality of sandcrete blocks. Visual inspection rather than laboratory testing was adopted as the means of ascertaining the quality. The Engineering Department of Standard Board for the past two years has not inspected the quality of sandcrete blocks in the Central Region.

Keywords: Central Region, compressive strength, Ghana, Mix Ratio, sandcrete block.

INTRODUCTION

In October 26 2005 the Ghana News Agency reported that The Ghana Standards Board (GSB),has launched new testing equipment for the building and construction industry to enhance the quality of operations in the industry. The six different types of equipment included a concrete pipe, a computer controlled testing machine, a hand-operated compression machine, an electrically operated machine and an operated slab machines as well as a mobile laboratory for the testing of sandcrete and pavement blocks.

However, one of the earliest warning signs of failure is often manifested by the formation of serious critical structural cracks long before the actual event. Recent structural collapses in Ghana precisely Kumasi and Accra in 2007 and elsewhere have raised serious concerns for more in-depth and intensified study on the mechanism of resistance of all components of the structure.

The National Building Regulation LI 1630:1996 Clause 29(1) and (2) noted that any material used in the erection of building shall be of suitable nature and quality for the

[1] centralpressnewspaper@yahoo.com

Bamfo-Agyei, E. (2011) Establishing the compressive strength of sandcrete blocks produced in the Central Region, Ghana *In:* Laryea, S., Leiringer, R. and Hughes, W. (Eds) *Procs West Africa Built Environment Research (WABER) Conference,* 19-21 July 2011, Accra, Ghana, 427-433.

purposes and conditions in which they are to be used. Section (2) stated that the use of any material should conform to an approved Ghana Standard Code of Practice.

At present, nearly 90% of buildings in Ghana are constructed with sandcrete blocks, i.e blocks made from sand, water and cement. This is highly undesirable because sandcrete blocks possess an intrinsic low compressive strength making them susceptible to any tragedy such as seismic activity (Andam, 2005). Past Research conducted showed dismal results for production of sandcrete blocks, which exhibited compressive strengths far below the standardized strengths for construction of houses.

RESEARCH OBJECTIVES

The main objective of this research is to investigate and establish the strength of the sandcrete block in the Central Region of Ghana. To compare the research findings to the standard crushing strength of sandcrete block and to establish the frequency of blocks inspection and test by the Ghana standard board

CLASSIFICATION OF BLOCKS

According to Obande (1989), building blocks are classified according to specified properties. The manufacturer usually has good varieties to choose from depending on the requirements of the user. There are three grades of building blocks; these are dense aggregates blocks, which are suitable for general use in load-bearing external walls including works below ground level damp proof course. Lightweight aggregates block, which are used for load-bearing internal walls, including use below ground level damp proof course and inner leaf of cavity and composite walls; and lightweight aggregates blocks, which are used for non-load, bearing partitions. The following information's will serve as a guide in determining the grade of a block. For first grade, blocks are those with not less than 1500kg/m density and a minimum average compressive strength of 2.8N/mm.

MATERIALS USED IN THE MANUFATURE OF SANDCRETE BLOCKS

There are three main materials used in the manufacture of blocks. These are: Sand; Cement; and Water.

Sand

Sand makes up about 80 percent of the mix. It is therefore necessary to ensure that good quality sand is used. It must be free from humus and vegetable matter, clean angular and coarse-grained. River sand is used extensively in preference to other sources of and, particularly the type of sand that is obtained on the ground surface along roadsides or form drains. The reason for this is that sand obtained from river is river is already washed and, therefore, contains less silt and other impurities than sand collected from drains, which may need washing before use.

Cement

The important thing about cement is to keep it dry. This can be achieved by storing in a shed (or a silo, for loose cement). Storing cement in the open, it needs to be arranged on a platform raised at least 100mm above ground. It is then covered with tarpaulin or other waterproof material. Any cover used must overlap properly to keep out rainwater.

Water

Water used for blocks making must be clean and free from deleterious matter. Pipe borne water is the best, but water from streams, rivers, lakes, and wells may be used. Water containing too many suspended solids must not be used, but can be left in a tank or suitable container for the solids to settle to the bottom. Chudley and Greeno (1997). A significant factor influencing this increase in the number of such production centres is the introduction of different rapidly assembled machines and other manually operated frameworks for the production of masonry units. The predominant three are:

1. Hand ramming compaction moulds.
2. Manual tamping compaction frame.
3. Motorised vibration machine.

All three employ both horizontal and vertical orientations in production. A quick survey of any of these block-making centres will show that anyone of these does not employ all three forms of production. For a particular type of compaction method used by any such centre, use is normally made of only one orientation for the production of block units. Different centres make use of different compaction methods with different orientations during production.

This research assesses the three main local methods of sandcrete block manufacture and its effect on strength when the blocks are produced in either the horizontal flat or the vertical straight positions. Differences in bulk density, water absorption capacities and compressive strength of block samples produced from each of the compaction methods are compared. The differences in properties between the different compaction methods and for similar orientations will also be considered.

Blocks and block type considered

A block is a masonry unit, which by usage in its normal function exceeds the actual dimensions specified for a brick that is 337.5 x 225 x 112.5 mm. By specification, it is also required that the height of the block does not exceed the length or six times the thickness to avoid confusion with slabs or panels. There are basically two types of blocks; the lightweight and the dense weight **block**. Lightweight blocks are made either with lightweight aggregate or with aerated concrete. Such lightweight aggregates are products of industrial plants [3].

Dense blocks are made from dense aggregates specified by BS 882 [4]. They include natural sand and crushed stone or rock. Dense blocks may be hollow, cellular or solid [5,6]. The solid type of the dense blocks is considered in this study. A unit of sandcrete block is made from a mixture of hard durable and clean sand, cement and water. Well-graded sand falling within the BS (2) grading zone is used. The mix proportion is 1:6 parts of cement to sand by BS 2028

Plants and Equipment

These are available in various makes and sizes. Some of these machines are operated manually. Either others are electrically or diesel operated. In addition, some of the block moulding machines only mould one block at a time, whereas others mould two or more blocks at a time are Petres and coronet multi-block and rosechomester machine.

Manually Operated Block Moulding Machine

This machine is popularly known as ‘Manpower’. Here the mould is filled with mixture and the mixture achieves compaction with a flat weighted mould cover made of metal. The strength of the levels blocks will depend on the force with which the cover is brought down on the mixture. Good blocks can be made from this machine.

Power Machines

These machines depend on electrical power for their operation. A high degree of compaction can be achieved, so that block of very high strength can be made. They cannot be used where there is no electrical power supply. Since they are not portable, they are always permanently installed.

THE COMPRESSIVE STRENGTH OF BLOCKS

BS 6073 required average crushing strength for ten blocks not less than 75mm thick not less than 2.8N/mm and the strength for any individual block to be not less than 80 percent of the average. Typical products have minimum crushing strength of;

Table 2.1 The Crushing Strength of Sandcrete blocks

Block type	Concrete density kg/m^3	Strength N/mm^2
Dense aggregate	1500-2100	2.8-3.5
Lightweight aggregates	700-1500	2.8-10.5
Autoclaved aerated	400-900	2.8-7.5

Adopted from Alan Everett (1994)

METHOD

The compressive strength of the block was determined for mixed proportion of, 1:8 , at the age of 28 days. Other related tests included sieve analysis of sand used and determination of densities. All the experimental works were carried out in accordance with BS 5628(1978) and 1377-2(1990). Nine block factories were randomly visited and and a total of 18 sandcrete blocks were tested in this research. Samples of soils used for production were also collected. The blocks were weighed and tested for compressive strength using the compressiontesting machine in accordance to BS 2028. Sieve analysis test was carried out on the soil samples to ascertain their suitability for block making in accordance to BS 1377.

RESULTS AND DISCUSSION

Table 2: Crushing strength of the factory blocks tested

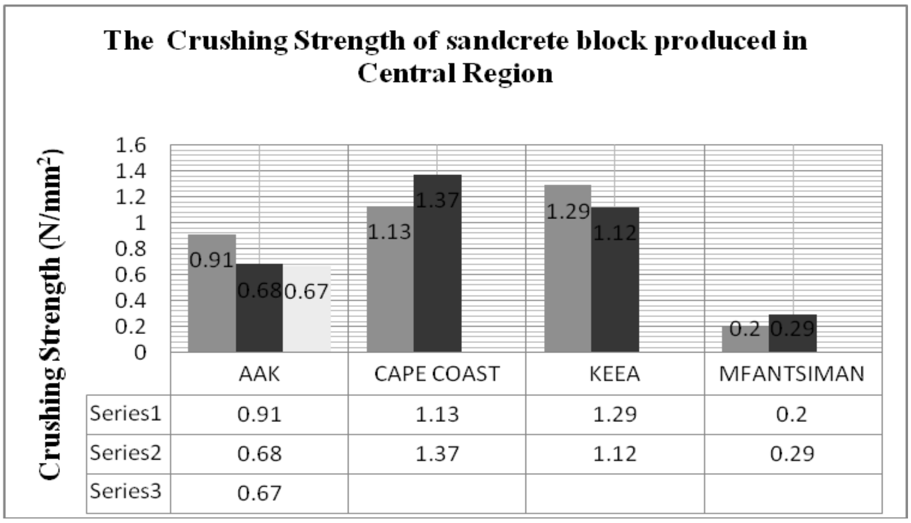
District	Factory	Weight in air (kg)	Weight in water (g)	Peak load (kg)	Strength of block n/mm^2
AAK	A1 (150*215mm)	25.12	14.19	29.20	0.91
	A2 (150*215mm)	24.76	13.95	21.90	0.68
	A3 (100*215mm)	21.63	13.25	14.30	0.67
CAPE COAST	C1 (150*215mm)	28.38	16.12	36.3	1.13
	C2 (150*215mm)	26.80	15.02	44.10	1.37
KEEA	K1 (150*215mm)	25.06	12.52	27.8	1.29
	K2 (100*215mm)	24.94	11.99	24.08	1.12
MFANTSIMAN	M1 (150*215mm)	26.51	15.06	6.45	0.20
	M2 (150*215mm)	26.75	14.77	9.35	0.29

The Strength Sandcrete Block Produced In Central Region is given below
CALCULATION OF CRUSHING STRENGTH OF SANDCRETE BLOCK

For Cape Coast, block factory
Peak load/ Area of the sandcrete block that went through the test
36300/ (150*215) = 1.13N/mm2

COMPARING THE RESEARCH FINDINGS TO THE STANDARD CRUSHING STRENGTH OF SANDCRETE BLOCK

Fig 1: The Crushing Strength of sandcrete block produced in Central Region, Ghana



At Abura Asebu Kwamankess District (AAK) the block factory recorded 0.91N/mm^2 instead of 2.8N/mm^2; Cape Coast metropolis two blocks were tested from the same factory and recorded different strength 1.13N/mm^2 and 1.37N/mm^2 respectively representing less than 50% of the standard crushing strength; at Komenda Edina Eguafo Abrem (KEEA) 1.29N/mm^2 and 1.12N/mm^2 were recorded and the standard crushing strength of 2.8N/mm^2 was not achieved; Mfantsiman municipality recorded the least crushing strength of sandcrete block 0.20N/mm^2 and 0.29N/mm^2 respectively representing 7% . Some of the supervisors of the sandcrete block factories that the research was conducted indicated that they lack equipment to determine the strength of the blocks produced, they measure the strength based on visual test or how long the block can absorb the water determines the strength. While others noted that if they are to achieve the standard then the selling cost of blocks would be very expensive making it difficult for their clients to patronise their goods.

PLATE 1 A block factory at Mfantsiman

PLATE 2 A-sandcrete block just produced.

PLATE 3 Submerge the block in water to measure weight in water.

PLATE 4 Crushing test of one the sandcrete blocks.

ESTABLISHING THE FREQUENCY OF BLOCKS INSPECTION AND TEST BY THE GHANA STANDARD BOARD

The research revealed that the Engineering Department of Standard Board in Ghana is responsible for the inspection of the quality of sandcrete blocks. Meanwhile the last time block factories were inspected in the region was 2008, the inspection was suppose to be every year. While at some factories, they said officials of Standard Board have not carried out any inspection for the past five years. Some of the block producers revealed that if they are to achieve the strength of 2.8N/mm^2 then the selling price of one block would be very expensive and the clients would not patronise their products. A block producer said they mould the block with strength that is 2.8N/mm^2 for inspection by the Ghana Standard board but do not produce that same strength for the public.

CONCLUSION

The research finding revealed that sandcrete blocks producers in the Central Region, Ghana achieved on the average 30.40% of the standard crushing strength of sandcrete blocks. No factory where the research was conducted was able to scientifically state their strength of sandcrete blocks due to lack of crushing test equipment. On the basis of the noted poor quality control, recommendations appropriate for improving the strength and effectiveness of sandcrete blocks production in Central Region are made. The Engineering Department of Standard Board in Ghana for the past two years has not inspected the quality of sandcrete blocks in the Central Region of Ghana.

ACKNOWLEDGEMENTS

The author is grateful to Mr. Eric Ewere and Freebody Mensah of the Civil Laboratory and to the staff of Building Technology laboratory.

The author is also grateful to Mr. Stephen Agyefi Mensah, Benjamin Ankomah and workers of the block factories where the research were conducted in Central Region.

REFERENCES

Abdullahi, M. 2005. "Compressive Strength of Sandcrete Blocks". AU J.T. 9(2): 126-132

Andam, K.A. (2002a) Compressive Strength of Commercial Sandcrete Blocks. Proceedings of the 4th International Conference on Structural Engineering Analysis and Modelling (SEAM 4); University of Science and Technology, Kumasi, Ghana, Vol. 1, p. 282.

Andam, K.A. (2002b) Enhancing the Compressive Strength of Concrete Blocks with Single and Mixed Coarse Aggregates. Proceedings of the 5th International Conference on Structural Engineering Analysis and Modelling (SEAM 5); University of Science and Technology, Kumasi, Ghana, Vol. 1, pp. 75–78.

Baiden, B.K.; and Tuuli, M.M. 2004. "Impact of quality control practices in sandcrete block production". Journal of Architectural Engineering, 10, 53 (2004); doi:10.1061/(ASCE)1076-0431(2004)10:2(53) (8 pages).

Barry, R. 1969. The Construction of Building. Vol.1. pp 54-55 & 94. Crosby Lockwood, London, England.

British Standard Institution. (1978) Structural Use of Masonry. Part 1. Unreinforced Masonry. London: BSI. BS 5628.

BS 8110 British Standard Institution. (1997) Structural Use of Concrete. London: BSI.

BS 1377-2 British Standard Institution. (1990) Methods of Test for Soils for Civil Engineering Purposes. Classification Tests. London: BSI.

BS 5628 British Standard Institution. (1978) Specification for Precast Concrete. London: BSI.

Chudley, R. And Greeno,R. 1997, Building Construction Handbook: (5^{th} edition) Butterworth-Heinemann Publisher London.

Hodge, J.C. 1971. Brick work. 3rd ed. Edward Arnold, London, England.

Obande, M.O. 1989, *Block laying and Concreting:* (2^{nd} edition) Longman Publisher Singapore Publishers Ltd.

Wenapere ,A.D. and Ephraim M.E. Journal of Building Appraisal (2009) **4,** 301–309. doi:10.1057/jba.2009.8.

EVALUATING THE BENEFITS OF BOT INFRASTRUCTURE PROJECTS IN NIGERIA

Alhassan Dahiru[1] and S. A. Bustani[2]
Department of Building, Ahmadu Bello University, Zaria, Nigeria

Build Operate Transfer (BOT) in project management is particularly relevant in most of the developing countries of the African region including Nigeria. Most African countries required extensive infrastructure to meet the economic development challenges. Therefore, BOT stands as a tool for bridging the critical infrastructure gap without utilizing the public sector funds. However, BOT is a relatively new experience in most developing countries of the African region and Nigeria in particular where the experience of the public sector has not always been positive. Many studies shown that majority of BOT projects offered in Nigeria were failed at the procurement stage due to the high costs of procurement process among others. Although the federal government had taken various steps by establishing a PPP Unit called Infrastructure Concession Regulatory Commission (ICRC) towards realizing the possible benefits attributable to the BOT projects in the country. This paper is aim at investigating the factors influencing the high costs of BOT procurement process and the possible benefits of BOT projects based on the respondents' agreement. The survey findings will serve as a way of encouraging both the public and the private sector participation in the development of BOT projects for sustainable infrastructure development in the country. Using questionnaire survey, the opinions of respondents such as clients, consultants, developers, lenders, and users group were assessed. Reliability index was employed to measure the attribute of each factor. One-way analyses of variance (ANOVA) were also performed to test whether the mean values on each benefit were equal for all groups of respondents. The survey has empirically identified and ranked ten factors influencing the high costs of BOT procurement process. Twenty benefits of BOT projects were identified based on the respondents' agreement. Therefore the overall benefits will give the public sector leverage in facilitating infrastructure development within the shortest possible time scale.

Keyword: BOT, procurement, infrastructure, Nigeria.

INTRODUCTION

Build-Operate-Transfer (BOT) has emerged as one of the major Public-Private-Partnership (PPP) approaches for delivering public infrastructure projects that attract high capital outlay. The concept is particularly relevant in most of the developing countries of the African region and Nigeria in particular where the government requires adequate finances to bridge the critical infrastructure gap and improve investment. If properly formulated and managed, BOT projects can provide a number of benefits to both the public and the private sector. However, the experience of the public sector with BOT projects has not always been positive. Many BOT offered projects were failed at the procurement stage due to the high costs of procurement process (Wigwe, 2008). Majority of BOT projects offered from 2003 – 2009 were

[1] Alhassan.dahiru@yashoo.com
[2] Sabustani2@yashoo.co.uk

Dahiru, A. and Bustani, S.A. (2011) Evaluating the benefits of BOT infrastructure projects in Nigeria *In:* Laryea, S., Leiringer, R. and Hughes, W. (Eds) *Procs West Africa Built Environment Research (WABER) Conference*, 19-21 July 2011, Accra, Ghana, 435-441.

failed at the procurement stage due to lack of adequate knowledge and technical skills from the public sector experience in BOT contract transaction (Ibrahim, 2007; Dahiru and Bustani, 2010).

Despite numerous negative experiences by the public sector, the federal government of Nigeria has continued to view BOT as one of the key strategies for delivering public infrastructure projects. Therefore, understanding and enhancing the benefits of BOT projects continue to be a matter of significance and importance. Many researchers have conducted studies on appropriate selection of concessionaires and critical success factors for BOT projects. This paper intends to determine the factors influencing the high costs of BOT procurement process and the benefits of BOT projects for the purpose of future BOT infrastructure development in the country.

THE BENEFITS OF BOT IMPLEMENTATION IN INFRASTRUCTURE DEVELOPMENT

UNIDO (1996) has defined BOT approach as an integrative procurement model designed to provide unique opportunity for financing public infrastructure facilities and boost the economic growth of the country without utilization of government finances. Nkado (2010) urged that BOT offers significant attractive opportunities to foreign investors, which in turn can generate substantial foreign exchange for economic growth and sustainable development. This innovative procurement approach promotes technology transfer as well as a variety of other benefits such as effective utilization of resources (World Bank, 2007; Levy, 1996). The worldwide experience has shown that if BOT projects are properly formulated and managed, can provide a variety of benefits to the government. Such benefits include: alleviating the financial burden on the public sector due to rising infrastructure development costs; allowing risks to be transferred from the public to the private sector; and increasing the value for money spent for infrastructure services by providing more efficient, lower cost, and reliable services (Kwak etal, 2009; Tiong, 1990; Nkado, 2010; and Adetola, 2010).

However, despite the broad benefits attributable to BOT projects, Wigwe (2008) concludes that BOT is relatively new concept that are not well understood in many African countries and Nigeria in particular. In addition, Ezeh (2008) opined that both the public and the private sectors still lack appropriate knowledge and skills to implement such long-term project financing. Furthermore, competition in BOT projects is limited due to the high costs of procurement process and projects are highly likely to be delayed by political debates, public opposition, and complex negotiation processes (Ibrahim, 2007; Nwankwo, 2008; and Weng etal, 2005). Similarly, BOT projects may cost more since the private sector cannot barrow capital to finance projects as cheaply as the public sector. This can result in to a monopoly situation and higher costs to the public users for using the infrastructure services (Yari, 2010; Henley, 2004; and Gupta, 2008).

RESEARCH METHOD

This section presents the procedures which were followed in achieving the aim of the study. Data used in the study were initially sourced from the pilot survey and a structured questionnaire was designed based on the data obtained from the survey and administered to major BOT stakeholders in the six geopolitical zones in the federation including FCT Abuja. Six states and the FCT were identified in the study as having projects that were contractually signed under the BOT approach. Therefore, the selected states include: Lagos, representing South-West; Enugu, representing South-East; Port-Harcourt, representing South-South; Kano, representing North-West; Bauchi, representing North-East; Plateau, representing North-Central and Abuja, the Federal Capital Territory.

The Pilot Survey

Pilot survey was initially conducted on the forty eight BOT projects offered across the country with the aim to secure the relevant data suitable for the analyses. These projects were initiated and planned to be completed within the range of the period 2003 – 2009 with different concession periods ranging from 15 to 35 years. Furthermore, oral interviews were conducted with the projects' participants such as concessionaires, investors and lenders who were directly involved in to the projects. Factors influencing the high costs of BOT procurement process and the top 20 benefits of BOT projects were obtained from an oral interview with view to ascertain the significance and importance of BOT projects to the national development.

The Structured Questionnaire

A structured questionnaire was designed to consist of all the identified factors and the top 20 benefits obtained from the pilot survey which were sent out asking the respondents to rate them based on their importance on a 1 – 5 scale. The purpose was to seek the respondents' agreement on the importance of the factors. The respondents were categorized in to clients, the consultants, the developers, the lenders, and the end users.

Survey Responses and Characteristics of Respondents

The distribution and details of responses from the administered questionnaire shown that in all the survey, 220 questionnaires were returned out of the 260 distributed, of which 47 were for clients, 42 consultants, 41 developers, 44 lenders, and 46 end users. This represents 85% effective response rate. The clients include federal and state government ministries, departments or agencies responsible for the provision of public infrastructures. Consultants include professional within the construction industry. Developers are simply referred to as the project promoters or concessionaires. Lenders include financial institutions such as commercial banks and insurance corporations. End users on the other hand include community group who were also categorized as users group.

Techniques for Data Analyses

The responses that were received from the survey participants were tabulated and analyzed individually. Reliability index was employed to measure the factors influencing the high costs of BOT procurement process while on the other hand, One-way Analysis of Variance (ANOVA) was used to test whether all groups of respondents have the same mean. F significant indicates whether the mean values between groups of respondents are the same. Lower probability value indicates that there is difference of agreement between the respondents, suggesting that there is difference of opinion between groups. A probability value (significance level = P) below 0.05 suggests a high degree of difference of opinion between groups of respondents on a specific factor.

RESEARCH RESULTS AND ANALYSES

The factors influencing the high costs of BOT procurement process were identified and ranked as shown in Table 1. The factors were initially obtained from the survey interview on 48 BOT projects and later included in to the questionnaire survey to seek the respondents' agreement on the factors. Result of the analysis shows that the relative inexperience of public officials in handling BOT projects was ranked the 1st most reliable attribute with computed RI value of 2.29. The complex contractual and financial structure of BOT projects was ranked 2nd most reliable attribute with computed RI value of 2.24. It is also shown that the lack of appropriate legislation to allow private sector participation in public infrastructure projects was identified and ranked the 3rd most reliable attribute with computed RI value of 2.22. Similarly, the lack of standardized project agreements and standardized bidding documents was ranked the 4th most reliable attribute with computed RI value of 2.19. Furthermore, the lack of clear criteria for evaluating BOT bids was ranked the 5th most reliable attribute with computed RI value of 2.14. It is also observed that the lack of independently commissioned feasibility studies to confirm that the project is viable and help the government solicit realistic project proposal was also identified and ranked the 5th most reliable attribute with the same computed RI value of 2.14.

Table 1 Weighted average (RI) on factors influencing high costs of BOT procurement process

Influential factors	Clients RI	Consult. RI	Develop. RI	Lend. RI	End. RI	Reliability Index of the weighted average of all responses (ARI)	Ranks Ordered R
1 The complex contractual and financial structure of BOT projects	2.23	2.21	2.24	2.16	2.35	2.24	2
2 The relative inexperience of the parties and of government officials in the development of BOT projects	2.28	2.38	2.27	2.25	2.28	2.29	1
3 The lack of a clearly defined project framework	1.85	2.00	2.22	2.27	2.04	2.08	7
4 The lack of appropriate legislation to allow private sector participation in public infrastructure projects	2.30	2.17	2.24	2.23	2.17	2.22	3
5 The lack of clear criteria for evaluating BOT bids	2.02	2.24	2.17	2.23	2.04	2.14	5
6 The lack of independently commissioned feasibility studies to confirm that the project is viable and help the government solicit realistic project proposals	2.09	2.12	2.27	2.11	2.13	2.14	5
7 The lack of standardized project agreements and standardized bidding documents	2.02	2.17	2.22	2.18	2.35	2.19	4
8 The lack of established methods of pre-qualifying bidders in order to limit the number of bidders and thus reduce the high bidding risk	2.02	2.10	2.10	2.05	2.11	2.08	7
9 The lack of a clearly established procurement procedure and schedule	1.98	2.33	2.10	2.11	2.00	2.10	6
10 Prolong & uncertain negotiations with preferred bidders before final acceptance of a tender	1.98	1.91	2.27	2.02	2.04	2.04	8

Meanwhile, the lack of a clearly established procurement procedure and schedule was ranked the 6th most reliable attribute with computed RI value of 2.10. The result has also discovered that the lack of a clearly defined project framework coupled with the lack of established method of pre-qualifying bidders in order to limit the number of bidders and thus reduce the high bidding risk became the 7th most reliable attribute with computed RI value of 2.08. Finally, the prolong and uncertain negotiations with preferred bidder(s) before final acceptance or closing of a tender was identified and ranked the 8th most reliable attribute with computed RI value of 2.04.

The above analysis has clearly shown that respondents were in full support of the constraint factors as found responsible to the high costs of BOT procurement process in Nigeria. The factors were ranked accordingly based on the level of attribute to each factor. Therefore, the findings will assist in minimizing the costs of procurement process which will significantly improve the implementation of BOT projects especially at the procurement stage of development.

Table 2 Profile of responses on the benefits attributable to BOT projects in Nigeria

Benefits of BOT projects	Clients	Consultants	Developers	Lenders	Users group	ANOVA F Stat. level	ANOVA Sign.
Better value for money	4.61	4.38	4.74	4.71	4.72	3.30	0.13
Reduced cost	4.47	3.92	4.67	4.70	4.71	3.03	0.12
Effective utilization of resources	4.45	4.19	4.58	4.57	4.52	3.49	0.14
Sharing of resources	4.17	3.89	4.41	4.14	3.88	2.58	0.10
Risks sharing	4.05	3.87	4.18	3.39	4.17	2.93	0.11
Increased user satisfaction	4.01	4.00	4.15	3.39	3.74	2.98	0.11
Improved time-scale	3.98	3.94	3.87	4.12	3.67	2.45	0.10
Improved return on resources	3.94	3.88	4.02	4.04	3.78	2.51	0.10
Effective service delivery	3.86	3.82	3.98	3.89	3.79	3.31	0.13
Reduced risk exposure	3.85	3.62	3.96	3.94	3.76	2.38	0.09
Improved administration	3.83	3.64	3.97	3.91	3.86	1.83	0.07
Transfer of technology	3.78	3.58	3.84	3.95	3.63	2.74	0.10
Offered investment opportunities	3.75	3.64	3.93	3.64	3.62	2.93	0.11
Enhanced mutual reward	3.69	3.38	3.97	3.67	3.64	2.03	0.07
Reduced public capital investment	3.68	3.61	3.74	3.71	3.32	3.14	0.12
Generate economic growth	3.66	3.65	3.64	3.76	3.30	3.11	0.12
Environmental protection	3.63	3.74	3.84	3.72	3.57	1.91	0.07
Reduced poverty level	3.62	3.94	3.64	3.78	3.56	2.61	0.10
Reduced corruption	3.71	3.74	3.76	3.82	3.62	2.53	0.10
Accountability and transparency	3.79	3.81	3.83	3.78	3.68	2.46	0.10

The second phase of the study had identified the top 20 benefits of BOT projects obtained from the survey interview. Table 2 presents the results of the analyses and the survey was sent out asking the respondents to rate the benefits on a 1 - 5 scale with view to find out whether they were indeed benefits. Therefore, the results are interpreted as follows: Better value for money with F- value of 3.30 and P – value of 0.13 stands as strong indication that all groups of respondents have positively agreed on the importance of the factor as a benefit attributable to BOT projects. Reduced cost has F – value of 3.03 and P – value of 0.12 while, effective utilization of resources is highly significance as all groups of respondents have rated the factor very high with F- value of 3.49 and P – value of 0.14. Sharing of resources (F- value of 2.58 and P – value of 0.10), risk sharing (F – value of 2.93 and P- value of 0.11), increase user satisfaction (F – value 2.98 and P value of 0.11), improved time scale (F – value of 2.45 and P – value of 0.10), improved return on resources (F – value of 2.51 and P – value of 0.10), effective service delivery (F- value of 3.31 and P – value of 0.13), reduce risk exposure (F value of 2.38 and P value of 0.09), improved administration

(F – value of 1.83 and P – value of 0.07), transfer of technology (F - value of 2.74 and P - value of 0.10), offers significant attractive opportunities (F - value of 2.93 and P - value of 0.11), enhanced mutual reward (F - value of 2.03 and P - value of 0.07), reduced public capital investment (F - value of 3.14 with corresponding P - value of 0.12), generate economic growth (F - value of 3.11 and P - value of 0.12), environmental Protection (F - value of 1.92 and P - value of 0.07), reduced poverty level (F - value of 2.61 and P - value of 0.10), reduced corruption (F - value of2.53 and P -value of 0.10), accountability and transparency (F - value of 2.46 and P - value of 0.10) as important benefits attributable to BOT projects in Nigeria.

The above survey findings revealed that respondents were in full agreement of the factors found to be the main benefits of BOT projects in Nigeria. This means to say that if BOT projects are properly formulated and well managed accordingly, the country will significantly benefits from infrastructure development to the attainment of the national economic growth in the short run.

DISCUSSION OF MAIN FINDINGS

The study has empirically evaluated the positive correlation between the respondents' agreement on the constraint factors influencing the high costs of BOT procurement process and the benefits of BOT projects. This has clearly shown what actors involved in BOT projects in Nigeria believe to be the main benefits of BOT. The survey indicates that If BOT projects are properly formulated and managed, the system will provide efficient and effective routes to utilize private sector funds, technology innovation, management skills and operational efficiencies in public infrastructure development. This will in turn provides efficient and effective infrastructure facilities that will alleviate the financial burden on the public sector due to rising infrastructure development costs; allowing risks to be transferred from the public to the private sector; and increasing the value for money spent for infrastructure services by providing more efficient, lower cost, and reliable services. Therefore, the system has the potentials of providing availability of public needed infrastructure in Nigeria which will substantially improve economic growth and development expansion in the near future.

CONCLUSION

The study had conducted a pilot survey on 48 BOT projects and identified the factors influencing the high costs of BOT procurement process and the top 20 benefits of BOT. A questionnaire survey was then sent out asking the respondents to rate the factors and the benefits on a 1–5 scale and found that they were indeed benefits. Therefore based on these findings, a conclusion has been drawn that if BOT projects are properly set up and managed they have the potential to contribute to economic and societal growth in Nigeria.

REFERENCES

Adetola, F.O. (2010). An over view of Public-Private-Partnership and concession in the delivery of public services and infrastructures. A paper presented at the NIQS Abuja chapter on infrastructure concession held at merit house, Abuja.

Dahiru, A. & Bustani S.A. (2010). Appraisal of factors influencing the implementation of BOT infrastructure projects in Nigeria. Proceedings of the West Africa Built Environment Research (WABER) Conference, Accra, Ghana. pp - 189.

Ezeh, E M. (2008). Procurement strategy/value for money for Public-Private-Partnership projects. A paper presented by the Bureau of public procurement during the Nigeria Infrastructure Summit, Abuja.

Gidado, Kassim (2010). A model for PFI implementation in the Sub-Saharan Africa-Nigeria as a case study. A paper presented at the third international world of construction project management conference held in Coventry University, UK

Gupta, S. (2008). Risk sharing under Publi-Private-Partnership. Speech delivered by the senior advisor, Fiscal Affairs Department, IMF during the Nigeria Infrastructure Summit, Transcorp Hilton Hotel, Abuja.

Ibrahim A.D. (2007). Contractual and tendering arrangements for Build-Operate-Transfer (BOT) projects. Journal of the Nigerian Institute of Quantity Surveying, Vol. 55, No. 2, pp 17-21.

Kwak,Y. H.; Ying, Y.C. and William, C.I. (2009). Towards a ComprehensiveUnderstanding of Public-Private-Partnerships for Infrastructure Development, California Management Review, vol. 15, No. 2

NEPAD (2001). A New Global Partnership; Implementation for the New Partnership for Africa's Development. Infrastructure and regional integration. A paper presented at International Conference by African Leaders, Abuja, Nigeria

Nigeria's Economic Reforms (2007). Nigeria's Economic Reforms: Progress and Challenges Global Economy and Development Program, The Brookings Institution, Washington DC.

Nkado, R. (2010). Public-Private-Partnership Approach to infrastructure development in Nigeria: Nature and features of railway construction. A paper presented at the international workshop organized by the NIQS on PPP approach to infrastructure development held in Abuja.

Nwankwo, A. (2008). PPP prospects in key infrastructure: roads and rails. A paper presented by the senior vice president, Parsons Brincherhoff PB at the Nigeria Infrastructure Summit, Abuja.

Tiong, R.L.K., (1990). Comparative study of BOT projects. Journal of management in Engineering, USA, vol.6, No.1, pp 107-122.

UNIDO (1996).UNIDO BOT Guidelines: Guidelines for infrastructure development through Build-Operate-Transfer (BOT) projects. UNIDO publication, Vienna, Austria, ID/SER.O/22.

Weng, T.C. et al (2005). "Interface management for China's BOT projects". Journal of Construction Engineering and Management, pp 645-655, ASCE.

Wigwe, J. S. (2008). Concessions in Nigeria: The reality. A book published in Nigeria by Victor Company Limited.

World Bank Group (2007). Private Participation in infrastructure Projects Database, Mailstop, Washington, D.C. 20433.

EXPLORING WASTE MINIMIZATION MEASURES IN THE GHANAIAN CONSTRUCTION INDUSTRY

J. Ayarkwa[1], K. Agyekum[2] and E. Adinyira[3]

College of Architecture and Planning, Kwame Nkrumah University of Science and Technology Kumasi, Ghana

The chronic problems of construction include low productivity, low quality, poor co-ordination and high costs. High product cost is also associated with poor quality, inefficiency and high waste generation. Various studies in the construction industry have developed best practices that are not only capable of improving organization's profit but also assist in producing systematic work processes which encourage the optimal use of resources. A structured questionnaire survey was conducted to provide empirical evidence on levels of significant contribution of waste minimization measures to waste reduction, and levels of practice of same measures using weighted average and coefficient of variation criteria. Purchasing raw materials that are just sufficient, using materials before expiry dates, and using more efficient construction equipment are perceived by construction professionals as three of twenty-six measures which most significantly contribute to waste minimization, and also the three most practiced waste minimization measures in Ghana. Encouraging re-use of waste materials, use of low waste technology and recycling of waste materials on site are, however, considered as the three least significant measures contributing to waste minimization and also least practiced. Among various suggested recommendations, the construction industry is encouraged to sort and re-use waste materials, and adopt environmentally friendly and low waste technologies on site. This paper presents measures which significantly contribute to materials waste minimization on construction sites in Ghana.

Keywords: Ghana, waste, waste minimization.

INTRODUCTION

The construction industry plays a vital role in meeting the needs of society and enhancing quality of life (Shen and Tam, 2002; Tse, 2001). However, the responsibility of ensuring that construction activities and products are consistent with environmental policies needs to be defined, and good environmental practices improved (Environmental Protection Department, 2002; Shen et al., 2002). Environmental protection has recently become an important issue all over the world. Compared with other industries, construction generates fairly large amount of pollutants, including solid waste, noise, dust and water (Ball, 2002; Morledge and Jackson, 2001). Since construction has a major and direct influence on many other industries by means of both purchasing the inputs from other industries and providing products to almost all other industries, eliminating or reducing waste could yield great cost savings to society (Polat and Ballard, 2004). The construction industry has been

[1] jayarkwa.feds@knust.edu.gh
[2] agyekum.kofi@yahoo.com
[3] eadinyira.feds@knust.edu.gh

Ayarkwa, J., Agyekum, K. and Adinyira, E. (2011) Exploring waste minimization measures in the Ghanaian construction industry *In:* Laryea, S., Leiringer, R. and Hughes, W. (Eds) *Procs West Africa Built Environment Research (WABER) Conference,* 19-21 July 2011, Accra, Ghana, 443-452.

encouraged to re-use built assets, minimize waste, recycle materials, minimize energy in construction and use of buildings, use environmental management systems to reduce pollution, enhance bio-diversity, conserve water, respect people and their local environment, measure performance and set targets for the environment and sustainability (Ofori et al., 2000). It is, however, regrettable that although stakeholders are now questioning the traditional routes of waste disposal in favour of sustainable waste management strategies, the majority of construction companies have placed waste reduction at the bottom of their agenda because of complexities over re-use and recycling.

CONSTRUCTION WASTE

Construction waste has caused serious environmental problems in many large cities (Begum et al., 2006; Chen et al., 2002; Teo and Loosemore, 2001). Polat and Ballard (2004) defined waste simply as “that which can be eliminated without reducing customer value”. Waste in construction is also defined as “the difference between the value of those materials delivered and accepted on site and those used properly as specified and accurately measured in the work, after deducting cost saving of substituted materials and those transferred elsewhere” (Polat and Ballard, 2004; Pheng and Tan, 1998).

According to Formoso et al. (1999), waste can be classified as unavoidable waste (or natural waste), in which the investment necessary for its reduction is higher than the economic benefit, and avoidable waste in which the cost of waste is higher than the cost to prevent it. The percentage of unavoidable waste depends on the technological development level of the company (Polat and Ballard, 2004; Formoso et al., 1999; Womack and Jones, 1996). Waste can be categorized according to its source- the stage in which the root causes of waste occurs. Bossink and Brouwers (1996) identified the main sources of waste in construction as design, procurement, material handling, operation and residual. Sources of waste are also identified from the processing preceding construction such as materials manufacturing, design, material supply, and planning, as well as from the construction stage (Formoso et al., 1999). According to Ofori and Ekanayake (2000), construction waste can be divided into three major categories: material, labour and machinery waste. The current study, however, focuses on material wastage since most of the raw materials from which construction inputs are derived come from non-renewable resources and once wasted, becomes very difficult to replace them (Ofori and Ekanayake, 2000). Garas et al. (2001) categorized material wastes by activity, to include over-ordering, overproduction, wrong handling, wrong storage, manufacturing defects and theft or vandalism.

The Environmental Protection Agency of USA (2000) defines waste minimization as “any method that reduces the volume or toxicity of a waste that requires disposal”. Poon et al. (2004) also define waste minimization as “any technique, process or activity which avoids, eliminates or reduces waste at its source or allows re-use or recycling of the waste. In the opinion of Begum et al. (2006), waste minimization includes source reduction and recycling. The same authors defined source reduction as any activity that reduces or eliminates the generation of waste at source, usually within a process, and recycling as the recovery and/or re-use of what would otherwise be a waste material. Different measures for minimizing materials waste have been discussed (Begum et al., 2006; Faniran and Caban, 1998). Coffey (1999) pointed out that solid construction waste management is generally seen as a low priority when financial constraints are present and suggested that considerable waste reduction can be achieved if waste management is implemented as part of project management functions. Polat and Ballard (2004) emphasized that reduction is the best and most efficient method for minimizing the generation of waste and eliminating many of the waste disposal problems.

Ayarkwa and Adinyira (n.d.) reports of a wide variation in wastage rates of between 5% and 27% of total materials purchased for construction projects in Ghana. As construction is a locomotive sector of the national economy, waste in the construction industry affects the overall national economy. It is important therefore to explore measures contributing to construction material waste minimization and assess the level of practice of such measures by the construction industry since cost reduction arising from minimization of materials waste is of direct benefit to all stakeholders.

This paper reports on a study conducted to assess the levels of contribution of some waste minimization measures to waste reduction, and the levels of practice of such measures in the Ghanaian construction industry.

RESEARCH METHOD

Twenty-six (26) waste minimization measures which have been extensively studied were extracted from the literature (Begum et al., 2006; Shen et al., 2002; Shen and Tam, 2002; Poon et al., 2001; Ho, 2001; Faniran and Caban, 1998; Peng and Scorpio, 1997; Sherman, 1996). These measures were pre-tested in a multiple pilot study using interviews and questionnaire involving ten selected experienced construction practitioners to evaluate their applicability to the current study. In the view of some interviewees, waste is an inevitable by-product of construction, and waste reduction activities will not be able to eliminate the generation of waste completely. Most of them demonstrated in depth understanding and knowledge of the 26 waste minimization measures extracted from the literature for the study. They agreed with the applicability of the selected measures to the current study and suggested modification and rewording of a few of the measures.

A structured questionnaire survey employing both closed and open-ended questions was conducted. The survey targeted site managers of construction organizations, and architects and quantity surveyors of registered firms in the Ashanti and Greater Accra regions of Ghana. The questionnaire was divided into three sections. The first part sought information about the respondents' profile, the second part assessed respondents' perception on how the measures identified from literature and pre-tested in the pilot study contribute to materials waste minimization, and the final part assessed the level of practice of the measures identified.

Building construction organizations operating within Ghana register with the Ministry of Water Resource, Works and Housing (MWRWH) in four categories: class D, K, E and G, based on the nature of work the organizations engage in - building, civil engineering, electrical and plumbing works respectively. There are four financial sub-classifications within these categories - Class 1, 2, 3 and 4 - which set the limitations for companies in respect of their asset, plant and labour holdings, and the nature and size of the projects they can undertake. Class 1 has the highest resource base, decreasing through classes 2 and 3, to class 4 having the least resource base (MWRWH, 2011). Site managers of D1 and D2 building construction organizations who are registered with the MWRWH as well as senior architects of architectural firms fully registered with the Architects Registration Council of Ghana (ARCG) and senior quantity surveyors of firms fully registered with the Ghana Institution of

Surveyors (GhIS) were involved in the study. D1/D2 firms were the focus of the study mainly because such firms have the capacity to employ most the waste minimization measures identified from the literature and confirmed through the interviews as applicable to the Ghanaian construction industry. According to the MWRWH (2011), there are 519 D1 and D2 building contractors in the Ashanti and Greater Accra Regions of Ghana. Records of the ARCG (2010) indicate that there are 114 fully registered architectural firms in the two regions, whilst the GhIS (2010) also had 60 fully registered quantity surveying firms.

A sample size of 226 site managers of D1 and D2 construction organizations was determined using the following formula recommended for such studies by Israel (1992):

n=

where n is the sample size, N is the population size and e is the desired level of precision (±5%). The questionnaire was administered through a face-to-face session which ensured that 188 out of the 226 site managers were completed, representing a response rate of 83%. Questionnaires were distributed to all the 174 architectural and quantity surveying firms fully registered with their respective professional bodies. Out of this, 123 were completed, resulting in a response rate of 71%.

The waste minimization measures identified from the literature and confirmed by pre-testing were considered to have different levels of contribution to waste minimization. The study therefore used the following weighted average model (Begum et al., 2006) to examine the relative levels of significant contribution of the waste minimization measures as perceived by the construction professionals:

Where ASS_i is the average significant score of the waste minimization measure *i*, X_j the waste minimization score assigned (on a Likert scale of 1 to 5). N_{ij} = the number of respondents who assigned the score X_j for the measure *i* and N is the total number of respondents. For each waste minimization measure, the respondents were asked to score the level of contribution to waste minimization on the Likert scale of 1 to 5 where 1= 'very low', 2= 'low', 3= 'Medium', 4= 'High' and 5= 'Very high'. The respondents were further asked to score each measures according to the level of practice in their organization on a scale of 1 to 5 where 1= 'Not practiced at all', 2= 'Not practiced', 3= 'Practiced', 4= 'Frequently practiced' and 5= 'Most frequently practiced'. The weighted average model (used to calculate ASS above) was used to calculate the average practiced score (APS) of the waste minimization measure *i*. To rank the levels of significant contribution of the minimization measures, the study employed the combined value of the weighted average and coefficient of variation. The coefficient of variation, measured as minimization index value (MIV), was calculated using the following model (Begum et al., 2006):

where MIV_i is the coefficient of variation of the waste minimization measure *i*, ASS_i is the average significant score of the waste minimization measure *i* and is the standard deviation of the average significance score for the measure *i*. The same model was used to calculate the practiced index value (PIV) for the ranking of the level of practice of the minimization measures. According to Begum et al. (2006), although the ASS and APS are weighted average measures and could be used to rank all the waste minimization measures, they do not consider the degree of variation between individual responses. Since a smaller variation between individual responses give better quality to the weighted average value, when two factors carry the same or very close weighted values, the factor carrying the smaller variation is given a higher ranking. Thus, the effective assessment of ranking attributes should consider both the weighted average and the coefficient of variation measured by the minimization and practice index values.

RESULTS AND DISCUSSION

Company profile

The average years of experience of the firms surveyed in the construction market are between 10 and 20 years. This implies that all the firms have significant experience in the building industry. With regards to the average number of permanent and temporary employees, none of the firms contacted was willing to disclose. The main reason given was that it is confidential. The respondents, however, indicated that they had enough employees and could recruit additional employees when necessary.

Architects constituted 58% and quantity surveyors constituted 42% of the consultant. For the contractors, project managers constituted 68% and site engineers constituted 32%. Forty percent of the contractor-respondents and 50% of the consultant-respondents had bachelors' degree, and 36% of the contractors and 34% of consultants had Higher National Diploma (HND) certificates. The study further showed that 15% of consultants and 8% of the contractors had Master's degree. Nine percent of the contractors and 1% of the consultants had doctorate degree. The results also showed that majority of the firms (58% of contractors and 60% of consultants) had both public and private sector clients. Seven percent of contractors and 15% of consultants had public sector clients and 35% of contractors and 25% of consultants had private sector clients.

Levels of contribution of the waste minimization measures

Table 1 shows a summary of average significant scores (ASS), minimization index values (MIVs) and rankings of the levels of significance contribution of the minimization measures on the basis of MIV. The waste minimization measure 24 (WMM 24) is ranked the first measure that most significantly contributes to waste minimization, indicating that 'purchasing raw materials that are just sufficient for a project' very highly contributes to waste minimization. WMM 1 is ranked the 26th, indicating that 'recycling of some waste materials on site' has the least significant contribution to waste minimization. The other measures evaluated have ASS ranging between 4.88 and 3.73. Thus, apart from 'recycling of some waste materials on site' (WMM 1), 'using of low waste technology' (WMM 12) and 'encouraging re-use of waste materials in projects' (WMM 16), all the other measures evaluated by the construction professionals have medium to high contribution to waste minimization in Ghana. The ranking profile (Fig. 1) shows empirical evidence of the levels of significant contribution of the various measures to waste minimization in the implementation of waste management.

Table 1: Summary of Average Significant Scores, Minimization Index Values and their Rankings

Waste minimization measures (WMM)	Average significant score (ASS)	Standard deviation (δ)	Minimization index value (MIV)	Rank of minimization index value (RMIV)
Purchasing raw materials that are just sufficient (WMM 24)	4.96	0.286	34.685	1
Using materials before expiry dates (WMM 25)	4.88	0.461	21.171	2
Use of more efficient construction equipment (WMM 5)	4.42	0.605	14.612	3
Good coordination between store and construction personnel to avoid over ordering (WMM 4)	4.46	0.689	12.946	4
Adoption of proper site management techniques (WMM 21)	4.37	0.727	12.022	5
Training of construction personnel (WMM3)	4.36	0.797	10.941	6
Accurate and good specifications of materials to avoid wrong ordering (WMM 26)	4.17	0.765	10.910	7
Proper storage of materials on site (WMM 7)	4.35	0.82	10.610	8
Checking materials supplied for right quantities and volumes (WMM 13	4.32	0.817	10.575	9
Employment of skilled workmen (WMM 14)	4.22	0.813	10.380	10
Minimizing design changes (WMM 23)	4.15	0.876	9.475	11
Change of attitude of workers towards the handling of materials (WMM 11)	4.12	0.893	9.227	12
Accurate measurement of materials during batching (WMM 15)	4.16	0.942	8.832	13
Mixing, transporting and placing concrete at the appropriate time (WMM 19)	4.21	0.978	8.609	14
Access to latest information about types of materials on the market (WMM 22)	4.07	0.948	8.586	15
Vigilance of supervisors (WMM 6)	4.13	0.982	8.411	16
Weekly programming of works (WMM 18)	4.10	0.896	8.384	17
Careful handling of tools and equipment on site (WMM 17)	4.07	1.032	7.888	18
Good construction management practices (WMM 2)	4.24	1.098	7.723	19
Adherence to standardized dimensions (WMM 10)	4.18	1.103	7.579	20
Waste management officer or personnel employed to handle waste issues (WMM20)	4.01	1.068	7.509	21
Just in time operations (WMM 8)	3.99	1.187	6.723	22
Early and prompt scheduling of deliveries (WMM 9)	4.01	1.203	6.667	23
Encourage re-use of waste materials in projects (16)	3.76	1.197	6.282	24
Use of low waste technology (WMM 12)	3.73	1.339	5.571	25
Recycling of some waste materials on site (WMM 1)	2.65	1.524	3.478	26

Empirical evidence of the levels of practice of the waste minimization measures

Table 2 gives a summary of average practiced scores (APS), practiced index values (PIVs) and rankings of the level of practice of the various measures on the basis of PIVs. WMM-25 is ranked the first measure highly practiced by the respondents to minimize waste indicating that 'using materials before expiry dates' is most frequently practiced to minimize waste in Ghana. WMM-1 is ranked the 26th, indicating that 'recycling of some waste materials on site' is the least practiced measure to minimize waste in Ghana. The other measures evaluated have APS ranging between 4.10 and 3.64. Thus, apart from 'recycling of some waste materials on site' (WMM 1), 'using of low waste technology'(WMM 12) and 'encouraging re-use of waste materials in projects' (WMM 16), all the other measures evaluated by the construction professionals are either practiced or frequently practiced to minimize waste in Ghana. The ranking profile (Fig. 2) shows empirical evidence of the levels of practice of the various measures to minimize waste in construction projects.

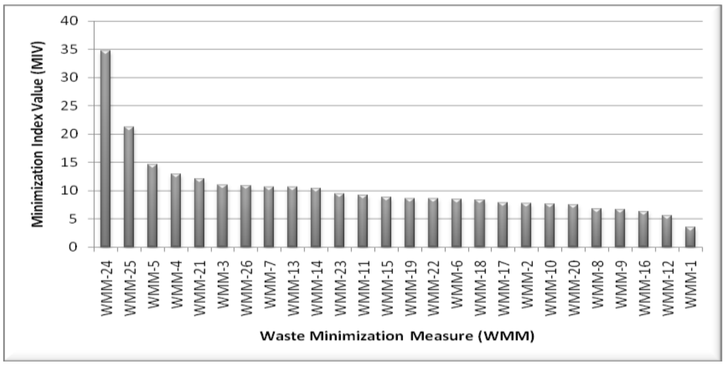


Fig. 1 Ranking profile of the levels of significant contribution of waste minimization measures

The empirical evidence presented in Tables 1 and 2 and Figures 1 and 2 shows that the ranking of the various waste minimization measures by the weighted average criteria (i.e. the ASS and the APS) give the same results as that by the coefficient of variation criteria (i.e. the MIV and the PIV). Thus, both criteria are effective for assessing the relative levels of significance contribution and relative levels of practice of the various measures in the implementing of construction waste management.

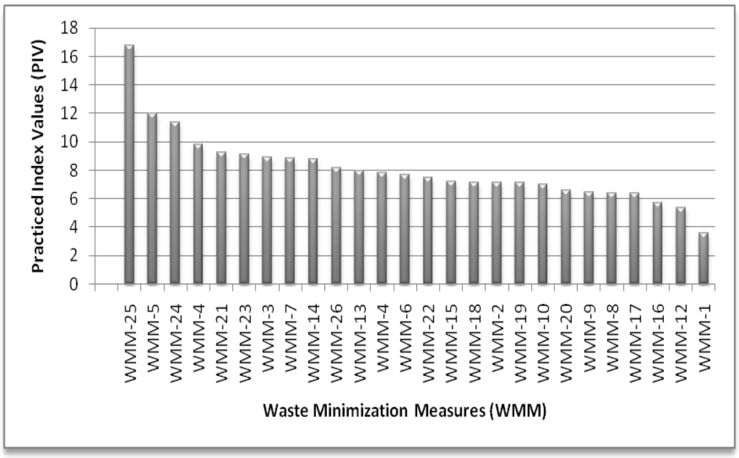


Fig. 2 Ranking profile of the levels of practice of waste minimization measures

The study has shown that the measures that are highly practiced by construction organizations (i.e. 'purchasing raw materials that are just sufficient' (WMM 25), 'using materials before expiry dates' (WMM 24) and 'use of more efficient construction equipment' (WMM 5), are those that directly result in cost savings to the organization, and the least practiced measures (i.e. 'encouraging re-use of waste materials in projects' (WMM 16), 'using of low waste technology' (WMM 12) and 'recycling of some waste materials on sites' (WMM 1) are those that require investment or further processing of materials to obtain value. Thus, the results show little awareness among construction professionals on the importance of waste minimization. This corroborates with the findings of Teo and Loosemore (2001) and Lingard et al. (2000) on waste minimization in Australia. In Australia, waste management was reported as a low project priority amongst construction workers. Waste sorting and recycling although widely publicized by government bodies in Australia, were still not used on most sites at the time. Applying environmentally friendly technology on site and using low waste technology are considered less attractive environmental management measure to construction organizations in Ghana, confirming findings of Begum et al. (2006) and Shen and Tam (2002). Such measures were seen as adding to their production cost hence defeating their perceived views of waste minimization as a cost saving technique.

Table 2 Level of practice of waste minimization measures among professionals

Waste minimization measures (WMM)	Average Practiced score (APS)	Standard deviation (δ)	Practiced index value (PIV)	Rank of Practiced index value (PIV)
Using materials before expiry dates (WMM 25)	4.83	0.575	16.800	1
Use of more efficient construction equipment (WMM 5)	4.18	0.693	12.063	2
Purchasing raw materials that are just sufficient (WMM 24)	4.68	0.821	11.400	3
Adoption of proper site management techniques (WMM 21)	3.92	0.848	9.245	4
Good coordination between store and construction personnel to avoid over ordering (WMM 4)	4.09	0.834	9.808	5
Minimizing design changes (WMM 23)	4.10	0.896	9.152	6
Training of construction personnel (WMM 3)	4.07	0.913	8.916	7
Proper storage of materials on site (WMM 7)	4.02	0.905	8.884	8
Employment of skilled workmen (WMM 14)	3.99	0.900	8.867	9
Accurate and good specifications of materials to avoid wrong ordering (WMM 26)	3.71	0.905	8.200	10
Checking materials supplied for right quantities and volumes (WMM 13)	3.95	0.989	7.988	11
Change of attitudes of workers towards the handling of materials (WMM 11)	3.83	0.978	7.832	12
Vigilance of supervisors (WMM 6)	3.95	1.030	7.670	13
Access to latest information about types of materials on the market (WMM 22)	3.83	1.025	7.473	14
Accurate measurement of materials during batching (WMM 15)	3.88	1.071	7.246	15
Weekly programming of works (WMM 18)	3.64	1.017	7.158	16
Good construction management practices (WMM 2)	3.96	1.113	7.116	17
Mixing, transporting and placing concrete at the appropriate time (WMM 19)	3.88	1.092	7.106	18
Adherence to standardized dimensions (WMM 10)	3.97	1.131	7.020	19
Waste management officer or personnel employed to handle waste issues (WMM 20)	3.73	1.134	6.578	20
Early and prompt scheduling of deliveries (WMM9)	3.76	1.169	6.433	21
Just in time operations (WMM 8)	3.67	*1.143*	6.422	22
Careful handling of tools and equipment on site (WMM 17)	3.69	1.154	6.395	23
Encourage re-use of waste materials in projects (WMM16)	3.42	1.203	5.686	24
Use of low waste technology (WMM 12)	3.53	1.312	5.381	25
Recycling of some waste materials on site (WMM 1)	2.55	1.422	3.586	26

CONCLUSION AND RECOMMENDATIONS

The study has provided empirical evidence on the levels of contribution and the levels of practice of waste minimization measures in the Ghanaian construction industry. It has shown that purchasing raw materials that are just sufficient, using materials before expiry dates and use of more efficient construction equipment are perceived as the three measures that most significantly contribute to waste minimization and also the most practiced waste minimization measures. Encouraging re-use of waste materials in projects, using low waste technology and recycling of some waste materials on sites are, however, perceived as the least significant factors that contribute to waste minimization and the least practiced measures simply because such measures are seen as adding to their production cost instead of reducing cost. These findings will assist in the formulation of appropriate policy interventions to address the construction waste management problem in the Ghanaian construction industry. The findings will also help firms to improve the quality of construction in Ghana.

In order to assist the construction industry to minimize materials wastage, the authors recommend that government should enact laws and establish policies that engender positive attitudes towards waste minimization at all levels in a construction project. Also the construction industry in Ghana should collaborate with relevant government agencies to develop appropriate guidelines for preparing waste management plans for the construction industry. The construction industry should also adopt low waste and environmentally friendly technologies on site, and government should provide incentives to the construction industry to encourage the reduction, recycling and re-use of construction waste. Construction organizations should also provide waste reduction training to site staff to raise their environmental awareness and improve working procedures to reduce waste generation in construction projects.

REFERENCES

Architects Registration Council of Ghana (2010) List of fully registered architectural firms in Ghana, available at http://www.archghana.org.

Ayarkwa, J. and Adinyira, E. (n.d.) Construction material waste in Ghana: Sources, causes and minimization. Submitted for publication in the Journal of Construction: South Africa ISSN 1994-7402.

Ball, J. (2002) “Can ISO 14000 and eco-labeling turn the construction industry green?” Building and Environment, 37:4, 421-428.

Begum, R.A., Siwar, C., Pereira, J.J. and Jaafar, A.H. (2006) “Implementation of waste management and minimization in the Malaysian construction industry”. Conservation and Recycling, 51, 190-202.

Bossink, B. A. G. and Brouwers, H. J. H. (1996) Construction waste: quantification and source evaluation. Journal of Construction Eng. and Management, 122:1, 55- 60

Chen, Z., Li, H. and Wong, T.C. (2002) “An application of bar-code system for reducing construction wastes”. Automation in Construction, 11, 521-533.

Coffey, M. (1999) “Cost-effective systems for solid waste management”. Waterlines, 17:3, 23

Environmental Protection Agency of USA (2000) Solid Waste and Emergency Response. EPA-530-F-00-001. United States.

Environmental Protection Department (2002) Hong Kong Environment 2002, Hong Kong Government.

Faniran, O. O. and Caban, G. (1998) “Minimizing waste on construction project sites” Engineering, Construction and Architectural Management, 5:2, 182–8.

Formoso, C. T., Isatto, E. L., and Hirota, E. H. (1999) Method for Waste Control in the Building Industry. Procs IGLC-7, University of California, Berkeley, CA, USA.

Garas, G.L., Anis, A.R. and El Gammal, A. (2001) Materials Waste in the Egyptian Construction Industry. Proceedings IGLC-9, Singapore.

Ghana Institution of Surveyors, GHIS (2010). List of fully registered quantity surveyors in Ghana. Available at http://www.ghisonline.org.

Ho, O.S.T. (2001) Construction waste management - a contractor’s perspective, The Hong Kong Institute of Builders. Hong Kong.

Israel, G.D. (1992) Sampling the Evidence of Extension Program Impact. Programme Evaluation and Organizational Development, IFAS, University of Florida. PEOD-5 management system operating in a large Australian contracting organisation: implications for company policy implementation”. Construction Management and Economics, 18:4, 383–93.

Morledge, R. and Jackson, F. (2001) “Reducing environmental pollution caused by construction plant”. Environmental Management and Health, 12:2, 191-206.

Ministry of Water Resource, Works and Housing, MWRWH (2011) List of registered building contractors in Ghana, available at http.//ghana-net.com/ Ministry of Water Resources_Works_and Housing_Ghana.aspx

Ofori, G. and Ekanayake, L.L. (2000) Construction material waste source evaluation. In: Proceedings of the Second Southern African Conference on Sustainable Development in the Built Environment, Pretoria, 35-1, 35–6.

Ofori, G., Briffet, C., Gang, G. and Ranasinghe, M. (2000) “Impact of ISO 14000 on construction companies in Singapore”. Construction Management and Economics, 18, 935-947.
Peng, C.L., and Scorpio, D.E. (1997) “Strategies for successful construction and demolition waste recycling operations”. Construction Management and Economics, 15, 49-58.
Pheng, L. S. and Tan, S. K. L. (1998) “How 'Just-in-Time' Wastages can be Quantified: Case Study of a Private Condominium Project”. Construction Management and Economics, 16, 621-635.
Polat, G. and Ballard, G. (2004) Waste in Turkish Construction- Need for Lean Construction Techniques. Proceedings of the 12th Annual Conference of the International Group for Lean Construction IGLC-12, August, Denmark. 488-501.
Poon, C. S., Yu, A. T. W. and Jaillon, L. (2004) “Reducing Building Waste at Construction Sites in Hong Kong”. Journal of Construction Management and Economics, 22, 461–470.
Poon, C.S., Yu, A.T.W. and Ng, L.H. (2001) “On-site sorting of construction and demolition waste in Hong Kong”. Resources, Construction and Recycling, 32:1, 157-172.
Shen, L. Y. and Tam, W. Y. V. (2002) “Implementation of environmental management in the Hong Kong construction industry”. International Journal of Project Management, 20:7, 535-543.
Shen, L. Y., Tam, W. Y. V., Chan, C. W. S. and Kong, S. Y. J. (2002) “An examination on the waste management practice in the local construction site”. Hong Kong Surveyor, 13:1, 39-48.
Sherman,R.L. (1996) Managing Construction and Demolition Debris: A Guide for Builders, Developers and Contractors. Published by: North Carolina Cooperative Extension Service. Publication Number: AG-473-19.
Teo, M.M.M. and Loosemore, M. (2001) “A theory of waste behavior in the construction Industry”. Journal of Construction Management and Economics, 19:7, 741–51.
Tse, Y. C. R. (2001) “The implementation of EMS in construction firms: case study in Hong Kong”. Journal of Environmental Assessment Policy and Management, 3:2, 177-194.
Womack, J. P. and Jones, D. T. (1996) Lean Thinking: Banish Waste and Create Wealth in Your Corporation. Simon and Schuster, New York, N.Y., USA.

FACTORS AFFECTING WOMEN ENROLMENT IN CONSTRUCTION EDUCATION IN NIGERIA

Joshua O. Dada[1]
Department of Quantity Surveying, Obafemi Awolowo University, Ile-Ife, Nigeria

The Millennium Development Goals (MDGs), as reflected in the agenda of many African countries, have advocated for the empowerment of women in all aspects of the economy for them to be economically self reliance and active participant in decision making. While construction industry was found to be a major player in the economy of any nation, in Nigeria and indeed a review around the world indicates that all parts of this industry are male dominated. This paper reports on a study carried out on assessing factors affecting women enrolment in construction education in Nigeria. Structure questionnaires were used to collect data from targeted students, within and outside construction related disciplines, of Obafemi Awolowo University, Ile-Ife, Nigeria. The result indicates that respondents placed importance on the fact that women were not at the fore front and their impact or participation not been felt in construction sector. The issue of gender discrimination was also revealed as one of the problems confronting the very few women in the sector. The paper also presents charts showing the trend of women enrolment in construction as compare to those of men over a ten year period. The charts show that women enrolment over the years is extremely low. The paper concludes on the need to make concerted effort in the enhancement of women enrolment and eventual participation in construction.

Keywords: construction education, enrolment, Nigeria, women.

INTRODUCTION

The issue of the role of women in the management of the world economy cannot be overemphasized. Globally, the construction industry contribute about 1/3 of gross capital formation and is an important vehicle for economic development through built environment assets such as houses, roads, utility networks, schools and clinics (Kenny, 2007). The construction industry has been male dominated for years, and on many jobsites women construction workers are not welcome. Inequalities along gender lines have been one of the main factors driving the establishment of women-focused and, more recently, gender focused programme. The earliest and most pronounced recognition of the gender disparities in development was the announcement by the international community of International Women's Year in 1975 and its later extension into a women's decade (Wamukonya, 2002). Clancy and Dutta, (2005) observed that gender mainstreaming has gained prominence since Platform for Action from the 4th International Conference on Women in 1995 called on governments to mainstream gender perspective in all policies and programme to ensure equalities of outcome for men and women.

All over the World, there is the issue of elimination of all forms of discrimination against women; discrimination against women violates the principles of equality of

[1] debbyjoe2002@yahoo.com

Dada, J.O. (2011) Factors affecting women enrolment in construction education in Nigeria *In:* Laryea, S., Leiringer, R. and Hughes, W. (Eds) *Procs West Africa Built Environment Research (WABER) Conference*, 19-21 July 2011, Accra, Ghana, 453-464.

rights and respect for human dignity. Particularly there is emphasis on women's right to non discrimination on education, employment and social activities, yet most women in Nigerian and indeed in African countries are subjected to discrimination based on gender and often suffer from neglect and abuse by men. Despite the fact that it is obvious that women are lagging behind in construction participation in Nigeria, the factors responsible for this have not been investigated and it was this lack of information that led to the research described in this paper. The paper also presents trend of women enrolment in construction as compare to those of men over a ten year period.

AN OVERVIEW OF SOCIO-ECONOMIC CHARLENGES CONFRONTING WOMEN

At the outset of the United Nation decade for women in 1975, it was noted that women constitute about 50 percent of the world's population. But unfortunately despite this population, they own only 1 percent of the world's wealth (Akande, 1996). In 1970, when Occupational Safety and Health Administration (OSHA) was enacted, women made up less than 1 percent of workers in the construction trades and in 1995 that percentage had only grown to 2.3 percent (US Department, 1996). Women play multiple roles as economic producer, as managers of households, as producer of services, as workers providing the household with all its necessities, as producers of children and in caring for their community. The Women Commission for Refugee and Women and Children (2006) pay particular attention to the problem women in refugee camps are facing. Millions of women and girls venture out from their camps into danger, risking rape, assault, abduction, theft, exploitation or even murder, in order to collect firewood to cook for their families. Moreover, there has been erroneous assumption for women in that men are involved in productive work outside the house while the women takes overall responsibility for reproductive and domestic work. Wickham (2001) remarked that even though women may be in the labour force, they are not achieving their full economic potential.

A REVIEW OF NIGERIAN WOMEN EDUCATION AND TRAINING IN CONSTRUCTION

The issue of education cannot be overemphasized in the development of any nation. It is generally accepted that it is through education that we can develop our human resources. Studies have shown that while in primary school, close to 60 percent of the enrolment is female; the proportion drops to about 32 percent in secondary schools and to about 12 percent in the universities. Williams (2006) established the fact that many females do not take their study seriously and many come out with very bad results. Likewise more boys are enrolled in school than girls due to cultural beliefs. From this premise she suggested that female students should take their academic work seriously as that is the only way through which they can disengage themselves from the shackles of cultural subjugation.

World figure for literacy, higher education in scientific and technical courses shows that women are lagging far behind men. Female enrolment ratios in higher education in developing countries are typically only half the male ratio. In Sub- Saharan Africa, women's enrolment rates for tertiary education are only a third of those of men. Even in industrialized countries women are poorly represented in scientific and technical study. As a result, there are few women Engineers, Architects, Builders, Planners, etc. (Ademororti, 1994). Research has shown that women suffer disadvantage in built environment that is planned chiefly by men and primarily for men and so changes need to be made. Mogbo (1999) belated the neglect of role of women in construction practices and education in Nigeria in the National construction Policy and Vision 2010.

RESEARCH APPROACH AND METHOD

The overall research project has been approached through the multiple methods of literature review and questionnaire survey. A case study approach, using a university, was adopted for the study. Edwin et al (2002) admitted that universities have a role to play in the training of competent professionals. Roesset and Yan (2000) also believed that universities with research capacities have a role to play that is “to assume a more active role in the formulation of rational continuing education programmes that will provide a solid opportunity for lifelong learning, rather than providing only a handful of short-course offering without any linking or continuity among them”. It was on this premise that the paper is focusing university as the training ground for construction professionals. The data for the study has been collected from two different groups of students from Obafemi Awolowo University, Ile-Ife Nigeria. The first group belongs to female students outside construction related disciplines and for this, a total of 200 students were randomly selected from various disciplines. The selected students cut across the 13 faculties of the institution. The second group comprises female students from construction related disciplines - architecture, civil engineering, building technology, quantity surveying, estate management, mechanical engineering and electrical and electronic engineering. For this a total of 50 out of the 109 female students were randomly selected. Measurement of perception of respondents on factors affecting women enrolment (response from group 1) and difficulties faced by female students in construction (response from group 2) was approached on relative importance index basis. The respondents were asked to rate, on a five-point Likert scale, the significance of the factors, where 1 = not significant, and 5 = highly significant. The numerical scores assigned by respondents were transformed to Relative Importance Index (RII).

For the purpose of comparing female enrolment as against their male counterparts, secondary data on students’ enrolment in the various construction related disciplines of the institution from 1995 - 2006 were collected from the administrative officers of the respective disciplines. These were used to generate the charts showing the trend for the period. It is to be noted that 2000 and 2004 academic year was cancelled at Obafemi Awolowo University.

RESULTS AND DISCUSSION

Respondent profile

A total of 250 questionnaires were administered, 200 to group 1 and 50 to group 2. A total of 156 respondents replied (118 for group 1 and 38 for group 2), achieving a response rate of 62%. The disciplines of the respondents are shown in Table 1 and 2. Of the 156 respondents who participated in the survey, 24.4% were from construction related disciplines while 75.6% were from disciplines outside construction related field. This justifies the essence of capturing the views of respondent outside construction related fields. In order to be sure that respondents has adequate understanding of construction and its operation (especially for those outside construction related fields); the term construction was defined and its activities highlighted in the questionnaire. Table 3 shows the level of understanding of the respondents about construction and its operations. On the basis of this it is inferred that the respondents has knowledge of construction and the data obtained from them can be relied on.

Table 1: Discipline of respondents (Group 1)

Discipline of respondent	No.
Sociology and Anthropology	5
Management and Accounting	9
Economics	6
Computer Sc. and Engineering	3
Medicine	9
Biochemistry	4
Geography	4
Physiotherapy	3
Agricultural Engineering	4
Law	8
English Language	7
Education Foundation and Counseling	2
Religious Studies	2
Dramatic Art	2
Nursing Science	3
Medical Rehabilitation	3
Political Science	5
Zoology	4
Crop Production	2
International Relation	4
Local Government	3
Microbiology	5
Mathematics	3
Pharmacy	6
Animal Science	5
Agricultural Economics	4
Total	118

Table 2: Discipline of respondents (Group 2)

Discipline of respondent	No.
Architecture	6
Building Technology	2
Civil Engineering	4
Electrical and Electronics Engineering	9
Estate Management	7
Mechanical Engineering	5
Quantity Surveying	5
Total	38

Table 3: Level of Understating of respondents about Construction

Level of Understanding	No.	Percentage
Adequate knowledge	43	27
Average knowledge	66	42
Fair knowledge	26	17
Faint knowledge	12	8
No knowledge	9	6
Total	156	100

FACTORS AFFECTING WOMEN ENROLMENT IN CONSTRUCTION

From the review of literature carried out, factors affecting women education and eventual participation in construction were identified. Employing the identified factors, the respondents were asked to indicate the importance they place on each on a five-point Likert scale, the significance of the factors, where 1 = not significant, and 5 = highly significant. Their response is shown in Table 4.

Lack of female role model to emulate

The study revealed the issue of lack of female role model to emulate as the highest rating factor affecting women enrolment in construction education. This revelation is not surprising as previous researchers have established it that less than 5 percent of Nigerian women are managers. Awe (1991) revealed that out of the 50 companies quoted in Nigeria, none of the blue chips bosses is a woman. In the same vein, while about 55 percent of the workers in the Nigerian public service, GL 1-6 are women, only about 9 percent of workers on GL 15-17, are women (Clark, 1992). The issue of role model and mentorship is very important in any human endeavour. If we have more women architect, engineer, quantity surveyors, builders, etc, in top position of their respective fields, it will serves as an impetus and morale booster for increase in women enrolment in construction fields of study. In this regard all forms of discrimination against women to get to the highest position in construction field (either in private or public sector) should be avoided. This is in line with Ferguson and Dunphy's (1991) suggestion that qualified women should be made more visible in organisations by promoting them to positions of real power. Recently in Nigeria, female activist under the aegis of Gender and Affirmative Action (GAA) and the 100 women Group Platform, have urged President Goodluck Jonathan to fulfill his campaign pledge of allocating 35% of his new cabinet position to women. This is to ensure adequate representation of women in appointive position in line with the National Gender Policy – the 35% Affirmative Action of the Beijing Conference and other International instruments, which Nigeria is signatory to.

Job opportunity

Low job opportunity was observed as the second highest rating factors affecting women enrolment in construction education. This calls for a serious concern as the pattern is similar all over the world. Of the 105,567 persons formally employed in Zimbabwe’s construction sector in 1999, only 6.3% were women (CSO, 2002). In the Czech Republic, 2.7% of entrepreneurs in the construction sector were women and 4.5% of influential positions in the construction business were held by women (Putnova, 2007). The Singapore Labour Force Survey reported that women constitute 42% of the local labour force, but only 15% of the construction industry's local labour force are female (Ling and Leow, 2008). In North America, women constitute about 10% of the construction participants (Sigcau, 2004) and in South Africa about 8% of construction sector managers are women (Mjoli-Mncube, 2005). This trend is also observed in other countries, whereby the construction workforce remains overwhelming male (Dainty et al., 2001). It has been found that equipping women with construction related skills as well as giving them confidence to champion their development, ensures that women engage in self – build housing projects which not only ensure that women are adequately shelter, but also that they earn an income from such skills. This works on the premise that getting women to participate in the construction industry empowers them to harness their development and thus reducing vulnerability amongst women.

Table 4: Index of importance placed on factors affecting female enrolment in construction.

Factor	*Mean Score	Rank
It is tasking and difficult	2.85	4
Lack of awareness right from secondary/high school	2.31	7
Perception of construction not suitable or meant for female	3.11	3
No female role model to emulate	4.08	1
Low job opportunity for female	3.72	2
Difficulty in coping couple with family responsibilities	2.46	5
Poor background in science and technical subjects	2.21	8
Religious factor	1.32	9
Female prefers social sciences and art discipline	2.39	6

* *Mean score calculated from five-point Likert scale, where 1= not significant, and 5 = highly significant.*

Construction not meant for women

Another important factor is the perception that construction is not suitable for women and invariably meant for men. This finding is in agreement with Loosemore and Galea's (2008) study which viewed construction industry as a male dominated and threatening environment, with an ingrained culture characterised by masculinity, conflict and crisis. In line with this finding, Powel et al (2005) highlighted the problems associated with the integration of women into construction despite their education status in the field. This they called the problem of transition from higher education to the workplace. Powell et al's research also indicated that women starts to develop strategies for coping within a male dominated workforce, although the coping mechanism have not been able to challenge the existing culture and structure of the construction sector.

In an attempt to ameliorate this problem, Bagilhole (1997) made a case for increasing the number of women in construction sector. Also, there has been a call for more gender-balanced construction organization. Etzkowitz et al (2000) have also argued that women face a series of gender related barriers to success in scientific carriers despite recent advances. Arising from all these myriads of problems confronting women, there have been calls for increase in women participation in construction and numerous initiatives have been suggested from many quarters. Mogbo (1999) suggested the review of the Nigerian National Construction Policy to make special provisions for women to be adequately involved in policy formulation and implementation as well as participation in construction services which had always been practically reserved for men. Women in the next millennium should cease to be "hewer of woods", "drawers of water" and "sellers of food" on construction sites.

They should be appointed construction site managers, project supervisors etc. Education and training programmes will have to create special quota for women as an encouragement in order to achieve these objectives.

Another major constraint on the participation of women in the labour force of construction sector related to labour-protection laws which imposes statutory restrictions on the conditions of women employment, though this is meant to be reviewed periodically in the light of scientific and technological knowledge but this is largely ignored in many countries. As a result, many protections –related occupation in the formal construction sector remain an exclusive preserve of men. Mutandwar et al (2008) in their opinion has advocated for the need to explore strategies that can reduce gender burden that arises due to the conflicts between social and economic activities. They also suggested the need for re-orientation of the national housing policies so as to explicitly incorporate the specific needs of women in the construction industry.

Construction subjects regarded to be difficulty and tasking

Akande (1996) challenged the Nigerian womenfolk in that their deprivation is not in men who have the right to preserve the status quo of the exclusive "men's club". Rather, it is that of women, who in spite of their culturally disadvantaged position and deprivation, still create more loopholes for exploitation. In view of this, the onus rests on women to take their destiny in their hand by rising up to the challenge.

Difficulty in coping coupled with family responsibilities

One of the factors militating against women in realisation of their full economic potential is the difficulties in coping with their career and family responsibilities. Wickham (2001) remarked that even though women may be in the labour force, they are not achieving their full economic potential because their specific needs and characteristics are often overlooked. The challenge of striking a balance between household chores and economic activities has been observed and as such there is need to develop a career programme that will allow women to combine work and family life more effectively. This is in consistent with Tigges and Green's (1994) recommendation, which advocated for real progress in closing the gender gap by developing program which will reduce their "double burden" of family and market work. This can be in form of introducing flexible practices, childcare arrangements and career-break schemes. Lee and Choo (2001) suggested various ways of implementing flexible work schedules. For example, employees can work an eight-hour day by choosing their preferred time. But, they must be in the office during specified "core" hours. They can also be given options to complete a 40-hour week in four 10-hour workdays.

Preference for other disciplines

The other factor rated high is that women preferred discipline such as social sciences and arts. Again this reflects the true picture of the situation in Nigerian education enrolment. Typical analysis of student enrolment in different discipline shows that we have more female in art and social sciences. Compared to other sectors, construction sector experiences negative/low growth rates. With unfavourable growth rates, career opportunities and prospects in the construction industry are bleak. Consequently, it will lose valuable human assets to other sectors.

Poor background in science and Technical subjects

Lane (1997), co-author of 'The Rising Tide' report on women in Science, Engineering and Technology (SET), commented, "Engineering…. is a subject where women are currently catastrophically underrepresented". Studies have shown, however, that women are not driven away from technology because of lack of ability but rather because of "an atmosphere dominant masculinity (Sagebiel, 2003). Lack of appropriate training of women in technical skill was noted as a major constraint that limits women participation in construction activities. This is corroborated by Mjoli-Mncube (2005) who indicated that the dearth of technical skill have been a major hindrance in effective participation of women in South African's booming construction industry. Technical training is therefore a strategy that could be used to improve women involvement in construction. Other factors, affecting the enrolment of women into construction are lack of awareness and religion factor factors. These factors were, however rated low. This means that women should rise up to the challenge confronting them rather than hiding under the issue of religion and lack of awareness.

DIFICULTIES FACED BY WOMEN ENROLED IN CONSTRUCTION

Respondents were asked to indicate the seriousness of 4 difficulties (identified from the literature) faced by female students who are in construction related discipline. Table 5 revealed degree of seriousness of the difficulties. The main problem here is on gender discrimination. This correlates with the submission by Dainty et al (2000) that sex discrimination and anti-women attitudes are still prevalent on worksites, despite the fact that sex discrimination is illegal. Several studies have shown that female construction workers suffer from gender and sexual harassment, a factor associated with low job satisfaction as well as psychological and physiological health symptoms and workplace injuries. The issue of gender discrimination should be totally eradicated or discouraged in the system. As was suggested by Mogbo (1999), there should be an enabling law giving equal chance to both male and female in the National Construction Policy. The decline in female enrolment in construction and eventual participation may be attributable to policies not favourable to them.

Table 5: Index of importance placed on difficulties faced by female enrolled in construction

Factor	* Mean Score	Rank
It is tasking and strenuous	4.56	3
Gender discrimination	6.84	1
Intimidation by male counterpart	4.90	2
Poor performance	2.14	4

* *Mean score calculated from five-point Likert scale, where 1= not serious at all, and 5 = very serious.*

Another factor is the intimidation by male counterpart. This may be due to the fact that men are the majority. These are good factor to be addressed in the promotion and enhancement of women participation in construction. We can also see from the table that the issue of tasking/difficulty of construction subjects and performance were rated low. This means that the female students can cope very well with construction subjects. If they can do well in sciences, social sciences, arts and humanities; they can as well perform very well in construction or engineering if they are given equal chance. The view that construction is tasking and strenuous was rated low. Women should not use this as an excuse for not coming into construction. The popular adage that "what a man can do, a woman can do, even better" should be seen as a challenge by women folk. In the same vein, the issue of poor performance is a mere excuse and should not stop women from participating in construction.

TREND OF WOMEN ENROLMENT IN CONSTRUCTION

A comparison between women and men enrolment was conducted for a 10 year period. From figure 1, it is clearly indicated that women are lagging far behind men in enrolment in construction. This is reflected in all the construction related disciplines considered as the charts are of the same pattern. Transposing the chart to a line graph gives the trend analysis in figure 2. From this the trends are brought to a clearer picture. In all, except in two occasions that we have women enrolment up to 50% of that of men, it can be observed that the percentages, as compare to those of men, remain below 30% on the average. This shows that women are grossly under enrolled when it comes to construction education. From this it is clearly indicated that something must be done to arrest this ugly trend so as to boost the participation of women in construction.

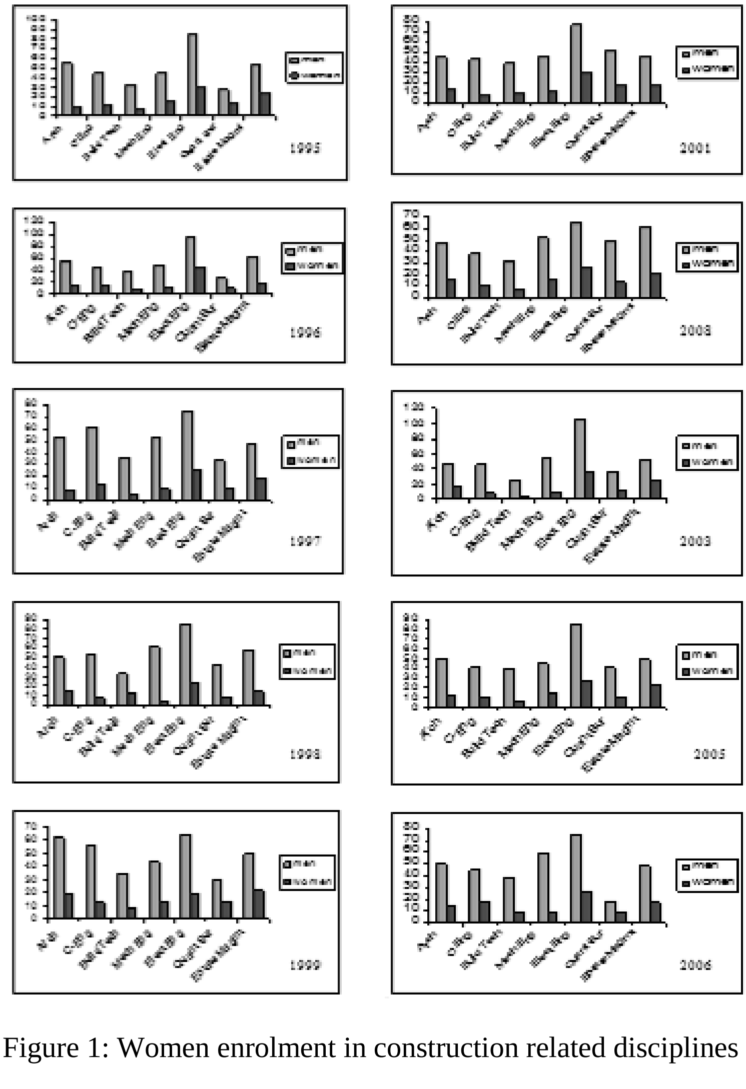


Figure 1: Women enrolment in construction related disciplines as compared to men

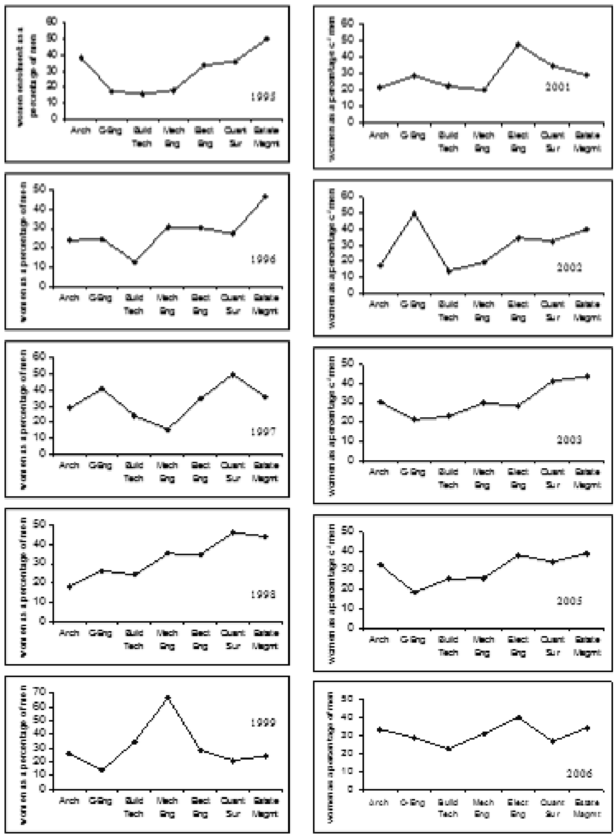


Figure 2: Trends in women enrolment in construction related disciplines

CONCLUSIONS AND RECOMMENDATIONS

This paper assessed women enrolment in construction education in Nigeria. It identified the factors affecting their enrolment and examined the trend over a 10 year period. The findings of the study indicates that the fact that women were not at the fore front and their impact or participation not been felt in construction sector is a major factor affecting women enrolment in construction education. This is attributable to the negative perception by the society towards women participation in construction works. The study findings also showed the issue of gender discrimination as one of the problems confronting the very few women in construction. The trend analysis shows that women enrolment over the years is extremely low in comparison with that of men. The research findings points to the need to revise the Nigerian National Construction Policy in such a way that women are given special consideration due to their peculiar nature. The issue of gender discrimination against women should be completely eradicated. The paper concludes on the need to make concerted effort in the enhancement of women enrolment and eventual participation in construction.

REFERENCES

Ademoroti, G. (1994). Technological Participation of Women in the Construction Industry. *Builder's Magazine*, Vol. ix, No. 3, October/December, 2-9.

Akande, J. (1996). Women in the Management of the Nigeria Economy. *Management in Nigeria (Journal of the Nigerian Institute of Management)*, Vol. 32, No. 1, January /March, 15-18.

Awe, B. (1991). The role of the Nigerian Women in Management in the 90's. *Management in Nigeria (Journal of the Nigerian Institute of Management),* Vol. 27, No. 1, November/December, 8.

Bagilhole, B. (1997). *Equal Opportunity and Social Policy: Issues of gender, race and disability*. London: Longman.

Clancy, J. and Dutta, S. (2005). Women and productive uses of energy: some light on shadowy area. *Paper presented at UNDP meeting on productive of renewable Energy*, Bangkok, Thailand, 9-11 May.

Clark, E. (1992). Breaking Gender Management Monopolies. *Management in Nigeria (Journal of the Nigerian Institute of Management)*, Vol. 28, No. 4, October/December, 10.

Central Statistics Office (CSO). (2002). *Men and Women in Zimbabwe*, Harare, Zimbabwe.

Dainty, A.R.J, Bagihole, B.M. and Neale, R.H. (2001). Male and female perspectives on equality measures for the UK construction sector, Women in Mnagement Review, Vol. 16, No. 6, 297-304.

Edwin, H.W., Chan, M.W., Scott, D. and Chan, A.T.S. (2002). Educating the 21st construction professionals. *Journal of professional issues in engineering education and practice*, January, 44 -51.

Etzkowitz, H., Kemelgor, C. and Uzi, B. (2000). *Athena Unbound: The advancement of women in science and technology*. Cambridge: Cambridge University Press.

Ferguson, T. and Dunphy, J. (1991). *Answers to the Mommy Track*. New Jersey: New Horizon Press.

Kenny, C. (2007). Construction, Corruption and Developing Countries. *World Bank Policy Research Working Paper 4271*, June.

Lane, N. (1997). Women in Science, Engineering and Technology: The rising tide report and beyond. In: *Maynard, M. (Ed.) Science and the construction of women*. London: UCL Press.

Ling, F.Y.Y. and Leow, L. (2008). Enabling Knowledge Flow: Retaining Graduate Women in the Singapore Construction Industry. *Journal of Construction in Developing Countries, Vol. 13, No. 2, 65-81.*

Lee, J. and Choo, S.L. (2001). Work-family conflict of women entrepreneurs in Singapore. *Women in Management Review*, 16(5): 204–221

Loosemore, M. and Galea, N. (2008). Genderlect and conflict in the Australian construction industry. *Construction Management and Economics*, 26: 125–135.

Mjoli-Mncube, N. (2005). Opportunities for women in housing. *Paper presented at "Creating sustainable human settlements, in KwaZulu Natal Conference*, Durban, South Africa, March.

Mogbo, T.C. (1999). Education and Training of Nigerian Construction Professionals (1991-2010). *The Quantity Surveyor. (Journal of the Nigerian Institute of Quantity Surveyors)*, Vol. 26, January/March, 5-14.

Mutandwa, E., Sigauke, N. and Muganiwa, C.P. (2008). Urban Women's Participation in the Construction Industry: An Analysis of Experience form Zimbabwe. *Journal of International Women's Studies*, Vol. 9 (3), May, 256-268.

Powell, A.D., Dainty, A.R.J., Bagilhole, B.M. and Neale, R.H. (2005). Coping in Construction: Female Students' Perspective. *Proceedings of 21st Annual conference of ARCOM*, Vol. 1, 7-9 September, London, 34-42.

Putnova, A. (2007). Czech women's entrepreneurship. *Electronic Journal of Business Ethics,* Vol. 12, No. 2, Business and organization Ethics Network.

Roesset, J.M and Yao, T.P. (2000). Roles of civil engineering faculty. *Journal of Professional Issues in Engineering Education and Practice,* 126(1), 8-15.

Sagebiel, F. (2003). New Initiatives in Science Technology and Mathematics Education at the Formal Level: Masculinity cultures in engineering departments in institution of higher education and perspectives for social change. *Proceedings of GASAT 11 Conference,* 6-11 July.

Sigcau, S. (2004). Messages from the Minister: 2004 Annual Report of South Africa's women in construction, Dezinamite Printers, Pretoria for the Development Bank of South Africa, Halfway House, Midrand.

Tigges, L.M. and Green, G.P. (1994). Does small business offer opportunities for women in rural areas? Department of Agricultural Economics, Community Economics, University of Wisconsin-Madison, No. 266, USA.

U.S. Department of Labour, Bureau of Labour Statistics (Employment and Earnings). (1996). Washington.

Wamukonya, N. (2002). A critical look at gender and energy mainstreaming in Africa. *Paper presented at the "gender perspectives in sustainable development",* side event organized by UNDESA/DAW and WEDO at Prp Com III, April.

Wickham, P.A. (2001). *Strategic entrepreneurship: A decision making approach to new venture creation in management*. London: Pearson Education Limited.

Williams, S. (2006). A legacy of Women Empowerment. *Gender Equity Initiative Bulletin (Bi –Annual publication of Centre for Gender and Social Policy Studies*, Obafemi Awolowo University, Ile Ife, Nigeria), Vol. 4, No. 1 September, 3-4.

Women Commission for Refugee and Women and Children (2006). *Beyond Firewood: Fuel Alternatives and Protection Strategies for Displaced Women and Girls*. New York.

FACTORS INFLUENCING LAND ACCESSIBILITY FOR HOUSING DEVELOPMENT IN ABUJA, NIGERIA

Andrew Mhya Stanley[1] **and O. Orobowale**
Department of Building, Ahmadu Bello University, Zaria, Nigeria

Housing has been rated the second most important need for human development. Its accessibility has continued to pose serious challenges to policy makers and stakeholders in most developing countries. It was identified that land availability has been a factor militating against housing development in Nigeria. This study was conducted to assess the factors associated with land accessibility for housing development in the Federal Capital City (FCC) Abuja-Nigeria. The method adopted for this study included; use of questionnaire, collate records from land administrators and articulation of literature from books, journals, internet etc. Results obtained shows that 63.64% of the respondents applied for land in the FCC and 61.9% were denied. This was due to non-compliance (100%) with mode of application. Other factors included; financial constraints (75%), bank high interest rate (66.67%), apathy (33.33%), cumbersome application process, revoked due to delay in development of allocated land (50%) etc. It was concluded that 2/3 (two third) of the applications were denied, accessing loan from financial institution by the applicants for development is difficult, there is cumbersome application process etc. It was recommended that; land application for housing development should be encouraged and applicants given equal chances, government should encourage more active participation of the private sector in housing delivery, prolong procedure of land accessibility should be reduce, financial institutions should relax the stiff conditions laid down to obtain fund without high interest and collateral.

Keywords: Abuja, housing, land accessibility, Nigeria.

INTRODUCTION

Housing has been universally accepted as important component of overall human development. It is rated second to food on human scale of preferences (Nubi, 2008). Inspite of its importance, its provision has continued to pose problems to policy makers and stakeholders. These problems are common in most Sub-Saharan African (SSA) countries where over 40% of the populace lives below the international poverty level of less than $1 a day (Groves, 2004). Groves (2004) attributed these to factors such as poor policy formulation, difficulties in accessing funds from the financial institutions and poverty level. Other factors included unavailability of land, rural-urban migration which account for over 65% urban population growth, inefficient mortgage system/financial intermediation process and ineffective land administration system.

In an effort to tackle these problems, several administrations in Nigeria have introduced different housing programmes and created institutional frameworks, but continued unabated. Records from 1979 to date showed that investment in the housing

[1] stanleywond@yahoo.com

Stanley, A.M. and Orobowale, O. (2011) Factors influencing land accessibility for housing development in Abuja, Nigeria *In:* Laryea, S., Leiringer, R. and Hughes, W. (Eds) *Procs West Africa Built Environment Research (WABER) Conference,* 19-21 July 2011, Accra, Ghana, 465-471.

sector by the public sector was 1.0 to 9.0% of the total annual budgets (Federal Office of Statistics, 1998). This figure is far below what is in operation (15%) in most developing countries (Ughamadu, 1991). There is therefore need for both the public and private sectors to create conducive environment to tackle the problems in Nigeria.

Land availability and ineffective land administration have been identified as the major factors militating against housing development in Nigeria despite the existence of the land use act over the past 30 years (Iseh, 2004). These problems have also been identified by previous researches (Olayiwola, 2000; Omirin, 1997; Onakerhoraye, 1984; Olaore, 1981; Mabogunje,1968). Abiodun (1997) observed that the major actors (public and private sectors) in housing delivery are also faced with the constraint to access land in Nigeria, mostly due to land bureaucracy. The complexity of land tenure system in the country has actually affected the development of housing in most urban cities. For instance, the customary law and cultural attachments to land conflicts with the land use act under the control of state governor and minister of the FCT. This has influenced difficulty to access land for urban housing development.

Abuja by virtue of its location and other important factors was made the federal capital city of Nigeria to solve problems which became impracticable in the then federal capital city Lagos. Government parastatals, private bodies, schools, businesses, NGOs etc flocked into the city from different parts of the country for greener pastures. This influenced the demand for housing in all parts of the city. The government in its effort to tackle this problem created the Federal Capital Development Authority (FCDA) which has been in existence for over a decade, solely responsible with the design, planning and implementation of the master plan, provision of infrastructural facilities, residential accommodation, provision of available plots of land for development etc. This paper assesses some of the factors affecting land accessibility and housing development in Abuja with a view to highlight the factors responsible and proffer solutions.

RESEARCH METHOD

The method adopted in this study included the use of primary and secondary sources for data collection. The primary source included use of questionnaire, oral interview and records from land administrators. Secondary source included articulation of literature from books, journals, internet etc. Fourty (40) questionnaires were carefully designed and administrated to respondents randomly to seek how they possessed and developed land for residential purposes in Abuja. The questionnaire was divided into two (2) parts. The first part seeks the respondents' profile, while the second part seeks to know if the respondents have ever applied for land in the Abuja, how many applied for, how many approvals were made, how it was developed, if not approved, what are the reasons etc. Also, interview was conducted with land officials in the FCT to seek modalities on land administration and criteria use for selection. Data generated were analysed using simple statistical tools such as mean, percentages etc and presented in tabular form.

RESULTS AND DISCUSSION

A total of fourty (40) questionnaires were administered to respondents, out of which thirty three (33) representing 82.5% were returned, while seven (7) representing 17.5% were not returned.

1. Respondents' Profile

Table 1: Respondents' Age Bracket

Age bracket	Frequency (N)	Percentage (%)
18-25	-	0
26-35	8	24
36-above	25	76
Total	33	100

Table 1 show that 8 out of 33 respondents were between ages 26-35 which represent 24% while 25 were between ages 36 and above representing 76% with the highest responses. This particular age group is more than 2/3 of the total respondents. It is believed that at this age group most are married and are regarded as more responsible in the society because they have families to care for. This may be the reason why most of the respondents applied for land as shown in Figure 2.

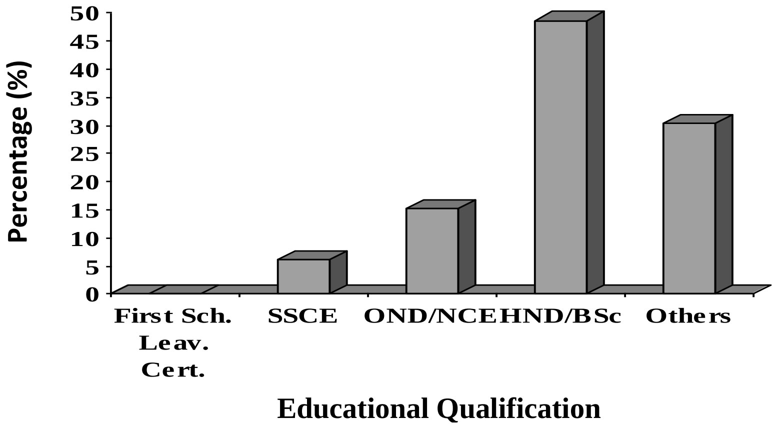


Fig. 1: Educational Qualification of Respondents

Figure 1 show the educational qualification of the respondents where 6% have SSCE, 15% OND/NCE, while the larger respondents (48%) have HND/BSc. Others not specified had 36%. These imply that most of the respondents are knowledgeable and the level of their education gives them the opportunity to know how to apply for land and the mode of application as shown in Figure 2. It could also be the reasons why the FCT land administrator receives an average of two hundred and fifty (250) applications per month as shown in Table 6.

2. Application for Land and Approval

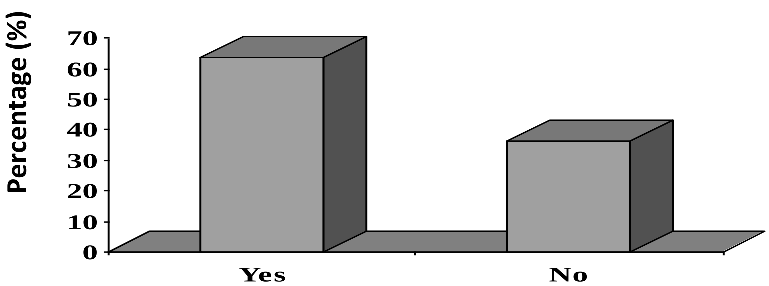


Fig. 2: Number of Respondents Applied for Land in FCT

Figure 2 shows that 21 respondents applied for land in the FCT which represent 63.64%, while 36.36% representing 12 respondents did not applied.

Table 2: Reasons for Not Applying

Reason(s)	**Frequency (N)**	**Percentage (%)**
Lack of fund	4	33.33
Ignorance	3	25
Apathy	5	41.67
Total	12	100

Table 2 shows that 33.33% of the respondents did not applied for land in FCT due to lack of fund, 25% were due to ignorant of the process, while 41.67% with the highest frequency were due to apathy. Majority of the respondents do not apply for residential land because they are not just interested in going through the rigorous application process. Some are ignorant, while some due to financial reasons. Those who have apathy for application of land feel so because they don’t have time to go through the process.

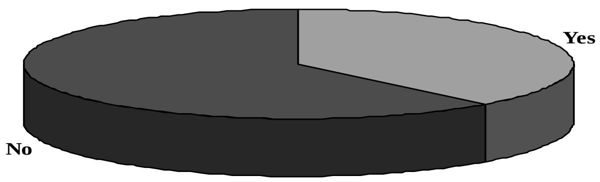


Fig. 3: Approval for Land Application

Figure 3 shows that 13 out of the 21 respondents who applied for land in the FCT representing 61.91% were denied, while 8 representing 38.09% were approved. These imply that the number of respondents who did not get approval for land in FCT out weighs those who got. The reason why those who did not get approvals might be because the applications do not comply with the requirements as shown in Table 6. This could also be the reason why land development is low as shown in Table 3.

100% of the applications received by the administrator were through paper mode, none use the online process. This is in conformity with the responses from the land administrators shown in Table 6.

Table 3: Land Developed at the Stipulated Period

Developed	**Frequency (N)**	**Percentage (%)**
Yes	4	50
No	4	50
Total	8	100

Table 3 shows that 4 out of 8 respondents who got land approval developed their lands, while the remaining 50% respondents have not developed same. This could be attributed to lack of fund for most successful applicants who are savings before embarking on the development.

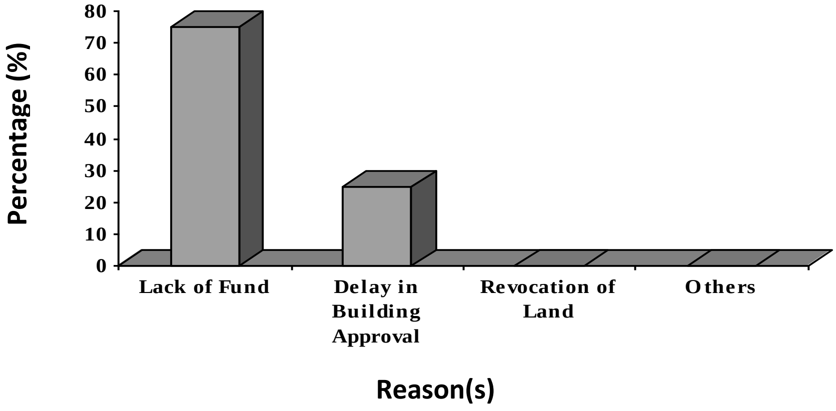


Fig. 4: Reasons for Non Development

Figure 4 shows that 75% of the respondents have not developed the land allotted to them due to financial constraints, while 25% represents those who could not develop due to delay in building approval. These imply that the respondents could not save from their income and they do not have access to loan facility from financial institutions as shown in Table 4. This is the major reason why housing delivery is low in the urban centres.

Table 4: Application for Funds from Financial Institution for Land Development

Applied	**Frequency (N)**	**Percentage (%)**
Yes	1	25
No	3	75
Total	4	100

Table 4 shows that 1 respondent representing 25% applied for fund from financial institution for the land development while 75% represents those who did not apply for fund from financial institution. Majority do not apply for fund from financial institution due to high interest rate and use of collateral for the application as shown in Table 5.

Table 5: Reasons for Not Applying for Fund

Reason(s)	**Frequency (N)**	**Percentage (%)**
High interest rate	2	66.67
Lack of collateral	-	0
Apathy	1	33.33
Total	3	100

Table 5 shows that 2 respondents did not apply for financial assistance because of high interest which represents 66.67%, while 33.33% were due to apathy. This may also be responsible for low development of residential lands shown in Figure 4.

3. Process and Mode of Land Application in the FCT

Interview conducted with land officials in the FCT were collated and the results are presented in Table 6.

CONCLUSIONS

Based on the limited findings, the following conclusions were made:

- Despite the existence of Act for over 30 years there are problems of land speculation and racketing in the FCT.
- Over 2/3 (two third) of the applicants who apply for residential land in FCT do not get approval because of non meeting up with the requirement stipulated by the administrators.
- There is rise in the number of undeveloped residential land due to lack of fund.
- Accessing loan from financial institution by the applicants is difficult due to high interest rates and use of collateral.
- The process of accessing residential land is characterized by a long procedure which takes quite a number of years and this discouraged the applicants to abandon the process.

Table 6: Process of Land Administration

Format	Process
Process of getting residential land	*filling of application forms *attachment of bank draft for the application fee on the form *submission of filled forms with the requirements.
Tools/Method for land application	Paper Application
Source of application form	Forms are collected from office of Abuja Geographical Information System or download from their website.
Time taken to process an application	No fixed time schedule for processing an application of land. The application moves from submission point to the next office for treatment.
No of applications received in a month	On the average 250 applications per month.
Rationales for Land Approval	The rationales for land approval are based on payment of application fees, attachment of all necessary documents and provision of necessary information.
Rationales for Disapproval of Application	No application is disapprove if the requirements are met.

The following recommendations were drawn:
- Government should provide a measure that can curb or eradicate completely the menace of land speculation and racketing.
- All applicants for residential land should be given equal chances which should be devoid of favouritism and nepotism.
- Government should encourage more active participation of the private sector in housing delivery.
- The prolong procedure of land accessibility should be streamlined and reduced to a more convenient and reasonable way.
- Financial institutions should relax the stiff conditions laid down to obtain fund so that applicants can have access to such without high interest and collateral.

REFERENCES

Abiodun, A. (1997): Land Accessibility in Nigeria. Pamphlet on Housing Issues.

Akujuru, V. (2004): Land Administration and Infrastructure Management for Urban Development. Paper Presentation at the Nigerian Institution of Estate Surveyors Annual Conference 1st April, pp 1-8.

Agbola T. and Olatubara C (2003): Private Sector Driven Housing Delivery in Nigeria: Issues, Constraints, Challenges and Prospects. Paper Presented At National Workshop by the Department of Estate Management, University of Lagos.

Babade T. (2002): Access to Urban Land in Nigeria – An Analysis of the Activities of Lagos State Land Use and Allocation Committee. Paper Presented at 1st National Workshop by Estate Management Department, University of Lagos.

Babatunde J. (2003): Housing the Masses in Democratic Nigeria: Issues, Constraints, and Prospects. Paper Presented at CPD Seminar Organized By NIESV, Niger State Branch.

Babatunde J. (2004): Land Administration and Effective Housing Delivery Paper Presentation at The Nigerian Institution of Estate Surveyors Annual Conference 2nd April. Pp 50-58.

Digest (2009): Land Administration in the FCT Under the Administration of Mall. Nasir El-Rufai – NIESV. Pg. 10.

Ebie, F. (2007): Land Rights and Secure Tenure as the Basis for Economics Empowerment and Housing Delivery Paper Presented at the Stakeholders Forum on Land Reform 6th -7th November. pp. 1-14.

Groves, L. (2004): Sustainable Housing Delivery-Survey of The National Housing Stock for Effective Planning. Paper Presented at National Conference of Chief Architects of the Federation 12th-17th July. Pp. 71-72.

Iseh, F. (2004): Land Accessibility in Nigeria – The Contribution of Lagos State Land and Infrastructural Policies. Paper Presented at the National Workshop on Private Sector Driven Housing Delivery Organization 1st April. Pp. 25-26.

Mabogunje, A. L. (1968): *Urbanization in Nigeria.* In: Olayiwola, L.M., Adeleye, O.A. and Oduwaye, A.O. (2005): Correlates of Land Value Determinants in Lagos Metropolis, Nigeria. J. Hum. Ecol., Vo. 17, No. 3. Pp. 183-189.

Mabogunje S. (2002): Land Management. Paper Presented at National Conference on Land Management and Taxation by Estate Management Department, University of Lagos.

Olaore, G.O. (1981): *Values of Land and Rentage of Shelter in Nigeria Urban Areas: A Case Study of Kaduna,* In: Olayiwola, L.M., Adeleye, O.A. and Oduwaye, A.O. (2005): Correlates of Land Value Determinants in Lagos Metropolis, Nigeria. J. Hum. Ecol., Vo. 17, No. 3. Pp. 183-189.

Olawoye C. (1974): Title to Land in Nigeria Ibadan, Evans Publisher.

Olayiwola, L.M. (2000): Techniques for Planning Sustainable Development for Towns and Cities in Nigeria. In: Olayiwola, L.M., Adeleye, O.A. and Oduwaye, A.O. (2005): Correlates of Land Value Determinants in Lagos Metropolis, Nigeria. J. Hum. Ecol., Vo. 17, No. 3. Pp. 183-189.

Omirin, M.M. (1997): Land Accessibility and Low Income House Building Activity in Metropolitan Lagos. In: Olayiwola, L.M., Adeleye, O.A. and Oduwaye, A.O. (2005): Correlates of Land Value Determinants in Lagos Metropolis, Nigeria. J. Hum. Ecol., Vo. 17, No. 3. Pp. 183-189.

Omirin M. (2002): Issues on Land Accessibility in Nigeria. Paper Presented at a National Conference of Land Management and Taxation on 25th – 26th April**.** pp. 12-17.

Onokerhoraye, A.G. (1984): *An Introduction to the History of Geographic Thought*. In: Olayiwola, L.M., Adeleye, O.A. and Oduwaye, A.O. (2005): Correlates of Land Value Determinants in Lagos Metropolis, Nigeria. J. Hum. Ecol., Vo. 17, No. 3. Pp. 183-189.

Onokwai, T. (2004): Sustainable Housing Delivery -Paper Presented at the National Conference of Chief Architects of the Federation Held at Uyo, Akwa - Ibom State 12th-17th July, page 2.National Housing Policy Draft, 2004 National Urban Development Policy, 2004.

Nubi, T.O. (2008): Affordable Housing Delivery in Nigeria - Developing Communities. The Southern African Housing Foundation, International Conference and Exhibition, Cape Town, South Africa. October 12th – 15th.

Ughamadu, F. (1991): Investment in Human Settlements. Business Times. March 4. pp. 24.

FACTORS INFLUENCING THE EXTENSIVE USE OF GLASS ON FACADES OF OFFICE BUILDINGS IN ACCRA, GHANA

Adwoa Difie Ampadu-Asiamah[1] and Emmanuel Akoi-Gyebi Adjei[2]
Building Technology Department, Accra Polytechnic, Ghana

Sustainability has become a much discussed topic globally. It affects various aspects of our lives i. e. environmentally, socially and economically. Many parameters have been drawn to pursue sustainability in all aspects of human life. Sustainable construction is one aspect where these parameters have been set to enable stakeholders in the construction industries all over the world to be mindful of the way and manner construction is undertaken, in order to minimise the misuse of natural resources and pollution of the environment. Climatic forces have been an important factor ever since man first constructed shelter. The nature of buildings in Ghana which is in a tropical climatic region was initially dictated by the climatic conditions thus they were tailored to make the most use of the climatic elements to give comfort to occupants without compromising the environment. However with the advent of modern methods of construction, construction materials and mechanical aids like air-conditioning, extractor fans and artificial lighting, these climatic conditions have been relegated to the background, whilst building styles in other climatic regions have been copied. Glass is now being used extensively on facades of buildings, especially office buildings. The increasing use of glass on façades of office buildings in Accra (the capital city of Ghana) raises a few questions in relation to sustainable construction. In order to answer these questions there is the need to find out why the increased extensive use of glass in buildings.

Keywords: glass façade, sustainable construction, tropical building

INTRODUCTION

Ghana is located in a tropical climatic region where the weather is warm and humid most part of the year. The traditional style of buildings in Ghana made use of natural climatic elements to provide comfort for occupants; features like openness, courtyards to facilitate ventilation and provision of natural lighting, sun shading devices to control ingress of the sun and provide thermal comfort were used to achieve this. Quite recently, these features have been substituted with closed up buildings, made up of glass facades, which seem to ignore the climatic elements present.

This paper has through literature review established requirements for sustainable construction and based on these have found out from stakeholders in the construction industry in Ghana the factors that are considered when designing and constructing office buildings in Accra. Occupants of some office buildings in Accra were also asked to give their opinions on the comfortability of these buildings.

[1] ampasnad@yahoo.com
[2] akoi26@yahoo.com

Ampadu-Asiamah, A.D. and Adjei, E.A. (2011) Factors influencing the extensive use of glass on facades of office buildings in Accra, Ghana *In:* Laryea, S., Leiringer, R. and Hughes, W. (Eds) *Procs West Africa Built Environment Research (WABER) Conference,* 19-21 July 2011, Accra, Ghana, 473-485.

This study is to bring out some of the problems we have in the construction industry in Ghana in relation to sustainable construction and also prompt further studies into how best to blend modern features with climatic requirements for buildings in tropical areas.

BACKGROUND

The Brubdtland report (1985) brought to the fore the need for nations to consider the harm that is being done to the earth and biosphere by actions of human beings. Man's quest to develop has resulted in the depletion of the earth's resources. Many countries especially in the developed countries have set out policies to check actions that are likely to compromise the sustainability of the earth and its resources.

Sustainability has been defined by the United States Environmental Protection Agency as 'social and environmental practices that protect and enhance the human and natural resources needed by future generations to enjoy a quality of life equal to or greater than our own'. www.epa.gov (2011)

'The goal of sustainable development is to enable all people throughout the world to satisfy their basic needs and enjoy a better quality of life, without compromising the quality of life of future generations. It involves balancing and integrating the economic, social and environmental considerations for any policy or decision'. United Kingdom Department of Trade and Industry (DTI) (2006). The Sustainable Construction Strategy of the United Kingdom which outlines better practices in aspects of the construction process and the requirements for buildings throughout their lifetime is an example of actions being considered by some countries towards sustainability.

Globalization has brought with it the copying of modern lifestyles by the inhabitants of developing countries like Ghana, from developed countries like the United Kingdom and the United States of America. The most glaring global change is in that of buildings worldwide, with features like extensively glazed areas and the use of air-conditioning which more often than not ignore the use of natural climatic components, thus overlooking sustainability.

Over the years there has been this revolution of the use of glazing (glazed aluminium doors and windows, curtain walling), as against the use of traditional doors and window (louvers and timber doors) and sandcrete block walls. Traditional features of tropical buildings like shading devices (awnings, overhangs, and trellises) and courtyards have given way to enclosed high rise buildings with curtain walls. One wonders if these buildings are sustainable in the hot/warm and humid climates where energy efficiency among other factors is supposed to be of paramount importance.

PROBLEM STATEMENT

The climate of Ghana can be described as warm and humid. With this type of climate the most prominent characteristics are hot, sticky conditions and continuous presence of dampness. Air temperature remains between 21ºC and 32ºC with little variation between day and night. Recently, over the past ten years office buildings that have been constructed in Accra have been characterized by multiple floors, the extensive use of glass on the facades and the general use of air conditioners. Old or existing buildings that have been or are being renovated also have the above mentioned characteristics. Preliminary interviews of some residents in Accra have revealed that they believe that extensive use of glass makes a building 'modern'. Preliminary interviews with stakeholders in the construction industry agree with the residents in that these types of features are what clients request for, thus that is what they provide. The question however is, do these features (glass walls, etc.) correspond with sustainability of buildings in the warm humid climate?

Ghana has been having problems with the reduction in water levels in the Akosombo dam (a hydro-electric dam and the principal source of electrical energy) to the extent that the supply of electricity is sometimes rationed. The use of air conditioners and artificial lighting (during daytime) in homes and offices has become a necessity due to the manner in which our buildings are constructed. The need for mechanical ventilation has resulted in an increase in energy consumption. Even though some of these office buildings have the kind of features that are needed to be incorporated into buildings in tropical areas in order for them to be comfortable, (like sun shading devices, the orientation of buildings to take advantage of air movement, etc.), there are others that have ignored or abandoned these features for 'the modern look'. Is it not possible to combine the use of glass with these tried and tested features for sustainable tropical buildings in order for the office buildings that are being constructed to make maximum use of elements like natural ventilation and natural lighting? This paper seeks to find answers to some of these questions.

HYPOTHESIS

Glass is used extensively on facades of office buildings in Ghana mainly for aesthetic reasons and not for reasons of sustainability.

This research aims at finding out the reasons behind the extensive use of glass on the facades of office buildings in Accra and whether considerations are given to sustainability when these buildings are being designed and constructed. It also seeks to establish whether the use of such buildings is effective without mechanical ventilation and artificial lighting.

LITERATURE REVIEW

Sustainability has been researched into and written about by many authors and researchers. They all agree that it is about living presently in a way that even though the needs of human being are being met, care is being taken so as not to compromise or damage the ability of future generations to meet their own needs.

What is Sustainable construction?

Sustainable construction involves the provision of built developments that are efficient and affordable, socially acceptable and less damaging to the environment.

'Sustainable construction not only refers to the buildings and spaces themselves but also the processes or activities used to construct them. It also includes the infrastructural elements such as waste management, transportation, and utility transmission systems put in place to serve this building space'. Presley and Meade. (2010)

According to the United Kingdom Department of Trade and Industry (DTI) (2006), there are three key strands involved in Sustainable construction:

- Environmental responsibility
- Social awareness
- Economic profitability
- Sustainable Construction includes the following actions:

- Minimising pollution during construction Halliday, (2008), DTI (2006)
- Preserving and enhancing biodiversity Halliday. (2008), DTI (2006)

Conserving resources - 'There should be the conscious efforts not to consume a disproportionate amount of resources during construction and also not to cause unnecessary waste of energy, water or materials due to poor design, inefficiency, or less than ideal construction processes.' Halliday (2008), DTI (2006)

Respecting people (Communities) and local environment Halliday (2008), DTI (2006)

Creating healthy environments Halliday (2008), DTI (2006)

Managing the process through the identification of appropriate targets, tools and benchmarks, and management of its delivery. Halliday (2008), DTI (2006)

Sustainability of the Building Envelope

'In the life time of an average building most energy is consumed mostly during the period when the building is in use. That is, when energy is being used for heating, cooling, lighting, cooking, ventilation and so on. Typically more than 80% of the total energy consumption takes place during the use of buildings and less than 20% during construction of the same'. United Nations Environment Programme (UNEP) (2007) Since buildings, especially office buildings are noted to be major electricity or energy consumers, it is important that stakeholders in the construction industry, especially architects, take a look at the planning and designing of buildings (especially office buildings) in Ghana in order to make the most of the climate and environment thereby producing environmentally friendly buildings.

Below are some sustainability requirements relating to the design and construction of the building envelope.

It is essential to consider the local climatic conditions (temperature, moisture, wind) in order to know the materials for construction of the building envelope, the amount of and effectiveness of glazing used specific to each orientation, and the overall energy performance of the building. Bolin (2009)

Designing to make maximum use of natural light whilst being aware of its limitations. Bolin (2009), Smith (2006)

Using Effective Solar Shading Devices especially exterior shading devices such as overhangs, vertical fins and light shelves as energy efficiency measures. Bolin (2009)

Integrating photovoltaic panels as part of the building envelope system or solar shading system as a way of generating on-site, renewable energy. Bolin (2009)

Providing windows that afford building occupants views outside but do not negatively impact the visual and acoustic comfort of the work environment. Bolin (2009)

Components of the building envelope should adequately address issues of thermal comfort at the building perimeter, particularly thermal and solar performance of glazing or fenestration. Bolin (2009), Smith (2006)

The potential for natural ventilation in the context of an overall climate control strategy must be exploited while minimising energy use and maximising comfort. Where appropriate, the use of operable windows for natural ventilation and occupant control must be considered. Bolin (2009), Smith (2006)

Sustainable Construction in the Tropics

Climatic forces have been an important factor ever since man first constructed shelter. Throughout architectural history, local builders have used great resourcefulness in providing the most comfortable internal conditions possible within the constraints and requirements of the local climates. Jones (1998)

Countries in the tropics have a long history of sustainable buildings in their vernacular architecture. The hot and dry regions for instance, developed over centuries, appropriate materials, a perfect balance of shading and day lighting, natural ventilation and heat storage to suit their climatic conditions. In the hot and humid regions natural ventilation and shading systems were perfectly adapted to the local climate as well. Laar and Grimme (2002).

'However a lot have changed with the introduction of airconditioners, extractors, artificial lighting, etc. Design and construction of buildings have become independent from the prevailing climatic conditions. Aesthetics has become the main aim for the design of buildings, overshadowing sustainability'. Laar and Grimme (2002). Viet (2008) also observed that 'generally, architects (in Hanoi, Vietnam) are not concerned about climatic issues caused by the use of glass, because they believe these issues can be solved by technology, but rather design according to client's (who see the use of glass in buildings as modern) request'.

Sustainable construction in the tropics is no different from sustainable construction in other climatic conditions. The actions listed in the previous sections that are needed to be undertaken to achieve sustainable construction are the same. The problem lies in the fact that while buildings in temperate regions are being improved to meet requirements on sustainability by using appropriate materials and methods, buildings in the tropics are being changed to imitate those in the temperate regions regardless of whether the changes are sustainable or not.

Description of Ghana's climate

As stated already Ghana happens to fall within the warm humid type of climate which has hot sticky conditions and the continual presence of dampness. Details of Ghana's climate are found below.

'The climate of Ghana is tropical but relatively mild for the latitude. Average temperatures range between 21° and 32° C (70–90° F), with relative humidity between 50% and 80%. Rainfall ranges from 83 to 220 cm (33–87 in) a year.' (http://www.nationsencyclopedia.com/Africa/Ghana-CLIMATE.html, 2004)

'In most areas, temperatures are highest in March and lowest in August. Variation between day and night temperatures is relatively small, but greater in the north, especially in January. No temperature lower than 10° C (50° F) has ever been recorded in Ghana.' (http://www.nationsencyclopedia.com/Africa/Ghana-CLIMATE.html 2004)

Requirements for Buildings in Warm Humid Climates

The requirements for buildings built in this climatic region has been discussed by many writers over the years and they all agree to the fact that buildings in this region like all other buildings elsewhere are supposed to provide comfort, be functional, and environmentally friendly or sustainable.

According to Koenisberger et al., (1980), buildings have to be opened up to breezes and orientated to catch available air movement in order for heat to be removed from the occupants' body into the environment. Other features that were suggested by Koenisberger et al. (1980) are shading devices to reduce radiation from the sky.

According to Jones (1998), some of the important considerations for building in tropical regions are 'natural ventilation, mechanical ventilation, night ventilation, artificial cooling, free cooling, light weight construction, daylighting and solar shading/control'.

Another writer, Stagno (2001) also suggests that in order to achieve an acceptable level of habitability and comfort in buildings in the tropics, consideration must be given to variables like 'the problems of excess rainwater disposal, air-cooling, decreasing relative humidity levels and reduction of excessive glare from the sun' and existing environmental factors.

According to Bay and Ong (2006), 'shading devices with verandas, sun breaks, and appropriate openings, are always more efficient and cheaper than any glass technology for climatic control in subtropical regions'.

Reasons for using Glass in Buildings

The introduction of glass in buildings was brought about due to certain needs that designers, occupants and owners had to meet. Some of these are the need to make buildings lighter, the need to have high amount of natural daylighting in order to reduce electricity consumption through the use of artificial lighting, the need to create views, blending interior and exterior views, the need to control the solar and thermal heat in interiors thus maintaining temperatures at comfort levels, the need for designers and architects to have least restriction in capturing desired shapes and forms and the need to control noise. http/in.saint-gobain-glass.com (2011)

In order to be able to satisfy the above stated needs however, different types of glass with different characteristics and properties are required; failure to match the correct type of glass with the specific needs may result in the creation of problems in the building. For example, according to Bay and Ong (2006), ' many designers are eager to find innovative glass technologies, such as reflective glass, double skin glass, and low –E glass, to cut down the cooling load of glass skin but still cannot change the basic material performance that bigger solar heat gain comes from bigger glass opening'. This means that the use of glass should be determined by the climate as against the properties of the glass; and should not be used in spite of the climatic conditions or the requirement for sustainability in a region.

RESEARCH DESIGN AND METHOD

This section gives details of the methods and procedure of this study. The methodology used in this study is survey questionnaire which can be categorised as quantitative research. Quantitative approaches are more specific and result oriented and it involves the collection of numerical data in order to explain, predict, and/or control phenomena of interest (Mojaheed, 2005).

Survey

Literature research was undertaken to identify variables considered in the sustainable design and construction of buildings. The sources of the research were published professional journals, academic works, internet search and other relevant literature. A survey was then conducted among stakeholders in the construction industry made up of professionals in the construction industry and occupants of office buildings in Accra.

Design of Questionnaire

Structured questionnaires were formulated for the professionals in the construction industry and occupants of office buildings in Accra. Basically the questionnaire for the consultants was made up of three parts and consisted of open and closed questions. The first part was made up of questions that enabled one to be familiar with the respondent. They included questions that sought to know the respondent's profession, contact number and email address. It also had questions which sought to know whether respondents have been involved in the construction or refurbishment of office buildings and details of the projects. They also had to indicate whether they used glass extensively and the reasons for that.

The next section of the questionnaire asked respondents to rate seven hypothetical factors (which were put in a likert scale format) that are likely to influence the extensive use of glass on facades of office buildings in Accra; thus they rated 'Very Common', 'Common', 'Averagely Common', 'Not Common' and 'Do Not Know'. The factors were, namely, aesthetics, to achieve modern looks, to regulate indoor temperatures, to keep away dust from the offices, to control solar ingress, to create access to external view and to control draft/wind movement indoors.

Respondents were also asked to rate five hypothetical variables that should be considered in sustainable tropical buildings according to the amount of consideration applied. These variables are 'natural ventilation', 'thermal comfort', 'natural lighting', 'sun shading devices', 'orientation of building'. The final section asked the respondent to give other variables they considered during design and construction and were also to indicate which among the stakeholders usually suggests the use of glass. The questionnaire for the occupants sought to know the type of buildings they had their businesses in and how they feel generally in the building. This set of questions sought to find out the effect of glass facades on the interior space. A purposive sampling method was used to select the class of construction companies for the questionnaires administration. The targeted buildings were situated in and around the central business district of Accra.

Administering of Questionnaires

A total of 65 questionnaires were administered to occupants of which 49 responses were obtained representing 75.38% response rate. A total of 25 questionnaires were sent out to professionals and clients. A response rate of 13 presenting 52% was received.

Data Analysis Tools

Two analytical tools were used in analysing the responses from the survey. These are statistics importance index and Kappa statistic for multiple raters.

Importance index facilitates the identification of tactical approaches to increasing productivity. The nearer the value of importance index of the identified factor is to unity (1), *the more significant it as a factor for using glass extensively on buildings*. A ranking of importance indices were undertaken to ascertain the most frequent factors.

$$\text{Importance index (I.I.)} = \frac{5n_1 + 4n_2 + 3n_3 + 2n_4 + n_5}{5(n_1 + n_2 + n_3 + n_4 + n_5)}$$

Where: n_1 –number of respondent answered 'strongly significant'
n_2 –number of respondent answered 'significant'
n_3 –number of respondent answered 'average'
n_4 –number of respondent answered 'not significant'
n_5 –number of respondent answered 'strongly not significant' Kadir et. al. (2005)

Kappa statistic for multiple raters

Kappa statistics for multiple raters using categorical classifications was employed to test the level of agreement for respondents. This analytical tool is used to test the consistency of values and is employed when there are more than two raters and or subjects. The determination of is demonstrated as follows.

The overall kappa value for occurrence = $\frac{\quad_j \quad_j \quad_j}{\quad_j \quad_j}$

Where: j = category of rating, k = number of category, $_j$ = overall proportion of ratings $_j$ = overall proportion of non-ratings, $_j$ = kappa value per category, = overall kappa value

The break down to find the overall kappa value for occurrence is as follows

m = $\quad_{ij}$ (1)

= $\frac{\quad_i}{n}$ $\quad_i$ = n x (2)

$_j$= $\frac{\quad_i}{n \ x}$ (3)

$_j$ = 1- $\frac{\quad_{ij}(m-x_{ij})}{nm(m-1) \quad_j \quad_j}$ (4)

Where $_j$ = 1- $_j$

m = number of different raters, x_{ij} = number of ratings on a subject,
i = subject, n = number of subjects, j = category of rating, k = number of category
= mean number of ratings per subject, $_j$ = overall proportion of ratings,
$_j$ = overall proportion of non-ratings, $_j$ = kappa value per category, = overall kappa value

Green (1996) explained that a perfect agreement will exist when =1.00. Also, a high degree of agreement beyond chance is said to occur when kappa value is 0.75 ≤ 1.00. This means that there is no divergence in response from respondents. In addition when 0.40 ≤ < 0.75, a fair or good agreement is said to exist which gives the indication that there could be the possibility of divergence in opinions but not much. Finally when < 0.40, there is said to be the existence of low agreement beyond chance.

SURVEY FINDINGS

Response from Professionals

A total of 13 questionnaires were received comprising 6 Quantity surveyors, 2 Engineer and 5 Architects representing 46%, 15% and 39% respectively of which 43% work in the government sector and 57% in the private sector.

The research revealed that 72% of respondents have been involved in the design and construction of office buildings whereas 43% have been involved in re-design and refurbishments within the last 10yrs. The office buildings under development within this period have about 30-70% of walls made up predominantly of glass. Some of the glass used for the buildings are reflective glass, translucent glass, and laminated glass. The buildings described by the respondents were storey buildings having between three and thirteen floors.

From the respondent's perspective, out of ten office buildings to be built in Accra in future, there is the probability of having between 5 and 9 buildings having facades made extensively from glass. This brings out the need for sensitization on sustainable construction among the stakeholders in the construction industry in Ghana to be able to have economical and environmentally friendly buildings.

It was found out from the response that most of the time the use of glass is suggested by either the client or the architect for the following reasons:

- To achieve lightness of structure,
- To achieve flexibility in composition,
- To show formality, and financial status of client,
- Because it is the order of the day.

These were reasons that were supplied by the respondents in addition to those provided in the questionnaire for rating (table 1).

Table 1: professionals' rating of the probable factors that influence the extensive use of glass on facades of office buildings in Accra, where 1-very common, 2- common, 3-averagely common, 4-not common and 5-do not know

PROBABLE FACTORS	Respondents on Significance					Importance Index (I.I.)	Rank (I.I)
	1	2	3	4	5		
Aesthetics	12	0	0	0	0	1.000	1
To achieve modern looks	10	2	1	0	0	0.262	7
To regulate indoor temperature	1	3	5	2	0	0.545	5
To keep away dust from the office	0	5	4	2	1	0.583	3
To control solar ingress	2	2	3	5	0	0.583	3
To create access to external view	5	3	3	1	0	0.400	6
To control draft / wind movement indoors	0	2	8	2	0	0.600	2

From the response of the professionals, they all agreed that the factors that influence the extensive use of glass on facades of office buildings in Accra (table 1), was rated as follows

1. Aesthetics
2. To control draft / wind movement indoors
3. To keep away dust from the office
4. To control solar ingress
5. To regulate indoor temperature
6. To create access to external view
7. To achieve modern looks

From the above it can be deduced that aesthetics is the main factor that influences the extensive use of glass on facades of office buildings.

The variables listed in table 2 are suggested variables that must be considered to achieve sustainability in a building. The ratings of the professionals indicate that all the variables are considered however, natural ventilation emerged as the most considered variable this is followed by the other variables as follows:

Sun shading device, Natural lighting, Orientation of building, and Thermal comfort.

Table 2: professionals' rating of variables to be considered in sustainable tropical buildings, where 1-highly considered, 2-considered, 3- averagely, 4-least considered and 5-not considered

VARIABLES	Respondents on Significance					Importance Index (I.I.)	Rank (I.I)
	1	2	3	4	5		
Natural ventilation	6	2	4	1	0	0.800	1
Thermal comfort	6	2	3	1	0	0.383	5
Natural lighting	6	3	4	2	0	0.427	3
Sun shading device	4	3	3	2	1	0.492	2
Orientation of building	5	3	4	1	0	0.415	4

Response from Occupants

Table 3: answers to questions from occupants of office buildings.

	Yes (%)	No (%)	Partially (%)
Occupants in public buildings	88.89	11.11	0.00
Buildings with facade predominately of glass	69.39	30.61	0.00
Favourable working condition without artificial lighting during the day	42.00	56.00	2.00
Staying in the office without artificial ventilation	22.00	76.00	2.00
Windows openable?	61.70	36.17	2.13
Effective working with open windows	41.18	55.88	2.94
Opening of blinds whiles in office	35.42	52.08	12.50
Having a good view when looking outside your window	78.79	12.12	9.09
Effect on the ingress of the sun when windows are open	33.33	60.00	6.67
Satisfaction with indoor condition of the office	83.67	8.16	8.16

From the response of the occupants (table 3), it was revealed that:

- 88.89% of respondent were accommodated in public buildings.
- 69.39% of respondents were reported to have the office buildings predominantly of glass facade.
- 56.00% revealed unfavourable working condition without artificial lighting during the day. This gives indication that the light intensity in the rooms or offices is reduced due to the inadequate natural lighting.
- 76% cannot work or stay in the office building without mechanical or artificial ventilation, even though 61.70% had windows that can be opened.
- 55.88% occupants do not have favourable working conditions although majority indicated that the windows can be opened
- 35.42% do not open their blinds when in the office, despite the fact that 78.79% have good external view.
- 33.33% are affected by the ingress of the sun when windows are opened.
- 83.67% are satisfied with indoor conditions due to air conditioning and nice internal arrangements.

Concordance of response

As has been explained above, Kappa statistics for multiple raters using categorical classifications was employed to test the level of agreement among respondents.

The agreement among responses on factors that influence the extensive use of glass in office buildings can be tested by reference Table 1 as follows:

The overall kappa value for occurrence = $= \frac{\quad_{j\ j\ j}}{\quad_{j\ j}}$

From table 1

$_{j\ j\ j} = 0.854$ and

$_{j\ j} = 0.857$

$= \frac{0.854}{0.857} = 0.996 \approx 1.00$

From the results obtained, it can clearly be seen that there is a perfect level of agreement beyond chance in responses related to factors influencing the extensive use of glass in office buildings. This means that there existed no divergence in opinions on factors given, an indication that it pertains throughout the understudied area.

Table 2, dealt with the variables that are usually considered in designing. The level of agreement to the response received is given below:

The overall kappa value for occurrence $= \frac{\quad_{j\ j\ j}}{\quad_{j\ j}}$

From table 2

$_{j\ j\ j} = 0.795$ and

$_{j\ j} = 0.796$

$= \frac{0.796}{0.799} = 0.997 \approx 1.00$

From the results obtained, it can be interpreted that there exists a perfect level of agreement with respect to ratings of the variables considered in designing office buildings. This means that all the variables are taken into consideration in designing so as to make the office buildings user friendly.

DISCUSSION OF FINDINGS

One aim of sustainable construction is to create buildings with comfortable indoor environment through the use of appropriate materials, without compromising on our natural environment. From the literature review conducted, some writers on the use of glass in tropical regions observed that aesthetics is the main reason for the use of glass in buildings, Laar and Grimme (2002), and that architects do not really think about the problems that the use of glass brings because they think the problems will be taken care of mechanically. Viet (2008). From the research conducted there it has been found out that glass is extensively used on facades of office buildings in Accra and the use is mainly for aesthetic reasons and that there is the heavy reliance on mechanical aids to solve the problems like ventilation and natural lighting.

According to the professionals' response the factors that determine the extensive use of glass on facades of office buildings in Accra are aesthetics, to control draft / wind movement indoors, to keep away dust from the office, to control solar ingress, to regulate indoor temperature, to create access to external view and to achieve modern looks. Other reasons were, to achieve lightness of structure, to achieve flexibility in composition and to show formality, and financial status of client. Comparing with the reasons for the use of glass in buildings identified in the literature review (the need to make buildings lighter, the need to have high amount of natural daylighting in order to reduce electricity consumption through the use of artificial lighting, the need to create views, blending interior and exterior views, the need to control the solar and thermal heat in interiors thus maintaining temperatures at comfort levels, the need for designers and architects to have least restriction in capturing desired shapes and forms and the need to control noise. http/in.saint-gobain-glass.com (2011)), one realizes that the research findings is in agreement with what was identified in the literature review. However there is the need to take a second look at these reasons and find out if they are effectively implemented in terms of sustainable construction since the occupants response tell a different story.

CONCLUSION AND RECOMMENDATIONS`

Even though the use of glass is seen as the order of the day, its use must be done with consideration to the adverse effect it is likely to produce on the Ghanaian economy, society and environment. The increase in energy demand for example, can be reduced effectively by considering and implementing the identified requirements to sustainable construction. In as much as the use of glass is desirable for a number of reasons (especially aesthetics), there is the need to thoroughly investigate ways of incorporating the use of glass without compromising the natural environment and to provide natural comfort to inhabitants. It is important for professionals in the Ghanaian construction industry to pay more attention to what constitutes sustainable construction and takes steps towards achieving it.

REFERENCE

Bay, Joo-Hwa and Ong, Boon Lay, Tropical sustainable architecture: Social and environmental dimensions. 2006 Elsevier

Bolin, Rob (2009) Sustainability of the Building Envelope. National Institute of Building Sciences, www.wbdg.org/design/envelope, accessed 6th March, 2011

Brent Richard, Dennis Gilbert (2006) New Glass in Architecture. Laurence King Publishing, London

Department of Trade and Industry (2006) www.dti.gov.uk accessed from www.bis.gov.uk

www.epa.gov/waste/education/quest/gloss1a.htm

Green A. M. (1996) Kappa Statistics of Multiple Raters Using Categorical Classification

Halliday Sandy (2008) Sustainable Construction. Butterworth-Heinemann, Oxford

Kadir, M. R. A.et. al. (2005) Factors affecting construction labour productivity for Malaysian Residential Project, Structural Survey Vol. 1, Pp 42-54

Koenisberger O. H, Ingersoll T. G, Mayhew A, Szokolay S. V. (1980) Manual of Tropical Housing and Building. Longman Group Limited, London

Laar Michael and Grimme F. W. (2002) Sustainable Buildings in the Tropics RIO 02 - World Climate and Energy Event, January 6-11, 2002

Lloyd, Jones David, (1998) Architecture and the Environment – Bioclimatic Building Design. Laurence King Publishing. London

Mojaheed Shahrivar (2005), A project improvement system for effective management of construction projects, PHD Dissertation (unpublished)

Presley Adrien and Meade Laura (2010) Benchmarking for Sustainability: an Application to the sustainable construction industry. Benchmarking: an international Journal, Vol.17 No. 3 2010 pp 435-451 Emerald Group Publishing Limited.

Viet Trinh Hong (2009) Roles of everyday lifestyle in the city's built environment: the use of glass in Hanoi's new shop-houses:, Universitas 21 International Graduate Research Conference: Sustainable Cities for the Future Melbourne and Brisbane. Nov 29 – Dec 5, 2009

Smith,Peter F.(2006) Architecture in a climate of change – A guide to sustainable design, second edition. Architectural Press, Oxford

SOSA G. MARIA EUGENIA (2007), Facades design strategies in a warm-humid climate to reduce thermal loads in Venezuelan buildings, Revista de la Facultad de Ingenier a Universidad Central de Venezuela Rev. Fac. Ing. UCV vol.22 no.4 Caracas 2007

(http://www.nationsencyclopedia.com/Africa/Ghana-climate.html 2004)

(http://www.ghanaweb.com/GhanaHomePage/geography/climate.php, 2011)

UNEP,2007 Buildings Can Play a Key Role in Combating Climate Change. http://www.unep.org/Documents.Multilingual/Default.asp?DocumentID=502&ArticleID=5545&l=en

Stagno Bruno (2001) designing and building in the tropics (www.brunostagno.info/.../Designing%20and%20Building%20in%20the%20Tropics.doc -) 4th April, 2011

Smith, Peter F. (2006) Architecture in a climate of Change- A guide to sustainable Design second edition. Architectural Press, Oxford

http/in.saint-gobain-glass.com (2011) Role of Glass in Green Architecture, in.saint-gobain-glass.com/upload/files/glass-in-green-architecture.pdf. Accessed 6th March 2011.

FRAMEWORK ANALYSIS OF TECHNOLOGY AND DESIGN OF SUSTAINABLE AFFORDABLE HOUSING IN NIGERIA

Olatunji Olagunju[1], David Oloke, Felix Hammond and Pat Costello
School of Technology, University of Wolverhampton, Technology Center MI building City campus North Wulfruna street Wolverhampton WV1 1LY United Kingdom

Architectural firms have a crucial part to play in the design of sustainable homes as majority of the decisions that drive the production of affordable housing and affect the buildings energy performance are made by architects, at the design phase. With advancement in technology and engineering, designers can evaluate the energy performance of a building at the early stage of designing building process The code for sustainable homes was derived from a study organized by the government to aid the improvement and standards of new homes in the UK. Can this be utilized in Nigeria? For sustainable construction practices, designers should look at materials that were traditionally used by locals. With a huge housing shortfall in Nigeria and the government policy seemingly defective and unable to cope with demand due to budgetary constraints and other competing needs. The market economy approach along with flexible, efficient economic instruments are key factors to enable the construction industry to positively respond to sustainable development in terms of resource efficiencies and environmental protection in a developing economy. This research would aim to discuss the above and consider some possible solutions.

Keywords: affordable housing, environment, housing policy, sustainability.

INTRODUCTION

This paper will appraise issues surrounding the design and technological aspects in the provision of sustainable affordable housing units for a growing Nigerian population. It is hoped this will highlight some points for success. Key questions arise such as: *With technology can we design and build close to zero carbon homes and equally provide affordable housing? Is it fair to expect the same standards for affordable housing in a developing country like Nigeria as one would ask for in UK a developed country?*

The aim of the research would be to try to answer the above proposed questions including 'Is affordable housing in a developing country like Nigeria sustainable or is there a price to pay?'

In the pursuit of the aim of this research the study would also seek to achieve the following objectives: (1) Conduct a literature review; (2)Collect data that are relevant to the research questions; (3)Analyse same and finally (4)develop a framework model or toolkit that can aid the design and technological implementation of sustainable housing in Nigeria.

[1] Olatunji.Olagunju@wlv.ac.uk

Olagunju, O., Oloke, D., Hammond, F. and Costello, P. (2011) Framework analysis of technology and design of sustainable affordable housing in Nigeria *In:* Laryea, S., Leiringer, R. and Hughes, W. (Eds) *Procs West Africa Built Environment Research (WABER) Conference,* 19-21 July 2011, Accra, Ghana, 487-499.

Zero carbon buildings in bulk can be cost effective if properly designed and all supply chain parties are on board and committed. At present zero carbon homes are presumed to cost more on the onset than the standard homes built as materials used are still being further researched. (Obertelli 2010)(Marburger 2010) Although we are recently informed that zero carbon in the UK is not exactly zero anymore but close. (King 2011) However, if research and development continues and the policies are geared towards encouraging and ensuring green homes delivery, then the manufacturers would have no choice but to adhere. Affordability in housing definition will be dependent on income of buyers and the level of need.

With housing as such a high priority in Nigeria there is a struggle to balance this delivery with saving the environment. It is generally understood that there is the need to have zero carbon homes whilst also looking at various ways of providing the homes using materials that would be kind to the environment.

A key challenge of the introduction of any housing standards (both in grant funded housing or in the open market) is that they are implemented in a cost effective way in order to ensure their volumetric success (Barefoot and Gilles, 2009). Nigeria is a country with a large population of over 155 million people (CIA Fact book 2011) spread across a diverse micro climate of equatorial in south, tropical in the center and arid in the north. Its presently the 8th largest country in the world, the most populous in Africa with a multicultural and varied group of people of more than 250 ethnic groups. One of the main dilemma the country is facing is the provision of affordable housing. As more and more Nigerians make towns and cities their homes, the resulting social, economic, environmental and political challenges need to be urgently addressed (Raji, 2008) Home prices and rents have grown ahead of inflation and the composition of homes for sale and rent on the market has been inexorably shifting towards very expensive homes (Nubi 2008)

DESIGN CONSIDERATIONS

The Nigerian designers and architectural firms have a great part to play as architectural firms can aid the development of a green tomorrow. As **80% OF THE SUSTAINABLE DESIGN DECISIONS** that affect a building's energy performance are made by architects, at the design phase. With gradual advancement in technology and engineering, Architectural firms can evaluate the energy performance of a building at the early stage of designing a building process (Brown, 2007)

This unique position is echoed internationally as in a study undertaken on the future for architects by the Royal Institute of British Architects (RIBA) in 2010, architects were quoted as saying that they expect to be crucial to decision making and initiating the design of buildings for the future. As architecture is an art in which habitable spaces are created and a relationship between man and his environment is forged, it has logically become a discipline that at times embraces environmentally friendly strategies (Marmol and Radziner, 2008) it however should always embrace environmental strategies as its paramount to satisfying the design brief and the client. Ethics in architecture are essential, if the objective is to increase environmental awareness and create a sustainable world. (Chueca, 2009) The designers will invariably be a voice for the protection of the earth and its resources.

Nigeria being a country with a unique population of people that spans various climatic, cultural and geographic zones, therefore the housing requirement varies across these zones. Preferably the design that would be required for the arid northern states will be quite different from the design and building materials for the swampy riverine humid regions. The primary function of all buildings is to adapt to the prevailing climate and provide an internal and external environment that is comfortable and conducive to the occupants. However, in this era of climate change and global warming, providing comfort for the occupants of a building is quite challenging and very fundamental. (Akande,2010)

Prior to commencement of any development, the designers training gives understanding that adaptation to local conditions means that a site must be studied with respect to nature, climate and community structure, as well as human activities. In order to achieve harmony with nature and for people, the conditions of the site must be used as the point of departure for planning. Existing development is made use of and environmentally adapted. (Bokalders and Block, 2010)

HOUSING ISSUES AND AFFORDABILITY

The low income of the average Nigerian makes home ownership challenging. A third of the nation in the lower income bracket can't get on the housing ladder. A fifth earn less than £30.00 per month (Oluwaluyi, 2008) with Lagos being one of the worst in the country. Land prices are highest in Lagos and unaffordable to a good proportion. There are no jobs and the population is rising. Waiting lists are long for rental apartments, and landlords charge a premium with tenants paying almost half their salaries on rent. (Daramola S and Aina, 2004)

Affordability is generally accepted as a household paying no more than 30% income for their housing, and the populace are considered cost burdened otherwise, as difficulties can arise in paying for other things like food, clothing, transport and medical care. (US dept of housing and urban devt. 2011)

The Minister of State Works and Housing and Urban Development in 2009, Mrs. Grace Ekpiwhere, was quoted as saying that Nigeria had an estimated 16 million housing shortfall. (This day, 2009) Also a claim that housing production would catch up by government and the private sector partnering to build at a rate of 400,000 new units per year seems untenable and unjustifiable. Building pace has been nowhere near that and present indications don't show any improvement on how the policy would bring that about. Acquiring mortgage debt is an insidious problem in Nigeria because of the imbalance of cost of building to an individuals earning power. Since the majority of the methods required in constructing a house are monopolised. As it were, these companies can fix the prices for the bricks, blocks and cement needed for construction (Nnanna, 2010)

The Nigerian building and construction industry last year contributed 1.98% to the GDP the highest contributor at 18% was the wholesale and retail arm closely followed by the oil and gas industry at 16% contributions (The Nigerian bureau of statistics). There is therefore the need for higher contribution from the housing sector and a need to make it a more sustainable process.

Present governments in developing countries like Nigeria do not take on this responsibility adequately to provide social housing. For example the Lagos state property development corporation (LSDPC) is an organisation in Lagos which has become a government enterprise that’s solely profit driven. They have adopted a policy to only build in areas that would generate the highest returns. The organisation commenced as a government parastatal and is now an autonomous organisation.

Nigeria has a long unenviable history of civil-military political cycles, the state seems to be perpetually in crisis. The country's several democratization attempts and the interchange with military rule, most of which often come with great promises, have failed with the result that both forms of government are now largely doubted by majority of the ordinary citizens. (Yagboyaju, 2010)

KEY INFLUENCES ON TECHNOLOGY AND DESIGN

Adaptation to nature: The local geography, geology, hydrology, flora and fauna, as well as micro climate should be studied. The results from this study would be the basis for building and layout. Adapting buildings to the local climate saves energy. Adapting to natural surroundings is positive for biological diversity and land based industries. As mentioned previously Nigeria is spread across micro climates that would have different impact on the various building materials available.

Social structure: Development of a sustainable society. Infrastructure and buildings should be planned so that transport needs are minimized. To achieve this, a multifunctional community connected by a well developed public transit system is required. The requirement is usually for the local government to provide the primary services like main roads, it would be beneficial if pedestrian walkways and bicycle paths are better incorporated in the designs as this is not the norm in many present developer schemes in Nigeria. Pedestrian and bicycle traffic should serve as a starting point for planning. Towns, communities and rural settlements must be integrated into a network structure.

Existing Buildings – Environmental adaptation of existing buildings, is required as they make up a good proportion of the total building stock. To achieve sustainable development, existing buildings must also be more healthy and resource efficient, better adapted to ecological cycles, to local conditions and the rest of the community. A huge effort is needed for this type of conversion, as the norm is for existing buildings on big developer sites tend to be demolished. However when local buildings utilizing local materials are remaining on site, it could be ideal to analyze the previous usage and see if this can be incorporated into the new development.

People: Building with people as the starting point. The goal should be to build a humane society with room for everyone. Safety, comfort and beauty make us feel good. Sometimes we need to be alone and sometimes with others. There should be opportunities at different levels to participate in community development. How can segregation and fear be avoided, and how do we make towns and communities flourish. (Bokalders and Block, 2010)

A holistic approach is adopted in this paper as a means of ensuring a useful outcome that recommends techniques that are deliverable at a reasonable cost both financially and environmentally. Architects should be at the forefront of this as they would be immediately involved from inception. The planning design and specification of the housing units will determine the materials to be used and the procurement methods to be utilized.

Housing delivery systems have been classified as developmentally-orientated or conventionally-orientated. It has been claimed that a developmentally-orientated approach to building procurement would encompass the parameters of community empowerment and participation in design, job creation via the development process, and economically and environmentally-sustainable procurement (Taylor and Norval 1995). However especially in upcoming developments in Nigeria, new building procurement systems display an increasing awareness of sustainability, but concentrate on economic and social sustainability, as opposed to environmental sustainability. (Dalgliesh, *et al*, 1997)

To commence in the local areas requires initiatives at the neighbourhood level supported by changes in the enabling environment. Changes such as housing finance policies and mechanisms that channel resources to the informal private sector for the provision of housing and access to land for low-income housing by individuals and small-scale developers and private entrepreneurs. (Ogu and Ogbuozobe, 2001) Planning and building regulations, and building materials to facilitate the production of new low-cost and low-income housing units

Population increase and city condition led to an expedite demand for new buildings, and concentrated stance on the importance of local building materials and techniques. In many parts of the world, such materials and techniques are widely used and help meet the growing demand for low-cost housing. Methods of improving such materials and technologies and for combining them in new ways are constantly being developed. (Gentileschi, 1999) However, the production of indigenous building materials requires that technologies are tested, tried, and above all, widely known at the local level. In some cases, it is dissemination of technological innovations is limited by the inability of local institutions to translate research findings to commercial scale operations and to self-help builders. Although the pace of research is slow, the Nigerian Building and Road Research Institute (NBRRI) is expected to be at the forefront of this exercise as is the case with the British Research Establishment (BRE) is in the UK and US Green building council (USGBC) in the USA .

Government Policies

The Nigerian government policies for housing development in the past have not been helpful to majority of developers. What is needed therefore are policies that are in tune with local realities, and are flexible and responsive to change. This is best achieved with home-grown policies. (Nubi and Oyalowo 2010) Turning enabling policy into effective practice requires far-reaching changes, involving a complex combination of development actors who bring their own perspectives on participation to bear on attempts to close the gap between principles and reality, and between the potential for action and the concrete activities (Cornwall, 2002).

One of the major problems facing private developers in Nigeria was the lack of finance to embark on meaningful housing delivery services amongst others. It is recommended that government housing policy need to be proactive, most especially in respect of addressing delay in getting registration on lands. The government should also focus its attention on the problem of poor infrastructural facilities; this is believed is necessary for more developments to take place in the real property market in Nigeria. (Gbadeyan 2011) Also with the uncertainty surrounding land ownership, efficient land markets and sustainable land use policies are indispensable and there is need to change the Land Use Decree to a more housing friendly legislation. (Ajanlekoko, 2001) Its also claimed that government efforts should be directed on social housing, this its said will force the three tiers of government to develop housing for disabled, elderly, single mothers and poor people who can't meet their own housing needs (Arigbola 2006) Its predicted Nigeria has the largest expected contribution from population growth over the next 40 years, which will significantly increase its working age population contributing to GDP growth. (Hawksworth and Tiwari, 2011)

Nigerian Building technology and Nigerian Building and Road Research Institute - NBRRI

The NBRRI a parastatal under the aegis of the Nigerian Federal Ministry of Science and Technology established in 1978. They have a mission to improve the quality of life of Nigerians in the area of affordable housing and increased economic empowerment through integrated research and development in building, road and engineering materials sector.

Their key mandates are (1). Research into local building and construction materials to determine the most effective and economic methods of their utilization and (2). Architectural design of buildings to suit the Nigerian climatic conditions with respect to lighting, ventilation, thermal comfort and humidity. (NBRRI website)

Some achievements have been made by NBRRI to date. These include producing brick making machines for cement stabilized bricks and blocks, fibre concrete roofing tiles and a few other machinery. However, there is the need for further proactive research to create more sustainable materials for the building industry and actually achieve their mission.

RESEARCHING EMERGING TECHNIQUES IN CONSTRUCTION DELIVERY

Government needs to create a research unit of expert consultants who will help and advise, making sure that developers and house builders maximize the potential of sustainable materials and off-site for each individual project by adopting and adapting the techniques and materials best suited to their own specific area requirements:

Fast delivery, creating large volumes of housing units quickly and easily

On time to meet critical target dates, such as new owners/tenants and terms

Exact repeatability every time, to house-builder/developers own particular specification

Minimizing disruption on active sites, with fewer build processes, contractors and deliveries

Viability allows better funding options, with various commercial arrangements and specialist funders

Research indicates that off-site can play a significant part in delivering sustainable construction. Technology and design by the architects should be emphasised and government policies should be geared towards helping off-site system manufacturers and the clients who specify them to promote and exploit the environmental benefits of off-site techniques. (Goss, 2010)

The growing demands on the construction industry to improve its environmental performance make it essential to integrate environmental and sustainability requirements into building design at the earliest possible stage.

Available building materials

The supply of low-cost but durable building materials is almost universally recognised as a major obstacle to improved housing conditions in developing countries, whether in urban or rural areas. There is a growing interest in the use of building materials that can be produced entirely from local resources, using simple small-scale production technologies to provide durable building materials at a cost that is affordable by the majority of potential builders. New building technologies that rely on locally available materials are likely to have the most significant impact. (Okwo and Soboyejo, 2006)

Despite the potential contributions of indigenous materials to the construction sector and national economies, and despite the opportunities that exist to promote these materials in several countries, the successful development of these materials has been restricted to a few countries only. The transfer of technologies between countries and establishment of a framework to identify and receive requisite technologies can overcome this limitation. This was highlighted by the Habitat Agenda, which stated that “International organizations have an important role to play in disseminating and facilitating access to information on technologies available for transfer” (paragraph 205, UN Habitat)

The way materials are organised, shaped and connected or configured is fundamental to attaining structural quality and durability of dwellings. Most functions of materials are tied to the physical safety and integrity of the building while some other functions are equally tied to operational and aesthetic aspects.

Cost comparison of available walling materials in Makurdi metropolis for example in Nigeria showed that the use of laterite bricks made from 45% sand and 5% cement resulted in a saving of 30 - 47% when compared with the use of sandcrete blocks while the use of fired clay bricks resulted in a savings of 19% per square meter of wall. The study therefore recommends the use of laterite bricks in Makurdi and other locations because it is more economical and environmental friendly than fired clay bricks. (Agbede, and Manasseh, 2008)

Also research is being done into using cement-fibres composite panels made of cement reinforced with palm kernel shaft, a by-product of oil palm for cost-efficient and low-cost building panels for walls and ceilings. Data from the field survey on 10 buildings shows that cement-bonded composite panels are comparatively cheaper, sound-proof, durable, lighter-weight and environmentally friendly than the conventional sandcrete blocks and asbestos ceiling board.(Adedeji and Ajayi, 2008)

Achieving cost efficiency by accelerated sustainable building can be by using for example Interlocking bricks. It’s crucial to accelerate the construction process as the traditional method can be laborious and slow. Efforts are being made to increase productivity through using different types of interlocking blocks (Adedeji, 2005)

In the rural areas of Nigeria, local materials are usually the most common, used because of the cost and time savings. One example of sustainable construction materials is adobe. In West Asia, North Africa, West Africa, South America, South-western and North America, and Spain adobe is used to construct all kinds of buildings. Not only is there almost no energy consumed in transportation, but the material is found everywhere. Many people simply use the adobe found right on the land where they are building. You will of course need a frame for support, but the adobe mixture is very strong and the home is somewhat naturally insulated because of the thickness of the walls and the density of the adobe itself. Once the home is built, the occupants will find lowered electric bills and less energy consumption than their neighbours who may not have used sustainable building materials, or indeed may not have Sustainable Homes (http://www.sustainablebuildingmaterials.net/)

RESEARCH METHODS

For the analysis and Interpretation of this research the quantitative and also qualitative methods have been chosen.

The quantitative research approach offers results in precise measurements and tends to be good for confirmation and deduction. Determining the relationship between one and the other is usually achievable. It's found to be good for knowing how many or how much, as some data is in the form of numbers and statistics. Quantitative research is objective and seeks precise measurements and analysis of target concepts. It's been employed for the user's surveys and questionnaires as it's more efficient and able to test hypothesis.

Qualitative – As this is usually recommended during the earlier phases of the research project, (Neill, J 2007) the design would emerge as the study unfolds. The data is in the form of words, pictures or objects. Qualitative research is subjective and individual's interpretation of events is important, e.g. uses participant observations and in depth interviews. This has commenced and is proceeding well. The qualitative method is also richer though time consuming, but less able to be generalized. The case study type of qualitative was also selected. Creswell (1998) defines the case study as an exportation of a bounded system or a case (multiple cases) over time through detailed in depth data collection involving multiple sources of information rich in context. Some consider "the case" as an object of study (e.g. Stake, 1995) while others consider it a methodology (e.g. Merrian 1998) According to Creswell, the bounded system is bounded by time and place and it is the case being studied.

<u>The Code for Sustainable Home</u>

Launched by the Government in 2007 the Code for Sustainable Homes replaces EcoHomes as the National standard to be used in the design and construction of new-build residential properties in England. The code is a set of sustainable design principles covering performance in 9 key areas: 1.) Energy and CO2 emissions, 2.) Water, 3.) Materials, 4.) Surface water run-off, 5.) Waste, 6.) Pollution, 7.) Health and well-being, 8.) Management, 9.) Ecology. The code uses a rating system of 1-6 stars and involves a Design Stage Report and a Post Construction Report which is submitted to the Building Research Establishment to provide a final code certificate. Formal code assessment of new-build dwellings can only be carried out by a suitably qualified licensed and registered, Code Assessor. Developers wishing to lead the field in sustainable development will want to have their developments assessed under the code as soon as possible in the project life cycle to achieve as high a code as possible. (Department for communities and local government, 2007)

These codes need to be adopted by the developing countries like Nigeria and even though they are beginning to realise the importance of sustainable development its been difficult to get out of the starting blocks due to other more pressing issues like rapid development of slums, transportation and ensuring reduction of building collapses prevalent in the country as an outcome of poor adherence to existing policies and codes. There is therefore a need to police the builders further and also to weed out corrupt practices amongst the officials, as a result of slack supervision and unprofessional conduct at different levels.

The code focuses on how these problems highlighted can be tackled right from the onset in the design aspect before the building gets to the construction phase. Analysis of existing regulations indicates that developing countries need to ensure that these requirements are adhered to as long time development can only be sustained if the design and materials are coordinated adequately with the right supervision for an efficient delivery. Inefficiency is the bedrock of failure in trying to create a guideline.

Adequate design will improve production taking cognizance of locality and culture. There is waste generated in energy, in developing countries inadequate power supply, an influx of individually generated power from home owners. The desire to create a thermal environment that would satisfy the human body condition has created the need for air conditioners in every room in the house, this is obviously not viable for affordable housing. Good design and usage of materials would eliminate this and make the house more affordable to run and maintain. Shared water supply source would negate the need for each home to have a borehole and a shared filtered ground source would supply a maximum number of householders creating a good economy of scale in delivery. A mix of climate appropriate design will make the delivery better and reduce running costs of buildings. Solar orientation of buildings to allow good cross ventilation. Reduction in water usage, rainwater harvesting techniques and good sanitation are some of the all-important infrastructure and service requirements.

Toolkit

A toolkit is being proposed and its likely to be developed in three parts namely (a) the principles will be highlighted, (b) the process will be shown and finally (c) case studies will be used to highlight the practical resource aspects. Its meant to help interpret the findings based on the information gathered using the 9 key areas of the sustainable code. This would be used as the key resource to draw conclusions on the way forward. It will serve to aid the users namely government planners and decision makers, house builders and home owners to make decisions. The toolkit can be defined as something focused around conscious, repeatable methods for gathering raw research from multiple sources in specific contexts and transforming it into real insight and information. (Beecher, 2008) It’s proposed that the toolkit will have a sustainability and affordability checklist as well as a menu of potential performance indicators.

This would be a systematic analysis of the prevailing surrounding situation to come to the most appropriate technological sustainable design for any proposed project. The toolkit as said will aim to look at the 9 key areas of the sustainable code focusing on design and technology of the materials as well as other factors surrounding creating affordable housing in a sustainable way. Energy and CO2 emissions is one of the bigger issues for sustainability and good designs can be created for the varied Nigerian climate by combining energy efficient construction with passive heating and cooling to achieve a sustainable society. Future buildings must be energy efficient, and energy conservation measures must be adopted in existing buildings.

The adaptation to Natural surroundings and the people in the area is also significant to forming a seamless relationship with all parties involved in the development.

In the UK the code for sustainable Homes and the ever tightening building regulations have had a big impact on house builders and ensured changed building practices. Likewise legislation needs to drive the move towards sustainability in the built environment in Nigeria.

The government needs to give incentives to consumers reducing their cost and to producers making it more viable to produce. As research meliorates the range of innovative materials and solutions for house builders to choose from also improves and helps to satisfy discerning consumers.

By 2020 45% of global construction is projected will be in emerging markets like Nigeria. Over the next decade infrastructure construction is expected to grow by 128%

in emerging markets compared with 18% projected growth in developed markets.(RICS 2010) While 70% of the global population will live in urban areas by 2050 (World fact book 2010) Affordable housing is therefore a key issue to target to avoid urban slums.

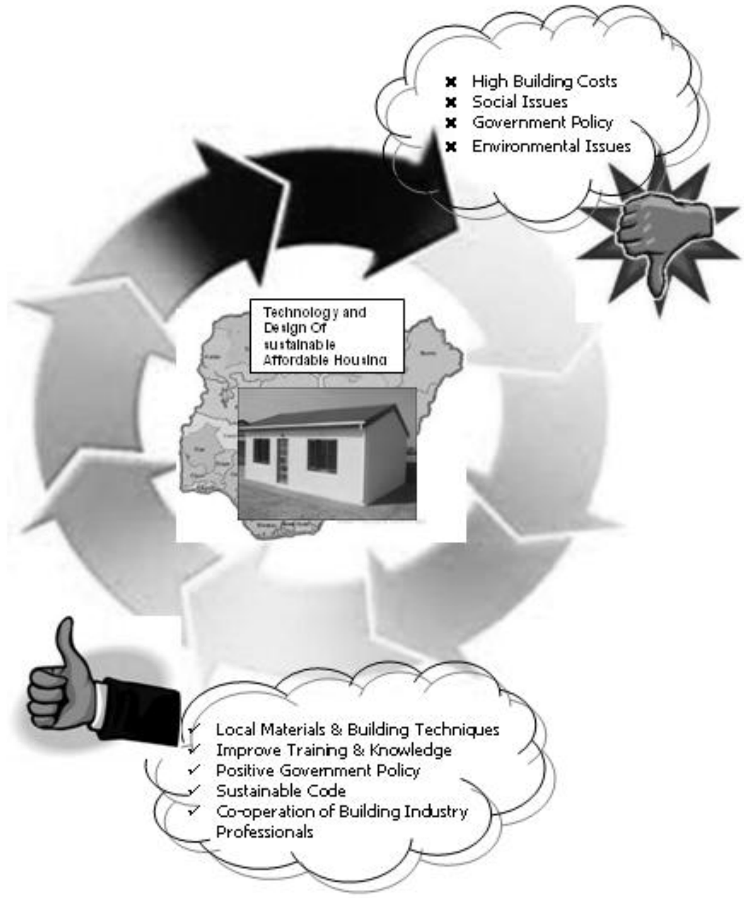


FIGURE 1

CONCLUSION

High building costs, environmental and social issues in the different micro climates in Nigeria are predominant. (FIGURE 1) There is a need for greater interaction and communication between policy, research and practice. The Government needs to be more proactive to create an enabling environment for improving the building codes and its proper implementation. This can be done by participating with the research and private sectors to create a sustainability code suitable for Nigeria that would highlight the beneficial aspects of the materials used in terms of energy efficiency and reduced costs.

Hence there is a need to have a revised building regulation that would ensure delivery of buildings by utilising materials that would be environmentally friendly and sustainable on the long term. Proper training of the local built environment professionals is cardinal as there is evidence of a dearth of knowledge of sustainability and zero carbon developments across the board. The degree of research that's being done by for example the NBRRI is still inferior. The professionals need to share knowledge and gather relevant data for improved shared research.

To facilitate this objective, there needs to be a comprehensive review of the energy policies in force today, going on to how the low carbon buildings can be made a reality with the relevant interventions in design and innovative materials and how the value and cost savings from operational performance would make these affordable housing buildings a viable proposition. As we have noted from the UK the focus is to have all new builds achieving near zero carbon by 2016, the provision of affordable housing is ongoing and hence the designers and developers have to be more creative and resourceful in the specification of materials and on site installation process in order to accomplish this.

As this research progresses, it is envisaged that appropriate outcomes and processes that would assist the designers and policy makers in drawing up a sufficient energy code enabling the specification of the right/available local materials to ensure sustainable affordable build in different microclimates all over Nigeria would emerge.

REFERENCES

Akande, O K and Adebamowo, M (2010)– Indoor thermal comfort for residential buildings in hot-dry climate of Nigeria proceedings of conference:adapting to change, new thinking on comfort – Cumberland Lodge Windsor UK 9-11 April 2010 Network for comfort and Energy use in buildings.

Adedeji, Y.M.D AND B. AJAYI, (2008) Cost effective composite building panels for walls and ceilings in Nigeria, Department of Architecture, Federal University of Technology, Akure, Nigeria and Department of Forestry and Wood Technology, Federal University of Technology, Akure, Nigeria

Adedeji, Y.M.D (2005) -Sustainable Low-Cost Housing Technology in cities: Accelerated Construction Initiatives Option – Journal of Land Use and Development Studies Vol. 1, No. 1, 2005

Agbede, I O and Manasseh, J (2008) - Use of Cement-Sand Admixture in Laterite Brick Production for Low Cost Housing- dept. of civil engineering Univ. of Agriculture, Makurdi, Benue state, Nigeria

Ajanlekoko, J S- FNIQS – Sustainable housing development in Nigeria - The financial and infrastructural Implication – international conference for spatial information for sustainable development in Nairobi, Kenya - October 2001

Aribigbola, A (2008) Housing Policy Formulation in Developing Countries: Evidence of Program Implementation from Akure Ondo State Nigeria. Dept of Geography and planning sciences, Adekunle Ajasin University Ondo State

Barefoot and Gilles, 2009 – Specialist Architectural practice in East London

Beecher, Fred (2008) Sr. User Experience Consultant Evantage Consulting (Interaction design association- IxDA)

Bokalders, V and Block, M (2010) The whole building handbook – How to design healthy, efficient and sustainable buildings. Earthscan and RIBA publishing

Brown, G - (2007) the Editor and mentor of Architectural Evangelist, A BIM consultant and 3D expert

Chueca, P- 2009, Today's City Houses - Architectural design, Links International Press

Cornwall, Andrea (2002). Beneficiary, Consumer, Citizen: Perspectives on Participation for Poverty Reduction, Swedish International Development Agency

Dalgliesh, C D, Bowen, P A and Hill, R C (1997) Environmental sustainability in the delivery of affordable housing in South Africa. Engineering, Construction and Architectural Management, 4(1), 23-39.

Daramola, S A and Aina O 2004 - Planning policies and affordable housing in Nigeria – An analysis of Abuja Master Plan Scheme and the re-validation of Certificate of Occupancy.

Gbadeyan, RA, 2011 Private sectors contributions to the development of the Nigerian Housing Market. Institute of public administration and management (ipam), Department of business Administration, University of Sierra Leone, Tower Hill, Freetown, Sierra Leone

Gentileschi,L,M 1999- Changing attitudes to traditional houses / Sardinia Island -Italy. http://www.csiwisepractices.org/?read=22 assessed 12/01/2011

Hawksworth, J and Tiwari, A 2011- The world in 2050, The accelerating shift of global economic power: challenges and opportunities, PWC economics practice London

Iweka, A and Adebayo A – Improving housing durability in deprived settlements of Lagos Megacity through ingenious use of sustainable indigenous materials.

Kabir, B and Bustani S A (2008), A review of housing delivery efforts in Nigeria, department of building, faculty of environmental design, Ahmadu Bello University- Zaria Nigeria

King, P (2011)- article on 230311 (UKGBCwebsite) Executive of the UK green building council assessed 05042011

Marmol, L and Radziner, R (2008) Between architecture and construction, Princeton architectural press (1st edition 15 May 2008)

Marburger, L, 2010 – High performance home building guide for Habitat for humanity affiliates.-Federation of American Scientists (FAS) guide accessed on the 4th April 2011 (http://www.fas.org/programs/energy/btech/advanced%20technologies/Habitat %20high%20performance%20guide.pdf) pg. 5

Nnanna, J.V (2010) Housing Crisis: A theoretical study of the home building industry in Nigeria. Graduate college of Business administration Argosy University Dallas, Texas USA

Nubi, T and Oyalowo B, 2010 – Housing Finance between social needs and economic realities: The dilemma of policy transfer under Neo-Liberalism.

Nubi O T 2008 - Affordable housing delivery in Nigeria. The South African foundation International conference and exhibition Cape town, October 2008, pp 1 -18

Obertelli, J – (2010) – Green homes will constrain affordable housing: Article in www.insidehousing.co.uk of 11th January 2010 assessed 03/02/2011

Ogu, Vincent I. and Joseph E. Ogbuozobe (2001). “Housing policy in Nigeria: towards enablement of private housing development”, Habitat International, vol. 25, issue 4, December 2001.

Okwo, A and Soboyejo, W O (2006) – An alternative holistic approach to affordable housing:Homes of foam. Perspectives on global development and technology Vol. 5 Issues 1-2 pgs 1-30

Oluwaluyi, Abiodun- 2008 International Housing Conference Nigerian Institution of Estate Surveyors and valuers, Lagos state Branch 2008.

The Central Intelligence Agency: The world fact book, 2010

This day newspaper, 2009 Article titled 'Country has 16 million housing shortfall – Minister 24/06/2009 http://allafrica.com/stories/200906240453.html assessed 02102010

Raji, O.2008-Public and private developers as agents in urban housing delivery in sub-saharan Africa. The situation in Lagos State, Humanity of social sciences journal, Vol 3, No. 2: pp 143-150.

RIBA , 2010 -The Future for architects (a report by the Royal Institute of British Architects) www.buildingfutures.org.uk assessed 03022011

RICS 2010 global construction forecast http://www.sustainablebuildingmaterials.net/ assessed in 2/03/2011

United Nations Economic and social council, 2004 -Creating an enabling environment for successful poverty, reduction initiatives --Subcommittee on Poverty Reduction Practices First session 30 June-2 July 2004 Bangkok

UN Habitat, 2008-Chapter three of UN Habitat annual report for 2008

US dept of housing and urban development. 2011, community planning and development - Article on 'who needs affordable housing?' http://www.hud.gov/offices/cpd/affordablehousing/assessed 15/04/2011

Yagboyaju, D,A (2010) The state and governance crisis in Nigeria, College press Ibadan, Nigeria.

FRAMEWORK FOR PERFORMANCE-BASED POST-OCCUPANCY EVALUATION OF EDUCATIONAL INSTITUTION BUILDINGS IN NIGERIA

Aliyu Suleiman Shika[1] and Abubakar Abdulazeez Dardau
Department of Building, Faculty of Environmental Design, Ahmadu Bello University, Zaria

Performance-based criteria for post-occupancy evaluation (POE) for individual buildings are based typically on the stated design intent and criteria contained in or inferred from a functional program. Assessment of performance of buildings of institutions delivering higher educational services has become a matter of particular interest to governments seeking to increase the effectiveness of educational provision and maximize value for money. This paper presents the characteristics of important aspects of a performance evaluation approach related to higher education properties, with the aim of developing a general guideline for the POE practice specifically for institutional buildings in Nigeria. The main objectives are firstly, to review and analyse the government and institutional building performance, secondly, to determine the occupants' satisfaction level, thirdly, to determine the correlation between building performance and occupants' satisfaction level. It will evaluate specific aspects of planning and detailed design as well as match performance against design expectations within the ambits of budget for capital project in terms of function, accessibility, purpose, economy, aesthetics, experiences and environmental quality in institution of higher learning in Nigeria. Data required for the study will be mainly numerical and direct observations at the scene of occurrence.

Keywords: accessibility, economy, performance evaluation, post-occupancy evaluation.

INTRODUCTION

There is a growing concern for organizations to structure their built asset to enhance the performance of their primary processes or core businesses. Building performance evaluation provides this platform as it is now assuming a prominent place in the strategic plans of most business concerns (Then, 2003) in (Okolie, 2009). Barrett and Baldry, (2003) opines that building evaluations are broadly divided into; user-based systems and expert-based systems. The user-based system uses a building's occupants to evaluate the suitability of a building for their particular needs and hence is also known as post-occupancy evaluation (POE). The expert-based evaluation relies on experts' assessments and typically covers far more areas, such as provision for information technology, organizational growth, energy efficiency and changes in work style. Accordingly, the building performance evaluation seeks to assess the extent to which a building after construction, occupation and use meets its conception and design purpose (Ornstein and Ono, 2009; Obiegbu, 2004).

[1] ssaliyu@abu.edu.ng; asshika1@gmail.com

Shika, A.S. and Dardau, A.A. (2011) Framework for performance-based post-occupancy evaluation of educational institution buildings in Nigeria *In:* Laryea, S., Leiringer, R. and Hughes, W. (Eds) *Procs West Africa Built Environment Research (WABER) Conference,* 19-21 July 2011, Accra, Ghana, 501-508.

Facility performance evaluation allows an organization to establish its position through the careful and consistent evaluation of facility performance; it stimulates action through identifying what is to be done, who is required to act and in what manner (Barrett and Baldry, 2003).

This suggests that the objective of performance evaluation is not limited to optimizing the running costs of buildings; though that is important, but encompasses other strategic management issues in an organization. For construction organizations, it encompasses the design and management of space and related assets for people and processes in such a way as to support the achievement of organizational mission and goals (Amaratunga and Baldry, 2002). As external and internal factors place more demands upon facilities in an organization, resources must be suitably combined for efficiency and cost. Performance evaluation explicitly focuses attention on feedback loops and this influences behaviour. For educational institutions, this feedback loop influences the overall project design for improved performance and flexibility. Facility performance provides a mechanism to learn from the past and evaluates contemporary future trends in the use of facilities (Cots, 1992; Lackney, 2001). It is therefore believed that the collection, interpretation and analysis of information about performance of buildings provide the key to better planning and design for the future.

LITERATURE REVIEW

Building Performance Evaluation Concept

To lay a theoretical foundation /framework for this study, a review of related literature is necessary. This frame-work, according to Bak (2004) is vital for guiding the research, ensuring coherence and establishing the boundaries of the study. The role of building performance evaluation in facilitating organizational performance is widely acknowledged. Amaratunga and Baldry (2002) stated that performance evaluation is a key factor in ensuring the successful implementation of organizational strategy. They maintain that it does not only play a vital role but also provides standards for establishing comparisons. Omirin (2005) in her contribution states that it is a very important tool for strategic studies, budget preparation, and organizational change.

In simple terms, performance has been defined in BS 5240 as the behavior of a product in use. It can be used in this context to describe the physical performance characteristics of a building as a whole and of its parts (Cliff and Buttler, 1995). It therefore relates to a building's ability to contribute to fulfilling the functions of its intended use. To make it clearer, it involves the inspection of a building between one and five years after its completion, and assessing whether and to what extent it has met its design goals for resource consumption and occupant satisfaction. The primary purpose of Building Performance Evaluation is to improve design practice. The methodology includes reviews of design documentation, interviews with operators and occupants, site inspection, analysis of utility data and occupant satisfaction surveys. Finally feedback is provided to the design team. Generally, Barrett and Baldry (2003) report that building performance evaluation can serve two broad purposes, namely; Improves current situations; and Aid in the design of future buildings (briefing). Douglas (1996) outlines specific areas where evaluation of buildings can be useful. These include:

Property portfolio review, acquisition and disposal; Highlighting the areas a building is lacking in performance; Helping in prioritizing maintenance or remodeling works;

Providing identification of performance or early warning signs of obsolescence in buildings; and Assisting in achieving value for money from building assets through achievements as well failures.

Baird (1996) maintains that the benefits of evaluation include: Better matching of demand and supply; improved productivity within the workplace; Minimization of occupancy costs; Increased user satisfaction; Certainty of management and design decision making; and higher returns on investment in buildings and people. It is obvious from the above, that building performance evaluation should be considered a potential success factor by the facilities manager. Building performance is important in both inter and intra building sense. Douglas (1996) distinguishes between inter and intra building evaluation by stating that inter building evaluation takes place when one building is compared against another building. Douglas (1996) further states that this is important where clients or occupiers are undertaking a comparative analysis of various properties for acquisition or portfolio assessment purposes. On the other hand, intra building evaluation takes place when the building is assessed on its own without direct reference to other properties. The goal here, according to Douglas (1996) is to ascertain how well the building is serving the needs of the occupier or identify any major deficiencies in its overall performance. It is in the later sense that this research is anchored which is in tandem with the definition of building performance evaluation earlier adopted for this study.

The Facilities Management Functions in Building Performance

From the standpoint of commercial property, facilities management means the coordination of management functions which concentrate on the interface between the physical work-place and people. But from the non-commercial property standpoint, the functions concentrate on the interface between the physical use-place and people (Hakkinen and Nuutinen, 2007). The premise of this view, according to the authors, is that facilities management has a role to play in supporting organizational effectiveness in a non-commercial context and buildings in educational institutions are no exceptions. Whatever the definition is, the consensus among authors is that facility management is not only about buildings, but also about the people that occupy the spaces within the buildings, the processes they are supporting within known constraints of available resources and the prevailing corporate culture (Then, 2003). Given the significance of buildings, it will be difficult to argue that they do not have a role to play in sustaining the core business in an organization. If this role is to be fully understood, Lavy and Bilbo (2009) submit that facilities maintenance managers must have some way of determining the extent to which buildings under their control affect the performance of business in an organization. This further suggests that a facilities manager needs adequate knowledge of building performance evaluation or building diagnostics. Building diagnostics is the systematic study and evaluation of building performance. It is sometimes used to describe facility performance evaluation activities (Preiser, 2005). Douglas (1996) argues that building diagnostics is very relevant to facility management and as part of facility performance evaluation; it should be considered as a potential success factor to the organization. Douglas (1996) concludes that whether or not it is a critical success factor depends on the circumstances and needs of the organization. However, the methodology for this study is not clear and must therefore be interpreted with caution.

In his work titled “post occupancy evaluation; how to make our buildings work better” Preiser (1995) opines that performance evaluation of buildings is a toolkit for facility managers. Preiser (1995) submits that the technique can be used for trouble shooting at the early planning and pre-design phases of a project. Thus, it can supply valuable advice on building performance aspects of specialized systems and materials as well as shed light on maintenance and operating costs. The other areas the tool can be useful to facilities managers include problem identification of performance issues in occupied facilities, intra-agency feed forward of design and guidance criteria to improve future facility performance and documentation of data for litigation purposes. This is because when facilities malfunction, the facilities manager is the first person to know.

PROBLEM IDENTIFICATION

According to Preiser et al (1988), hundreds of POEs have been conducted on a variety of building types over the last 25years. Some solutions included increasing involvement of the organization being studied, better presentation of results, and better targeting of information to appropriate decision makers (Zimring, 1988). Preiser (1995) stated that historically, building performance was evaluated in an informal manner, and the lessons learned were applied in the next building cycle of a similar facility type. Because of relatively slow change in the evolution of building types in the past, knowledge about their performance was passed on from generation to generation of building specialists. Therefore, building performance criteria are an expression and translation of client goals and objectives, functions and activities, and environmental conditions that are required in relation to evaluation of building performance using POE application.

Currently, one of the challenges facing Nigerian universities is the massive expansion in higher education participation and the explosion in yearly students' in-take. As a result of this, space requirements of classrooms, lecture theatres, hostels, laboratories and workshops are hardly met in over 70% of tertiary institutions (Obaka, 2008; Okebukola, 2002). Okebukola (2002) noted that facilities are overstretched, thus presenting a recipe for rapid decay in the face of dwindling funds for maintenance. There is no doubt however that the above scenario imposes severe constraints on the institutions to effectively deliver their educational objectives and user value. These call for strategic and proactive facilities management skills.

RESEARCH AIM AND OBJECTIVES

The aim of this research is to undertake Post Occupancy Evaluation of some selected educational institution buildings in Nigeria, with the view to identify the key performance-based indicators for best practice. In this regard, the following specific objectives were highlighted for the study.

a) To appraise the nature and type of building facilities in the study area.

b) To assess the existing tools and approaches to performance evaluation of buildings.

c) To obtain the correlation between performance of the buildings and occupant's satisfaction level

RESEARCH APPROACH

The proposed guideline to this study is illustrated in Figure 1. This guideline consists of a systematic sequence of six (6) steps involving identification of building parameters; evaluation of objectives; selection of planning approach; conducting of the POE inspection; application of findings and actions in response to feedbacks. The steps fall within three (3) phases namely, the initial phase; process phase, and recommendation phase, illustrated in Figure 2. Each phase illustrates issues or activities that need to be addressed in the POE. This guideline provides an initial framework to facilitate the application of POE in the selected facilities.

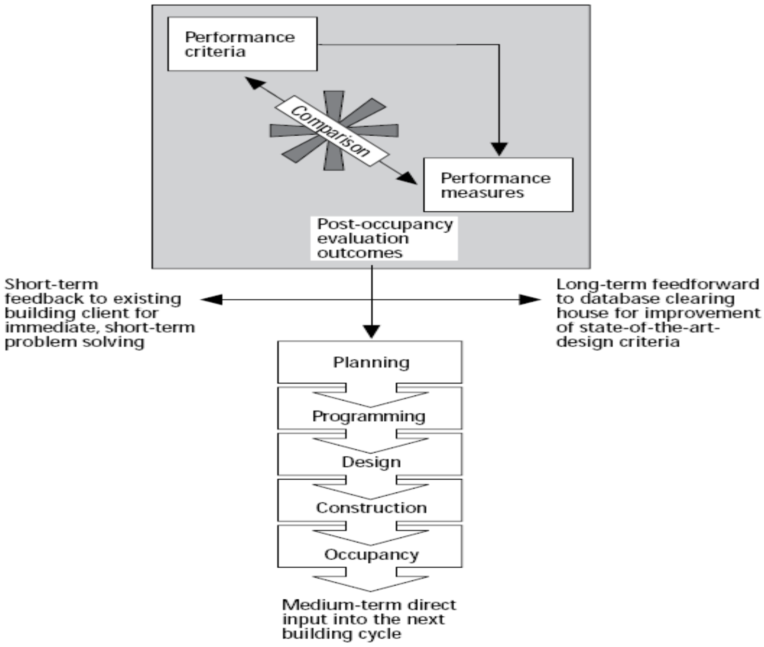
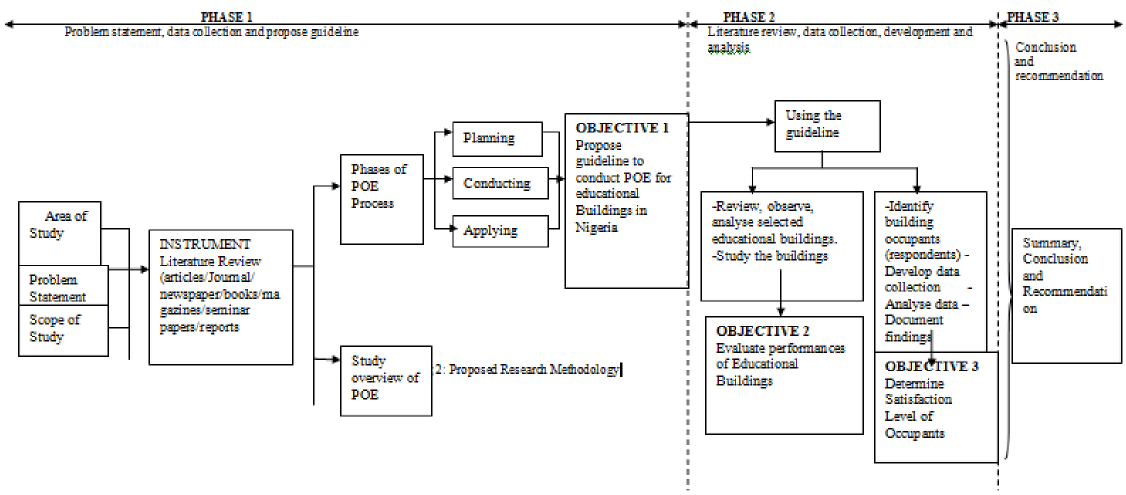


Figure 1. The performance concept in the building delivery process

(Source: Preiser, 1995)



ANALYSIS AND FINDINGS

Based on the POE guideline, a POE inspection survey will be conducted in the selected facilities. The analysis of this research will be divided into three (3) sections. The first section will features comparative analysis on building performance review in the pursuit of determining the score of performance either under poor, medium or good performance. The second section will feature the presentation of result which will consists of analysis on the survey findings pertaining to the satisfaction level of the surveyed building occupants in terms of building elements, services and environment. Survey questionnaire sets will be distributed and the respondents will consist of the building occupants in the education institution concerned. Answers obtained from the questionnaires will be used to provide specific findings to the study and to provide recommendations. The final section will feature the correlation analysis between building performance scores and the building occupants' satisfaction score.

The survey under Section B of the questionnaire will be designed to determine the satisfaction level of the building occupants on the 19 parameters as stated earlier based on a likert scale from 1 to 5:

"1" - Very Unsatisfied

"2" - Unsatisfied

"3" - Medium Satisfied

"4" - Satisfied

"5" - Very Satisfied

The final section of the analysis involves finding the correlation coefficient of the building occupants' satisfaction in relation to the building performance. The correlation analysis will be carried out using Kendall's tau correlation, using the statistical software program SPSS (Statistical Packages for the Social Sciences, version 12.00). The hypotheses will then be statistically tested with a two-tailed alpha level of 0.05. This will be done to see whether building performance correlates with the level of building occupants'. High correlation between building performance and building occupants' satisfaction indicates that the proposed guideline is effective and relevant to be used to evaluate performance of institutional buildings in Nigeria.

CONCLUSION

POE provides a valuable approach in analyzing the performance of institutional buildings, application of POE is relevant, effective and able to determine occupants' satisfaction level as well as provide recommendation to improve building performance. The approach has a great potential in analyzing building performance as it uses a strategic approach to achieve the best quality in building services, whereby the assessment integrates the building occupants' behaviour, perception and opinion as the building users.

Inevitably, POE is a useful tool for building asset and facilities management; as long as the approach employed to collect feedback from users is effectively integrated towards sustainability of government and public buildings. POE also seems to have a natural place in strategic planning of building management and can be developed under public sector. The key to this application is by allocating the needs of POE in building design and planning phase. The research also noted through literature search that, much ideas and solution are developed to achieve buildings' sustainability and this can create an opportunity for wider application of POE, especially to government and public buildings. POE is able to mitigate emergence of defective problems as the process comprise a strategic assessment to building current performance.

More importantly, design of the buildings should also consider parameters that will determine the good respectable performance of the buildings in line with high satisfaction and comfort to the building occupants as the users of the buildings.

The research has also outlined the important considerations and recommendations towards improving the performance of the institutional buildings.

REFERENCES

Amaratunga, D. and Baldry, D. (2002). Performance measurement in management and its relationships with management theory and motivation *Facilities*. 20(10); 327-336.

ASTM (American Society for Testing and Materials). 2000. *ASTM Standards on Whole Building Functionality and Serviceability*. West Conshohocken, Pa.ASTM.

Bak, N. (2004). *Completing your thesis: A practical guide*. Pretoria, Van Schaik.

Baird, G. (1996). *Building evaluation techniques*. New York, McGraw-Hill.

Barrett, P. and Baldry, D. (2003). *Facilities management. Towards best practice*. Oxford. Blackwell publishing.

Cotts, D. and Lee, M. (1992). *The facilities management hand book*. Newyork. Amaloen; A division of American Management Association.

Cliff, M. and Butler, R. (1995). *The Performance and Cost-in-use of Buildings*: A New Approach, BRE Report. Building Research Establishment. Garston.

Douglas, J. (1996). Building Performance and its relevance to facilities management. *Facilities*, 4(3/4); 3-32.

Hakkinen, T. and Nuutinen, M. (2007). Setting Sustainable Solutions for Office Buildings. *Facilities*, 25(11/12) 437-451.

Lackney, J. (2000). *Awarding Innovative Educational Design*. The School Construction News and Design Share Awards 2000 Program.

Lackney, J. (2001). *Post-Occupancy Evaluation in the Practice of Educational Design*; Paper presented at the Environmental Design Research Association. Scotland. July, 5th 2001. Pp. 2-18.

Lavy, S. and Bilbo, D. (2009). Facilities Maintenance Practices in large public Schools. *Facilities*. 27(1-2); 5-20.

Ornstein, S. and Ono, R. (2009). *Performance Evaluation of a Psychiatric Facility in Sao Paulo. Facility. 27(3-4); 152-167.*

Obiegbu, M. E. (2004). *Overview of total Performance concept of buildings: Focusing on Quality, Safety, and Durability.* Paper presented at the 34th Annual Conference of the Nigerian Institute of Building. Abeokuta. 2004.

Obaka, D. (2008). *Current Challenges for Nigerian Students: Tertiary Education in Nigeria* [Online]. Available from: www.gieva.org; www.ece.org. (Viewed 29th December, 2010).

Okolie, K, C. (2009). *Building Performance Evaluation in Educational Institution: A Case Study of Universities in South East Nigeria. RICS COBRA* Research Conference, University of Cape Town, 10-11 September 2009: 1598-1625

Omirin, M.M. (2005). *Principles of Facilities Management*. Paper presented at the international conference organized by the Nigerian Institute of Building. Nasarawa. April, 20-22.

Ornstein, S. (1997). "*Post-Occupancy Evaluation Performed in Elementary and High Schools.Greater Sao Paulo, Brazil: The Occupants and the Quality of the School Environment*", *Environment and Behaviour*. 29(2): 236-263.

Okebukola, P. (2002). *The State of University Education in Nigeria.* Abuja: National Universities Commission.

Preiser, W. F. (1995). Post-Occupancy Evaluation; How to make buildings work better. *Facilities.*13(11); 19-28.

Preiser, W. F. (2005). Building Performance Assessment; From Post-Occupancy Evaluation to Building Performance Evaluation. *Architectural Science Review*. 48(2); 20-25.

Preiser, P. and Vischer, J. (Eds) (2005). *Assessing Building Performance*. Oxford: Elsevier.

Preiser, W.F.E., Rabinowits, H.Z. and White, E.T. (1988). *Post Occupancy Evaluation.* New York: Van Nostrand Reinhold Company CRS Sirrine Houston, TX

Then, D. S. (2003). Strategic Management; In: Best, R., Langston, C. and De Valence,G. (Eds), *Work place strategies and facilities management; Building in value*, Butterworth, London.

Watson, C. (2003). Review of building quality using post occupancy evaluation. *Journal of programme Education Building*. Vol. 35, pp. 1-5

Zimring, C. (1988). *Post-occupancy evaluation and implicit theories of organizational decision-making.* The Proceedings of the 19th Annual Conference of the Environmental Design Research Association. Pomona, CA., pp.277-280.

GENDER ISSUES IN LAND: IMPLICATIONS FOR HOUSING DEVELOPMENT IN NIGERIA

Ajayi Mary Adebola[1]
Department of Estate Management, Federal University of Technology, Akure, Nigeria

The basis of all development or construction is land and access to this gift of nature in most traditional African societies has been restricted from the female gender through the customary laws guiding its use and ownership. The factors of cultural attitude of male dominance, lack of inheritance rights, low education and income levels of the female gender have been found to reduce their participation in housing development. The aim of the study is to investigate how males and females secure access to land and housing in four selected ethnic groups in southern Nigeria with a view to ascertaining the existence of gender discrimination in access to landed property. Methodology includes administration of close-ended questionnaires to 1,518 indigenous homeowners across Akure, Benin City, Owerri and Calabar using cluster sampling, stratified and systematic random sampling techniques. Data analysis includes the use of Discriminant Function Analysis, Hypothesis Test for Difference in Proportion and Phi Correlation. Findings reveal that there is a significant relationship between gender and inheritance rights and that this has implications on housing development. Recommendations are made on promoting female participation in housing production and legal backing for women to ensure security of tenure in real estate development.

Keywords: gender, housing development, inheritance, land, southern Nigeria.

INTRODUCTION

Rights to land in Africa stem from many different sources, such as first settlement, conquest, allocation by government, long occupation or market transaction. In some cases these rights are transferable to heirs or can be sold (Toulmin, 2006). Down through the ages, land is handed down to the next generation as an asset and so inheritance is the surest and cheapest way through which any member of a family or clan could access land. Unfortunately, the customary laws of property inheritance in various communities in Africa and Nigeria in particular are mostly discriminatory against the property rights of women. As a result, in most of Africa, women do not have right to land. In many societies, women's claim to land within the customary systems is usually realized through men, as daughters, sisters but especially as wives. Such rights are known as secondary rights since they are of uncertain duration, are not well-defined and are subject to change based on maintaining good relations between parties (Kironde, 2006).

The Nigerian government promulgated the Land Use Act No 6 of 1978, drafted into cap 202 of the laws of the Federation of Nigeria in 1990 in order to ensure that land is within the reach of all citizens irrespective of gender or ethnicity and prevent fragmentation of rural lands arising from the application of the traditional principle of

[1] bolseg2002@yahoo.co.uk

Adebola, A.M. (2011) Gender issues in land: implications for housing development in Nigeria *In:* Laryea, S., Leiringer, R. and Hughes, W. (Eds) *Procs West Africa Built Environment Research (WABER) Conference*, 19-21 July 2011, Accra, Ghana, 509-516.

inheritance (Aluko and Amidu, 2006). Even though the Act would have ensured equality of men and women in land allocation and management in the country, it is an open secret that land still continues to change hands outside government regulatory mechanism, in accordance to native law and customs of the people. This has, therefore, hindered the hope of promoting equality of access to land to men and women under the Act since the customary land tenure system discriminates, in land matters, against women.

Mullins (2008) attests that there is a direct link between a country's attitude toward women and its progress socially and economically. Having secured property rights and easy access to land reduces the poverty level of a lot of women and boosts the economy of the nation as a whole. Meinzen-Dick (2001) reveals that secured property rights empowered women by increasing the agricultural productivity, securing access to services, providing incentives and ability to invest, raising the status of women, providing greater security and improving bargaining power. Women’s equal property rights are important because they are fundamental to women’s economic security, social and legal status and sometimes survival. This paper hopes to investigate how males and females secure access to land and housing in selected ethnic groups in southern Nigeria with a view to ascertaining the existence of gender discrimination in access to land and housing.

EMPIRICAL STUDIES ON WOMEN’S TRADITIONAL ACCESS TO LAND IN AFRICA

According to Kevane and Gray (1996), the various means through which women secure land rights in Africa include through marriage, kinship, Islamic inheritance laws and through local norms that are not gender bias. Customary laws in many African societies enjoin a husband to provide his wife with land. In Sudan-Sahelian West Africa, where land is under extensive agricultural production, women gain land chiefly through marriage while single women rarely have rights in land. However, these rights are lost upon divorce, widowhood and relocation. For instance among the Tiv in Nigeria, women land right depend on either residence or marriage. A wife has right to a plot large enough to support her and her dependants. If not given a plot of land after marriage, she can leave and re-demand her bride wealth (Bohannan and Bohannan, 1968).

Women also have land rights through their kinship status as among the Hausas in Niger and Nigeria where women especially non-Muslim gain access to land through the ‘Gandu’ system. In this case, a woman is given a plot from the general family holdings which she holds for her life time and then it reverts to the corporate group for re-allocation to other lineage members. Her right to alienate the land is limited and only by permission from the family (Starns, 1974). This kind of right is limited and restricted, just like most land rights of women. In Akan society in Ghana, where matrilineal system of inheritance operates, both men and women can own property.

Duncan and Brant (2004) conducted a gender study in the Volta Region of Ghana on access to and control over land and found that ninety-six percent of women respondents indicated that both men and women had access to lineage, stool or clan land. However, access rights of men and women were less equal than initially presumed as women’s rights were generally “secondary’’ rights. As a result, women feared that they could be the first to lose their access rights due to growing population pressures, agricultural intensification and commercialization. The study also revealed the strong impact of marriage on especially women’s access rights to land among the patrilineal communities studied. Women generally gained (secondary) access rights to their husbands' land through marriage, but lost their access rights to their own lineage land at the same time. A similar study was conducted by Owusu (2008) on land tenure dynamics in Volta and Central Regions of Ghana to determine the effect of gender and access to land on livelihood of males and females. Although gender did not have statistically significant effect, having access to land turned out to be the main determining variable for livelihood. This shows the importance of access to land.

Furthermore, the areas of sub-Saharan African where women have historically had the strongest right occur where they inherit land according to the precept of Islamic law. Here, women have right to land that allow them to alienate or allocate them. Upon the death of a father, a daughter can inherit a share of her father's property equal to one half of her brother's. Also, husbands and wife inherit each other's property; a woman receives one-eighth of her husband's property while a husband can receive on quarter of his wife's property. Barnett (1977) reveals how women in Eastern Sudan regained access to land through Islamic inheritance laws in Gezira irrigation scheme. Land was confiscated from both men and women but only redistributed to men in form of semi-permanent tenancies. Over time, women regained their land rights through the Islamic inheritance law.

Although, women's land rights are usually restricted in most societies, there are a number of areas where women have strong land rights. Keller et al (1990) reveals that women in Central Africa have clear private rights to land and could pass their land rights to heirs. Also, Grundfest (1985) writes that the land belongs to women in Lemba of Zaire and they have a say in everything relating to land. Another example of areas where women have strong land rights is among the Akure people, a part of the Yoruba ethnic group in south-western Nigeria where females especially the first female inherit land and houses from their parents (Ajayi, 2004).

GENDER ISSUES IN HOUSING DEVELOPMENT

Sokomba (1987) differentiates the importance of housing between the genders. To the male, a house is an asset for future generation and a place to relax after a day's job. The female however sees the house as a place to undertake her traditional roles and a means of survival in a hard world. Differentiating the significance of housing between the genders, it was observed that the urban woman rates housing highly because it provides a base for household formation, income generation, workplace, networking, security and urban identity. The house has a use value for women and their life revolve more or less around it.

Despite the importance of housing to the female gender, a lot of factors have constrained women's involvement in housing development. First on the list is the cultural attitude that housing construction is a man's affair. In a survey carried out in Ibadan by Agbola in 1998, a lot of married women show disinterest in the land acquisition and housing construction process. Illiteracy and poverty were further discovered by Okewole (1997) and Opoko (1997) as constraints to female participation in housing development. Studies across Africa reveal that the population of female decreases as one moves up the educational ladder (Anker, 1986; Mamman, 1996; Ajayi, 2000 etc). Another factor inhibiting women in housing development is the lack of property inheritance rights. In many cultures in Nigeria and most of Africa, female children are not usually allowed to inherit land because they will be married out of the family. Ajayi (2004) however revealed that lack of property rights was not a factor affecting women's involvement in housing supply in Akure as the inheritance system was favourable to the female gender. As such, about 20% of the existing stock in Akure belonged to women.

RESEARCH METHOD

A set of close-ended questionnaires was the basic instrument for eliciting data for this research. The target population includes all adult males and females who are residential property owners and indigenes of the selected ethnic groups. Southern Nigeria comprises of many ethnic groups out of which four groups were selected namely Yoruba, Bini, Igbo and Efik and represented by Akure, Benin City, Owerri and Calabar towns respectively. Each town was stratified into two, that is, the core and the periphery with the aim of reaching the indigenes who are predominantly at the core. Stratified and systematic random sampling techniques were employed to reach male and female home owners, in selected streets in the core of the town till the sample size of 381, 381, 376 and 380 respectively was reached making a total of 1518 respondents. Data analysis includes the use of Discriminant Function Analysis while the Hypothesis Test of Difference of Proportion and Phi Correlation were used to test the two hypotheses postulated for the study.

DATA ANALYSIS AND DISCUSSION OF RESULTS

Table 2: Cross tabulation of Gender and Socio-economic Characteristics of Respondents

Response	Frequency			Percentage
Marital status	Male	Female	Total	
Single	180 (17.1)	83(18.1)	263	17.3
Married	734(69.5)	231(50.0)	965	63.6
Divorced	55(5.2)	21(4.6)	76	5.0
Separated	34(3.2)	34(7.4)	68	4.5
Widowed	53(5.0)	92(19.9)	145	9.6
Total	1056 (100.0)	461(99.7)	1517	99.9
Missing	0(0.0)	1(0.3)	1	.1
Total	1056 (100.0)	462(100.0)	1518	100.0
Religion				
Christianity	889(84.2)	396(85.7)	1285	8.7
Islamic	69(6.5)	48(10.4)	117	7.7
Traditional	88(8.3)	13(2.8)	101	6.7
Others	0(0.0)	0(0.0)	0	0
Total	1046(99.0)	457(98.9)	1503	99.0
Missing	10(1.0)	5(1.1)	15	1.0
Total	1056 (100.0)	462(100.0)	1518	100.0
Educational status				
No formal education	111(10.5)	69(14.9)	180	11.9
Primary	68(6.4)	56(12.1)	124	8.2
Secondary	298(28.2)	78(16.9)	376	24.8
Tertiary	545(51.6)	250(54.1)	795	52.4
Total	1022(96.7)	453(98)	1475	97.2
Missing	34(3.3)	9(2)	43	2.8
Total	1056 (100.0)	462(100.0)	1518	100.0
Monthly Income (₦)[2]				
10,000 and below	166(15.7)	83(18.0)	249	16.4
11-20,000	186(17.6)	123(26.6)	309	20.4
21-50,000	238(22.5)	91(19.7)	329	21.7
51-80,000	248(23.5)	24(5.2)	272	17.9
Above 80,000	104(9.9)	56(12.1)	160	10.5
Total	942(89.2)	377(81.6)	1319	86.9
Missing	114(10.8)	85(18.4)	199	13.1
Total	1056(100.0)	462(100.0)	1518	100.0

Source: Field Survey, July 2010

The data got can be grouped into two namely the socio-economic variables of respondents (which are gender, marital status, religion, educational status and monthly

[2] US$1 equals approximately 160 Naira, as at March 2011.

income) and data on the means of gaining access to land and housing in the four towns. Table 2 shows that the highest percentages of respondents in both male and female genders are married. Christianity is the predominant religion in the study area while about half of the respondents have tertiary education which shows that literacy rate is high in the study area among both males and females. The table also reveals that the income range with the highest percentage of respondents is ₦21- 50,000 while the least percentage of respondents earn above ₦80,000.

Table 3: Distribution of Respondents by Means of Gaining Access to Land and Housing

Response	Frequency			Percentage
	Male	Female	Total	
Purchase	479(45.4)	238(51.5)	717	47.2
Inheritance	525(49.7)	183(39.6)	708	46.6
Gift	16(1.5)	22(4.8)	38	2.5
Government allocation	22(2.1)	8(1.7)	30	2.0
Others	1(0.1)	4(0.9)	5	0.3
Total	1043(98.8)	45598.5)	1498	98.7
Missing	13(1.2)	7(1.5)	20	1.3
Total	1056(100.0)	462(100.0)	1518	100.0

Source: Field Survey, July 2010

Table 3 reveals that 47.2% of respondents got access to land and housing through purchase which is closely followed by those who got through inheritance (46.6%). Males got access majorly through inheritance (49.7%) while females account for 39.6%. This shows that the more males than females inherited their houses. With limited access through inheritance, females are better represented in gaining access through purchase, that is, 51.5% as against 45.4% for males.

Table 4: Distribution of Access to Land and Housing through Inheritance

Location	Male	Female	Total
Akure	83(56.1)	65(43.9)	148 (100.0)
Benin City	156 (83.4)	31(16.6)	187(100.0)
Owerri	158(85.4)	27(14.6)	185(100.0)
Calabar	128(68.1)	60(31.9)	188(100.0)
Total	525	183	708(100.0)

Source: Field survey, July 2010.

Sequel to Table 3, the 708 respondents who gained access to land and housing through inheritance were further presented in Table 4 through cross tabulation based on gender and location. The table reveals that in all the towns, greater number of males than females had access to land though inheritance. This shows that access to land through inheritance operates in all the selected towns with the same trend of being more favourable to the male gender although to different degrees. Access to land and housing through inheritance is greater for women in Akure (43.9%) as against 14.6% in Owerri.

Data Analysis

Discriminant Function Analysis was used to establish the variables with the greatest effect on access to land and housing ownership among the two groups of those who have property inheritance right and those who do not. The variables related to how access to land and housing can be got through inheritance include gender, education, income, ethnicity, marital status and religion. Mathematically, the model is given as:

$$d=b_0+b_1x_1+b_2x_2+b_3x_3+b_4x_4+b_5x_5+b_6x_6$$

A total of 1518 homeowners were sampled out of which 1277 were used for the analysis because 241 have at least one missing discriminating variable. This number was divided into two groups (Group 1 and 2) according to their cultural right to property inheritance. These were selected and used for the classification purpose.

Table 5: Eigenvalues

Function	Eigen values	% of Variance	Cumulative %	Canonical Correlation
1	.048(a)	100.0	100.0	.214

a First 1 canonical discriminant functions were used in the analysis.

Table 5 shows the efficacy of the Discriminant function. The canonical correlation of 0.214 is good while the value of Wilk's Lamda (0.954) as shown in the next table indicates the discriminatory ability of the function.

Table 6: Wilks' Lambda

Test of Function(s)	Wilks' Lambda	Chi-square	Df	Sig.
1	.954	59.735	6	.000

In addition, the small significant value of Chi-square statistics indicates that the Discriminant Function did better than chance at separating between the groups of those who have right to inherit land and those who do not.

Table 7: Tests of Equality of Group Means

	Wilks' Lambda	F	df1	df2	Sig.
Monthly Income	1.000	.151	1	1275	.698
Educational Status	.999	1.257	1	1275	.262
Religion	.999	1.134	1	1275	.287
Marital Status	1.000	.041	1	1275	.839
Gender	.957	56.826	1	1275	.000
Ethnicity	1.000	.198	1	1275	.657

This table provides an insight into the relative contribution of each of the variables. It shows that gender is the best discriminatory variable among the six variables in discriminating between the two groups based on cultural right of inheritance. Also, the percentage of cases that were correctly classified in group 1 is 74.4% while in group 2 is 65% indicating a high degree of accuracy in the model. The percentage of grouped cases correctly classified is 73.4%.

Two hypotheses were postulated for the study and tested. The first hypothesis (H_{01}: There is no significant difference in housing ownership through inheritance between the male and female genders in southern Nigeria) was tested by using the Hypothesis Test for Difference between Proportions. The formula is given as:

z =

where p_1 = proportion of success in sample one (number of males having residential property through inheritance in the study area)

p_2 = proportion of success in sample two (number of females having residential property through inheritance in the study area)

1 = 1- 1

2 = 1- 2

n_1 = size of sample one (total number of male respondents)

n_2 = size of sample two (total number of female respondents).

The decision rule is to reject H_{01} and accept the alternate hypothesis if z is greater than 1.96 at 5% level of significance. The observed value of z is 3.8151 which is in the rejection region and thus H_0 is rejected in favour of the alternate hypothesis. This means that the difference in the proportion of males and females who secured housing ownership through inheritance in southern Nigeria is significant.

The second hypothesis (H_{02}: There is no significant relationship between gender and property inheritance rights in southern Nigeria) was tested using the Phi Correlation. Using gender and cultural right to inherit property as the variables for Hypothesis 2, then the phi correlation coefficient is derived as:

$\Phi = 0.1895$

$\chi^2 = 1518(0.1895) = 54.51$

The critical value of a chi-square (χ^2) for one degree of freedom at 5 percent level of significance is 3.84. If χ^2 is larger than 3.84 at 0.05 level of significance, then phi coefficient is significant and falls on the zero range on the correlation line. Therefore, the null hypothesis that there is no significant relationship between gender and property inheritance rights in southern Nigeria is rejected. This means that there is significant relationship between gender and property inheritance rights.

CONCLUSION AND RECOMMENDATIONS

This study has revealed that there is significant relationship between gender and property inheritance in southern Nigeria and that gender is a strong discriminating factor in inheritance. There is variation in the levels of access of women to land through inheritance in the towns of southern Nigeria. In Owerri and Benin City, there is greater level of bias in customary laws against access of women to land and housing through inheritance, while in Akure and Calabar, customary inheritance laws are not rigidly against women's and this has impact on housing development by the female gender. A higher percentage of female home owners secure access to land and housing through purchase while inheritance was the means through which a greater percentage of males do. This study has thus shown that where women's access to land and housing are not constrained through discriminatory inheritance laws, they are more involved in housing development. Through public awareness campaigns by government and NGOs, discrimination against women in access to land and housing through inheritance can be discouraged in order to promote female participation in housing production. Legal literacy and backing should also be given to women to ensure security of their tenure in real estate development.

REFERENCES

Ajayi, M.A. (2004). Women's involvement in housing supply in Akure, Nigeria, M.Tech dissertation, Department of Estate Management, Federal University of Technology, Akure.

Ajayi, M.A. & Olotuah, A.O. (2005). Violation of women's property rights within the family. *Agenda* No. 66, *Gender-Based Violence Trilogy* 1 (1), 58-63.

Ajayi, M.O. (2000). Appraising gender participation in housing production and management. *Effective housing in 21st century Nigeria,* (pp 215-219) Ibadan: AKT. Ventures Ltd.

Aluko, B.T. & Amidu, A. (2006). Women and land right reforms in Nigeria, paper presented at the 5th FIG regional conference, Ghana.

Barnett, T. (1977). *The Gezira scheme: an illusion of development.* London: Frank Cass.
Bohanan, P. and Bohannan, L. (1968). *Tiv economics.* London: Longman.
Duncan B.A and Brants, C. (2004). Access to and control over land from a gender perspective a study conducted in the Volta Region of Ghana. Commissioned by the SNV Netherlands Development Organisation, Ghana Office and the Gender and Development Unit of the Food and Agriculture Organization of the United Nations, Regional Office for Africa, Accra, Ghana: SNV/FAO.
Grundfest, S.B. (1985). The 'wild,' the 'lazy' and the 'matriarchal': nutrition and cultural survival in the Zairian Copperbelt. *Working Paper 96, Office of Women in International Development,* Michigan State University.
Kariuki, C. (2006). The role of women in rural land management and the impact of HIV/AIDS. Paper presented at Africa Region CASLE Conference on Promoting Sustainable Land Management in Africa, Bagamoyo, Tanzania, 14-16, March.
Kevane, M. & Gray, L. (1996). Land tenure status of African women. *Background Paper for Project on Gender and Property Rights in Africa*. The World Bank.
Kironde, L. (2006). Good governance as a fundamental framework to deal with problems of access to land, land delivery and land conflicts in Africa. Paper presented at Africa Region CASLE Conference on Promoting Sustainable Land Management in Africa, Bagamoyo, Tanzania, 14-16, March.
Meizen-Dick, R.S. (2001). Property rights for empowering low-income women. Retrieved on May 4, 2005 from http://www.ifpri.org/2020conference
Mullin, J. (2008). Gender discrimination: why is still so bad? Retrieved on August 26, 2008 from http://childreninneed.org/magazine/gender.html
Okewole, A.I. (1997). Women's access to and control of housing accommodation in urban centres of the South Western zone of Nigeria: an assessment. Proceedings from *The House in Nigeria.* Obafemi Awolowo University, Ile-Ife, Nigeria.
Opoko, A.P. (1997). In search of adequate housing: a gender-aware approach. Proceedings from *The House in Nigeria.* Obafemi Awolowo University, Ile-Ife, Nigeria.
Owusu, G.A. (2008). Gender, land tenure dynamics and livelihood: a comparison of Central and Volta Regions of Ghana using Logistic Regression Analysis. *Studies in Gender and Development in Africa,* 1, 34- 57.
Sokomba, M.J. (1987). The role of women in rural housing and development in Nigeria being a paper delivered at a National Seminar on Rural Housing Development, Abuja.
Starns, W. (1974). *Land tenure among the rural Hausa.* Wisconsin: Land Tenure Centre Publications.
Toulmin, C. (2006). Securing land and property rights in sub-Saharan Africa: the role of local institutions. *Global Competitiveness Report '05-'06.* Switzerland: World Economic Forum.

GEOSOPHIC PERSPECTIVE IN YORUBA URBANISM

Olaniyi Okedele[1] and Tunji Adejumo[2]

[1]*Department of Architecture, Faculty of Environmental Sciences, University of Lagos, Akoka, Lagos, Nigeria*

[2]*Department of Urban and Regional Planning, Faculty of Environmental Sciences, University of Lagos, Akoka, Lagos, Nigeria*

Geosophic consideration is important in achieving sustainable design for nations outside the western hemisphere. Such design is underpinned by the philosophy of mimesis. The research explored geosophy to understand the mimetic design principles in Yoruba urbanism. It adopted qualitative methodology. Data gathered through scoped literature and two hour each interview of seven Ifa educational system sages were analyzed using grounded theory to conceptualised Yoruba city design intents. Four categories of conceptual framework including “cosmological world view”, “harmonic ideal”, “seat of power” and “nodal symbol” were found to influence urban design in the study area. While “cosmological world view” emerged as the core category the remaining three constitute sub categories. The core hypothesis which stemmed from theory generation is that Yoruba urbanism is influenced by her cosmological world view. The cosmological world view is based on 16 sided polygonal cosmic urban forms with a square inset that corresponds to the cardinal points. Sustainable design in Yoruba cities must explore the prime position of architectural numerology that operates on “4”, “16” in ‘sense of place’ determination. This is in addition to the accommodation of bio-mimicry of the ecosystems and their living communities within the bioregion that naturally exhibit identified characteristics.

Keywords: cosmological world view, geosophy, geomantic planning, mimesis.

INTRODUCTION

Sustainable design had been the concern of built environment professionals since the advent of postmodernism. Post modernism preaches a systemic approach to design with climate and biophysical variables to create human habitats in harmony with nature. Simulating ecological process in designing of human settlement is what Ryn and Cowan (1999) referred to as ecological design. Such design followed the principles of bio mimicry. Bio mimicry examines models, systems, process and elements in nature with goal of imitating or acquiring information to solve human problems. Form, process and ecosystem are the three levels of mimicry in design with nature. Nature in this instance is viewed on a bioregional platform where daily relationship of man with his immediate environment is paramount (Nicholls 2004). As examined by Downton (2002) bioregionalism is having “a sense of place”. This principle seeks a localized design solution. It emphasize that man and earth are intrinsically related and the sustainability of the earth depend on man’s consciousness of his ecosystem which consequently determines the way he interact with the

[1] okedeleolaniyi@yahoo.com
[2] oadejumo@unilag.edu.ng

Okedele, O. and Adejumo, T. (2011) Geosophic perspective in Yoruba urbanism *In:* Laryea, S., Leiringer, R. and Hughes, W. (Eds) *Procs West Africa Built Environment Research (WABER) Conference*, 19-21 July 2011, Accra, Ghana, 517-527.

environment (Berg, 2001). Hence bioregionalism demands that sustainable design must be built on "sense of place".

The concept of 'place' addresses man's relationship to his environment especially how such landscape is used over a period of time to create a site specific identity. Such identity emanates from the fusion of spiritual, social and traditional meanings a 'place' generates to the inhabitants. *Verhagen* (2008) citing Rifkin (1983) observed that "Every age has its own unique view of nature, its own interpretation of what the world is all about. Knowing a civilization's concept of nature is tantamount to knowing how a civilization thinks and acts." That is, world view varies with local people's perception of what is called nature at point in time. Lefferts (2007) referring to Buckminster Fuller research works submitted that nature and the universe uses a particular set of energetic relationships that influence the way naturally designed systems are sustainable. If nature mimics the cosmos for sustainability then imitating nature in design works will meet the needs of man for generations. Understanding this cosmic world view is what Lefferts (2007) called cosmometry, which he defined as 'the study of the fundamental patterns, structures, processes and principles that are at the foundation of reality and the application of this knowledge towards the design of sustainable and healthy living systems". The knowledge manifests in commercial, social, culture, and belief system developed in partnership with contextual landscape. That is why Arbab (2000) made case for the creation of alternative development strategy that seeks to apply spiritual principles to the transformation of physical, social and economic structures. This is borne out of conviction that scientific perceptions in sustainability constitute an inquiry into matter and nature of external world while religion is an inquiry into consciousness, spiritual and the nature of unseen world (Kapur 2000). At the centre of such alternative strategy is Geosophy- the sum total wisdom man developed in living at a particular place in the biosphere. This paper examines geosophy to understand the mimetic design principles in Yoruba urbanism. Such principles will find relevance in people driven sustainable architectural design; effective land use planning that accommodates human dimensions in decision making; identifying and building on distinctive local cultural resources for city branding – a marketing tool for successful cultural, conference, anthropological and ecological tourism industry.

STUDY AREA

Yoruba nation lies between longitudes $1^0\ 25^/$E and $6^0\ 45^/$E; Latitudes $5^0\ 55^/$N and $9^0\ 10^/$N above the equator. In Nigeria, Yoruba nation inhabit the south western geopolitical region (Figure 1). It is fully made up of five federating units of Nigeria including Lagos, Ogun, Oyo, Osun and Ondo states. Parts of Kwara, Kogi and Edo states are inclusive. According to NPC (1991) the total population of Yoruba speaking states in Nigeria was 25,000,000. All classic Yoruba cities share the same form (Obateru, 2006). There seemed to be a distinct traditional school of planning with unwritten urban design manual.

MIMETIC ART THEORY AND DESIGN FORM

Mimetic theory is a world view art concept that emanates from the philosophy of universe. Universe is traditionally on three levels namely the natural world, human society, and the non material world. Mimetic theory of art simply states that art is essentially an imitation of nature.

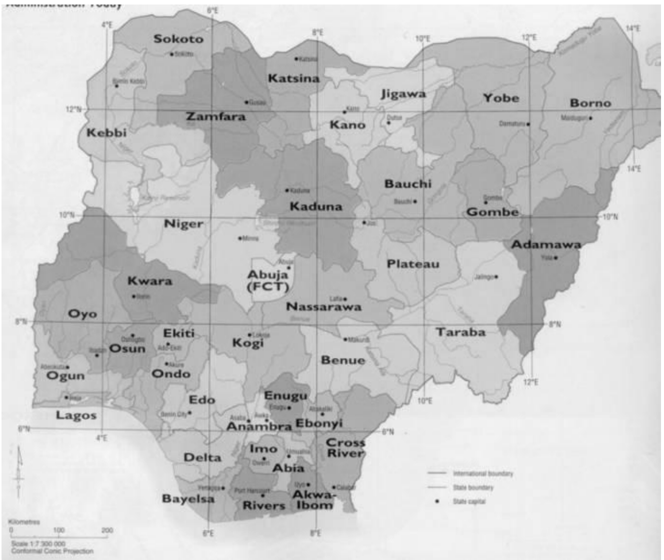


Figure 1. Map of Nigeria showing the 36 States

AS noted by Sorbom (1992), theory of *mimesis* as documented in ancient texts is not exactly a theory of art in a modern sense; it is rather a theory of pictorial apprehension and representation. The theory of *mimesis* was based on the relationship between ‘mimemata’ and real things. For example, a house is a real thing whereas a perspective drawing or an architectural model of the same house is a *mimema* (Sorbom 1992). That is, the painting is a thing that looks like a house but is not a house. Thus ‘mimema’ as a thing becomes a vehicle for ‘man-made dreams produced for those who are awake’, as Plato suggestively formulated it (Lane 2007). Neither the dream nor the *mimema* is a real thing. The real thing then exists in an immaterial realm. Hagen (2006) observed that Plato theorized forms are tetrahedron (4 sides), the hexahedron or cube (6 sides), the octahedron (8 sides), the dodecahedron (12 sides) and the icosahedron (20 sides).

Plato postulates a metaphysics in which the four elements of Greek science - earth, air, fire, and water are associated with four of the five solids. Many parts of the human existence are metaphysical including thoughts, feelings, memories, dreams, and ideas. Generating metaphysical experience demands interaction between the human mind and the material world. For the designers, this experience is achieved through the interaction between the human mind and the physical elements of the environment. What the designer does is to manipulate any effect that an intended object has on man. In the case of the built environment, the architect tampers with the effect of the object whose original form is domicile in the intangible realm of ideas. Thus design at any level is the imitation of ideal forms in the intangible realm. That is why Russell (1961) testified that platonic forms are perfect templates that exist in an immaterial world. These forms, Plato said, are the ultimate reference points for all objects we observe in the physical world. They are more real than the physical objects in this material world (Lane 2007). These complex platonic forms have recently been discovered to be planetary grid that served as geosophical planning model for Neolithic man. Geosophical planning is a world view design and planning techniques operating on ancient philosophy relating and living on earth. All geomantic planning does is to relate human design with cosmic design forms so as to harmoniously access intangible attributes entrenched in radiant earth energy.

Oriental nations, including Japan and China, had long acknowledged the place of earth energy in sustainable spatial configuration of cities and other urban components. Bring et al (1981) research works on the foundation of garden design and urban planning in Japan is a relevant case study. Spatial consideration in Japanese environmental design is traced to the concept of Chinese “harmonic ideal”. The goal of Chinese environmental planning is to achieve harmony with nature, that is, harmony of forces within and between physical and immaterial environments (Bring et al, 1981). This translates into Chinese art principles where man is positioned to harness the positive heavenly energies in his quest to survive on earth.

While Feng Shui is Buddhism influenced on Taoist art of placement in China and Oriental nations, environmental design and planning is culturally done in India through Vastu Shastra. Vastu Shastra is the traditional Indian architecture and design system (Raman, 2004). It is a Hindu system of philosophy based on the belief that human life can be improved by rearranging the spaces or design elements where we live and work to benefit from cosmic influences (Ananth, 1999). The Hindu philosophy that drives vastu shastra emphasized that successful human existence on planet earth depends on how man is able to harness the gifts in nature. Ancient Chinese Feng shui geomantic planning recognizes earth energy as dragon lines that influence oriental human settlements. *Vastu shastra* is ancient India’s planning philosophy that allows creative access to ‘bioforce’. Hermetic philosophy elucidates planetary grid as planning tool for neolithic man. Greek esoteric traditions and philosophers including Plato and Pythagoras attested to position of grid lines and nodes in creative design that attracts man. There seems to be consensuses that planetary grid and its biophysical ingredients possess intangible attributes that are culturally interpreted to attract man over the ages. Aboriginal perceptions and relationship to the earth influence the physical form of created settlements within the contextual bioregional landscape. This corroborates Obateru (2006) submission that physical composition and configuration of aboriginal towns is a reflection of the communal philosophical perception of planet earth. At the core of this community doctrine is earth creation. This is geosophy – the philosophy of man’s relationship to the bioregion. This paper examined the root of Yoruba indigenous sustainable design principles. The study recognized Rapoport (1988) model for reading meaning in built environment. His three level model is made up of high level meaning; middle level meaning; and low level meaning. Rapoport (1988) high-level meaning describes cosmological and supernatural symbolism that was embedded in buildings and urban platting reflecting the culture and the philosophical system of local people.

RESEARCH METHOD

This research is interpretive in nature. It adopted qualitative methodological approach. Qualitative research is exploratory and descriptive in form with characteristic ongoing data collection and inductive analysis. Grounded theory was the adopted method to theorize Yoruba city design intents. Black (2009) refers to grounded theory as a research method of comparative data analysis, applied in an inductive research process. Data collection spans a variety of empirical materials including scoped reviewed literature on the phenomenon, interviews and personal observation. Extant literatures, journals and conferences are research submissions that can be subjected to qualitative analytical process (Jabareen, 2009; Kamba, 2009). The use of literature review as secondary data is hinged on the fact that the authors undertook some measure of research before writing. The research process is in two stages namely pre study and data gathering and analysis (Figure 1).

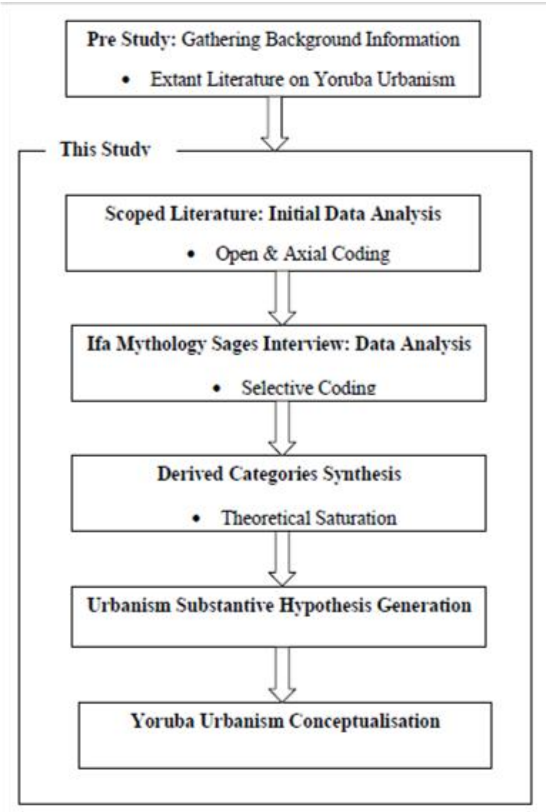


Figure 2, Research Process

Data gathering and analysis is also in two phases. The first phase of textual data gathering and analysis were from reviewed literature on Yoruba traditional urban design documented in various research works and books on Yoruba nation building. Seven scoped secondary textual sources made up of five books and two articles were used. Each scoped literature was subjected to open coding to derive incidents, codes, concepts and categories on the phenomenon. The open coding proceeded in parallel, treating each extant literature as confirmation or further development of results from earlier one. The second group of textual data was semi structured interviews of seven sages in Ifa educational system to obtain first hand information on Yoruba urban design and planning system.

This second phase is directed by emerging concepts, involving a more strategic selection of 7 informants knowledgeable in traditional Yoruba Ifa educational system. All conducted interviews were interspersed with transcription and selective coding which allowed for the confirmation of scoped literature findings or further generation of codes, memos, concepts and categories. A very important milestone in grounded theory methodology is taking decision on when to stop data gathering and analysis

RESULTS

The open coding of all the 7 scoped literature produced 20 different concepts, which were organized, following a process of axial coding, into 4 categories. The selective coding phase of Ifa sages transcribed interviews led to the emergence of 18 concepts. The concepts were organized, following a process of selective coding into four categories namely “Numerology”, “City Building Strategy”, “Symbolic Linkage” and “Geomancy”.

Codes, memos, concepts and the categories derived from scoped literature and Ifa sages interview were properly synthesised for similarities and differences with the intention of changing, modifying or detecting new categories. Five categories emanated from the synthesis namely “Cosmological World View”, “Harmonic Ideal”, “Seat of Power”, “Nodal Symbol” and “City building Strategy” (Table 1).

Table 1 Scoped Literatures and Ifa Sages Categories Synthesis

S/N	Scoped Literature	Ifa Sages Interview	Remark	New Category
1	Eco Form	Numerology	Changed	Cosmological World View
2	Environmental harmony	Geosophy	Combined	Harmonic Ideal
3	Seat of Power		Retained	Seat of Power
4	Nodal Symbol	Symbolic Linkage	Combined	Nodal Symbol
5		City building Strategy	New	City building Strategy

Grounded Theory Synthesis (2010)

Conceptual Frameworks for Understanding Mimetic Design in Yoruba Urbanism

Identifying design intents in the configuration of these cities looked at the grounded theory analysis and synthesis of scoped extant literature and Ifa Sages interview to derive four categories including cosmological world view, harmonic ideal, seat of power, nodal symbol.

Category 1: Yoruba Cosmological World View

The initial scoped literature analysis core category was Eco Form composed of the cosmology and mimesis concepts. While cosmology refers to mythology and Yoruba aboriginal city foundation, mimesis highlights the principle of mimicking heavenly divinities in this material realm to arrive at 16 radial forms with prominent 4 cardinal points. In the Ifa sages interview analysis similar category evolved as ‘Numerology’ with additional use of ‘16’ and ‘4’ in divination system. There are 16 major ‘Ifa Odus’. There are 16 major deities including Ifa that also has 16 disciples. Divination in Yoruba land is done by 16 cowries or 4 halves of Cola nitida seed (Ologundudu, 2008). The recurrence of ‘16’ and ‘4’ is a Yoruba cultural adherence to Hermetic principle which states that, "As above, so below; as below, so above.” That is whatever is below is like unto that which is above’. In the Yoruba understanding of heaven (intangible realm) there are “16 deities” (orisas) on the beck and call of Supreme God (Olodumare). On the earth (material realm) there are also 16 chiefs (Oloye) answerable to the king (Oba). Everything in Yoruba world view runs on ‘16’ and its divisible indices of ‘4’.

Category 2 *Harmonic Ideal.*

Geomancy divinely relates human design with cosmic design forms so as to harmoniously access intangible attributes entrenched in radiant earth energy. This is achieved by locating most auspicious position on the landscape. Ifa sages interview confirmed such locations through divinations to be followed by sacrifices at the inception of Yoruba city building that often commence from the panoramic palace landscape. Textual analysis of scoped literature identified hilly landscape as the preferential site planning criteria for the city core made up of the palace and the adjoining king’s market.

Category 3: Nodal Symbol.

Religion is at the centre of aboriginal city planning. Nodal Symbol category is a group of concepts highlighting the place of animist religious belief system in Yoruba city planning. Ifa geomantic planning identifies the city core as major city dome where earth energy is assessed. Most of the national Yoruba deities are located within the palace and adjoining land uses accepting sacrifices through their priests under the leadership of the King. The city core is therefore a Yoruba city mindscape composed of local and external images of the city. It carries the economic, social, festive, religious and recreational image of the city.

Category 4: The Seat of Power

The Seat of Power category from scoped literature revealed the social, economic and political institutional frame work of the town. The King administered the city state from the palace city core through the quarter chiefs to compound heads (Oloriebi). The political structure is also an imitation of the cosmic Olodumare (supreme God) and the 16 divinities. The "King" is the political leader as well as chief priest of the city. The quarter chief (Oloye) assumes the same role on quarter basis while the 'Olori ebi' control the compound and family deity. The King's palace is therefore the vista of Yoruba city. All physical objects radiates to him. This is not unconnected with his position as the spiritual head of the kingdom receiving positive bio force from the major city dome.

Yoruba Mimetic Urban Design Theoretical Framework

The core category that emerged from synthesized categories is Cosmological World View while the sub-categories include Harmonic Ideal, Seat of Power, Nodal Symbol and City Building Strategy. The category network is represented as Figure 2. The core hypotheses which stemmed from the theory generation process are:

- *Hypotheses 1*: Yoruba Urbanism is influenced by Her Yoruba Cosmological World View
- *Hypothesis 2:* There is a relationship between Yoruba Cosmological World View and Harmonic Ideal.
- *Hypothesis 3:* There is a relationship between Yoruba Cosmological World View and Seat of Power.
- *Hypothesis 4:* There is a relationship between Yoruba Cosmological World View and Nodal Symbol.

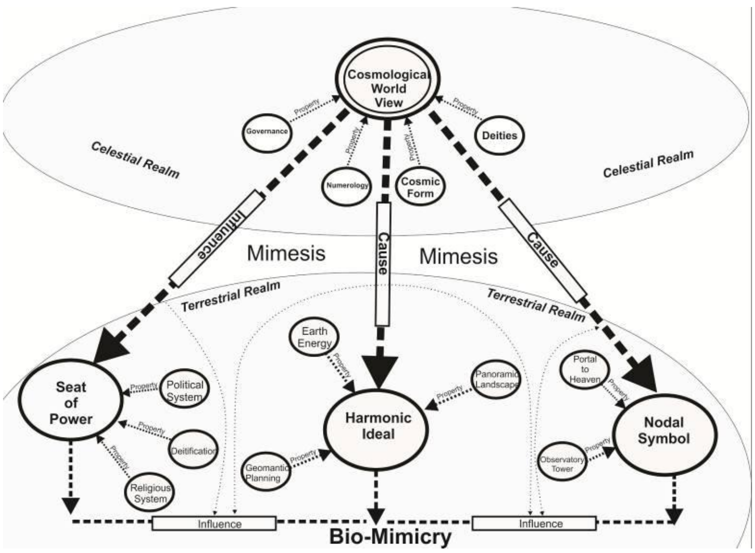


Figure 2.0 Category Frameworks for Yoruba Urbanism

The influence of cosmological world view on Yoruba urbanism manifested in the four properties that constitute the major category namely cosmic urban form, urban numerology, principal deities and governance. Cosmic urban referred to the 16 sided polygons influenced by the 16 divinities in Ifa earth creation. In addition to cosmic form is the square that corresponds to the cardinal points often attached to primordial deities. The same 16 and 4 constitute numerology in Yoruba daily living and art works. The political governance with the king at the centre of affairs and 16 chiefs ruling over quarters is rooted in the cosmic personalities that recreate the earth after the flood in Yoruba world view.

Yoruba cosmological world view had a direct cause on achieving environmental harmony. The belief system identified domes on earth (Igbo Odu) where extra terrestrial energy flows from celestial world. Such energy points must be geomantically located to enhance successful living on earth. Three properties of “harmonic ideal” are geomantic planning, earth energy and panoramic landscape. Major energy points in the city are geomantically chosen as the city core made up of the palace and king’s market. Such locations correspond to panoramic landscapes. The grand nodal space in the city corresponds with king’s market within the city core. Other nodal points are the road intersections belief to be minor energy points.

Yoruba cosmological world view also had a direct cause on “Nodal symbol”. The nodal points, the city core and the inter sections are treated as outdoor temples with shrines for periodic propitiation according to the polytheist nature belief. The last category, ‘seat of power’ is influenced by the cosmological world view. Political, religious system and the personification of the city by the king are the properties of this category. The political structure is a reflection of the heavenly contingent that created earth. While mythological frame work identified the supreme position of self existing God ‘Olodumare’ and 16 divinities in heaven, a copy of this administrative model was instituted on city scale. In retrospect, the theoretical framework for Yoruba cities fit perfectly into Rapoport (1988) high-level meaning’’ sacred architecture’. Citing the works of Eliade (1959), Smith (2007) identified four basic beliefs about cosmological significance including principle of heavens on earth; the cosmos are set in four cardinal points so planning works on earth should do likewise; there is an axial linkage between heaven and earth; and that the art of divination is needed to locate and sanctify sacred space on earth.

CONCLUSIONS

Traditional Yoruba urbanism is a geosophic perspective of cosmic statement as expressed in the Ifa mythology of earth creation. Beckley (1980) classified urban designers in two categories namely self- conscious and un-self- conscious. The latter is intuitive in nature and is capable of affecting urban form. Self-conscious group are professionals who rely upon sets of principles to create city forms that are liveable. Principles employed by the self-conscious group actually evolved from the unwritten knowledge and wisdom the intuitive group developed in living harmoniously in a defined geographical setting. MacLean (1997) noted that organic architecture, green architecture or sustainable architecture respond to issues of the heart, spirit, mind and body. By responding to these four qualities, organic architecture embraces and fuses together two fundamental concepts namely sustainability and geomantic site planning which is divination art of locating positive earth energy empowered from the cosmos. On this note sustainable design in Yoruba cities must explore the following:

- Imitating 16 sided polygonal cosmic form with possible insertions of square that define the cardinal points.
- Accommodate the prime position of architectural numerology that operates on "4", "16" and theirs multiples in 'sense of place' determination.
- Bio-mimicry of biotic communities within the bioregion that naturally exhibit identified numerology. Phenomenological interpretation of bio mimicry foundation of form, ecosystem and process illuminates designs that respond to sustainability on local scale.
- The prime position of traditional institutional frame work and the religious apparatus rooted in nature.
- Consideration for local knowledge on how man relates to earth especially reliance on landscape indicators to understand site planning with necessary bio force in the absence of geomantic knowledge.

The cosmic 16 sided polygonal form imitated in Yoruba city lay out is meant to give symbolic meaning to the sum total way of living. This was physically achieved through the location of the palace in the most holy city core, location of central open space called King's market as twin core land use and incorporation of sacred forms in different quarters of the city.

REFERENCES

Ananth, S. (1999). The Penguin Guide to Vaastu: The Classical Indian Science of Architecture and Design

Arbab, F. (2000) Promoting a Discourse on Science, Religion and Development. In The Lab, The Temple and The Market: Reflections at the Intersection of Science, Religion and Development. Edited by Sharon Harper. International Development Research Center, Kumacricum Press. Bloomfield, CT 06002. Pp149-210

Awolalu, A. O. (1979), Yoruba Beliefs and Sacrificial Rites

Berg, P. (2001) The post Environmentalist Directions of Bioregionalism. Being a lecture at University of Montana Missoula. Planet Drum Foundation. P.O.Box 31251, San Francisco. CA 94131. U.S.A.

Black, (2009). Methodology -. Introducing a Constructivist Grounded Theory Method. In BLOOD MONEY: A Grounded Theory of Corporate Citizenship. University of Waikato. Myanmar .Burma. Pp 81-100

Bring, M. and Wayembergh J. (1981) Japanese Gardens: Design and Meaning. McGraw-Hill Book Company. New York.

Brolin B.C. (1976). The Failure of Modern Architecture. Cassel and Macmillian Publishing Limited 35, Red Lion Square. London WC1R4SG Pp70.

Corbin, J. and Strauss, A. (1990). Grounded Theory Research: Procedures, Canons, and Evaluative. In Journal of Qualitative Sociology, Vol. 13, No.1

Cowan, S. and Sim Van Der Ryn. (1996). Ecological Design. Island Press. Washington DC. U.S.A.

Downton, P. F. (2002). The Ecopolis Development Principles. The Urban Ecology Australia. Newsletter #43. Adelaide; Australia.

Fadipe N.A. (1962). The Sociology of the Yoruba. Ibadan University Press. : USA

Fatunbi A.F. (2004) Odu and Ifa Concept of History: The African Perspective. Part IV. Awo Study Center.

Gasson, S. (2001). Rigor in Grounded Theory Research: An Interpretive Perspective on Generating Theory from Qualitative Field Studies. Drexel University, USA. Retrieved from www.library.drexel.edu on 5th of March 2008

Giles, D.C. (2002) Advanced Research Methods in Psychology. Hove: Routledge

Hagens B. (2006). The Divine Feminine in Geometric Consciousness. Anthropology of Consciousness Journal of American Anthropological Association Vol. 17, Issue 1, Pp. 1-34.

Handel M (1993) John K. Wright and Human Nature in Geography. In America Geographical Society of New York. New York

Jabareen, Y. (2009) Building a Conceptual Framework: Philosophy, Definitions, and Procedure. In International Journal of Qualitative Methods. University of Alberta. Canada. Vol. 8, No 14. Retrieved from http://creativecommons.org/licenses/by/2.0 on 10/9/2010

Kakulu, I. , Byrne, P. and Viitanen, K. (2009) Phenomenological Research in Compulsory

Land Acquisition and Compensation.FIG Working Week 2009 - Surveyors Key Role in Accelerated Development Eilat, Israel.

Kamba,M.A.(2009). Harmonizing the Use of Research Terminologies: An Explanation and Clarification of Meanings of Some Research Concepts. In The African Symposium: An On Line Journal of African Educational Research Network. Vol.9, No 2. Pp 99-110

Krapf-Askari E. (1965). Yoruba Towns and Cities: An Inquiry into the Nature of Urban Social Phenomena. Oxford.

Lane, M. (2007). Plato: The Republic. Translated by Desmond Lee. Penguin Books Limited, 80 Strand, LondonWC2RORI, England.

Lefferts,M.(2007). Cosmometry: Embracing a New Paradigm of Understanding and Design. Retrieved from http://www.cosmometry.net/pdf on 5/12/ 2010

MacLean, H.P. (1997). Organic Architecture: Sustainability and Geomancy As One Timeless Architecture. Boston. Retrieved from http:// Timearch.com. on 6/9/2010

Michl, J. (1995). Form Folow What? The Modernist Notion of Function as a Carte blanche. In 1:50-Magazine of the Faculty of Architecture and Town Planning. Technion Israel Institute of Technology, Haifa. Israel.

Michl,J. (2009) E. H. Gombrich's Adoption of the Formula Form Follows Function: A Case of Mistaken Identity? In Human affairs Vol. *19*, Pp274–288.

Munoz, L. (2005). The Geography of Traditional Yoruba City. In Globalization, Culture and the Nigerian Built Environment. Faculty of Environmental Design and Management. Obafemi Awolowo University. Ile Ife Vol. I Pp 31-39.

Newman, H (2008) Earth Grids - The Secret Patterns of Gaia's Sacred Sites. Wooden Books: Retrieved from http://www.woodenbooks.com/ on 9/8/2009

Nicholls, R. (2004). Bioregionalism: A context for Sustainable Patterns of Living. Urban Ecology, Australia. Adelaide. Australia

Obateru, O.(2006) The Yoruba City in History: 11^{th} Century to the Present. Penthouse Publications (Nig.)30 Ilaro Street, Old Bodija Estate, Ibadan

Okedele,O.S. (1981) The Design of "A Residential Planned Unit of a New Community" for Oyo, Nigeria. A Dissertation Submitted to the School of Engineering and Architecture of the Catholic University of America in Partial fulfillment of the Requirement for the Degree of Master of Architecture. Washington D.C.

Ologundudu, D. (2008). The Cradle of Yoruba Culture. Center for Spoken Words/Institute of Yoruba Culture.

Raman P (2004) Vastu Shastra: Ancient Indian Architecture. In What's Happening -Tri Cities Voice Newspaper. Fremont, Union City, Newark Califonia.

Rapoport, A. (1988). Levels of Meaning in the Built Environment. In *Cross-Cultural Perspectives in Non Verbal Communication*, ed. Fernando Poyatos (Toronto: C. J. Hogrefe,), 317-36;

Russell B. (1965). The History of Western Philosophy: And its Connection with Political and Social Circumstances from the Earlier Times to the Present Day. George Allen and Unwin Limited. London p125- 163

Shannak R.O and Aldhmour,F.M, (2009). Grounded Theory as a Methodology for Theory Generation in Information Systems Research. In European Journal of Economics, Finance and Administrative Sciences. Issue 15. Retrieved from http://www.eurojournals.com on 10/12/2010

Smith, M. E. (2007). Form and Meaning in the Earliest Cities: A New Approach to Ancient Urban Planning. In Journal of Planning History, Vol. 6, No. 1, 3-47

Sörbom, G. (1992) 'The theory of imitation is not a theory of art. Some stages in a conceptual tradition', in Jeanette Emt and Goran Hermeren, (eds), *Understanding the Arts. Contemporary Scandinavian Aesthetics*, Lund University Press, pp. 217–35

Verhagen , F.C. (2008).Worldviews and Metaphors in The Human-Nature Relationship: An Ecolinguistic Exploration Through the Ages. In the journal of Language *and Ecology* vol. 2 no. 3.

HEALTH AND SAFETY IN THE GHANAIAN CONSTRUCTION INDUSTRY: TOWARDS THE ESTABLISHMENT OF ROLES AND RESPONSIBILITIES OF KEY STAKEHOLDERS

A. Nimo Boakye[1], B. B. Akomah[2] and David Coles[3]
[1]*Department of Building Technology, Sunyani Polytechnic, P. O. Box 206, Sunyani, Ghana*
[2]*Department of Building Technology, Cape Coast Polytechnic, P. O. Box AD 50, Cape Coast, Ghana*
[3]*Faculty of Built Environment, Han University, The Netherlands*

Efforts aimed at addressing the health and safety issues in the Ghanaian construction industry are not encouraging. This is because in the local contracts, the criteria for determining the competency of contractors and the subsequent evaluation of tender lays little or no emphasis on health and safety issues. It is true with other similar documents. This shows that from the outset of the construction project less attention is given to health and safety. The paper appraises the roles and responsibilities of key stakeholders on health and safety in the Ghanaian construction industry - in comparison with UK model – as a means of establishing best practice. The study focused on professionals in the Ghanaian construction industry. Primary data were obtained through structured questionnaire and informal interviews. The secondary data were also obtained through desk top study. The data were analysed using both qualitative and quantitative data analysis method. The study revealed that, management commitment to health and safety seems to be at the lowest side. It also came to light that UK construction industry is doing more to improve health and safety of construction workers than their Ghanaian counterparts. However it was conceded by the majority of the respondents that future adaptation of Construction (Design and Management) Regulations 2007 (CDM 2007) to suit local conditions by emphasising much on how roles and responsibilities concerning health and safety of duty holders are spelt out. It is recommended that health and safety should be made part of the criteria to select suitable contractor through tendering.

Key words: CDM 2007, health and safety, tender.

INTRODUCTION

The construction industry plays an essential role in the socio-economic development of a country (Khan, 2008). Notwithstanding it is positive impact on the economy of most countries in the world, it is characterized by poor safety record (Rawlinson, 2004). The poor state of the industry is partly due to the irresponsible manner in which some of the stakeholders or the players within the industry take issues concerning health and safety. It's also emphasized that the physical nature of the construction process, the attitude of the people involved in the production process is normally influenced by their cultural believes, the production environment. The culture of the industry itself, coupled with other factors, contribute immensely to the poor health and

[1] nimoboakye@yahoo.co.uk

Boakye, A.N., Akomah, B.B. and Coles, D. (2011) Health and safety in the Ghanaian construction industry: Towards the establishment of roles and responsibilities of key stakeholders *In:* Laryea, S., Leiringer, R. and Hughes, W. (Eds) *Procs West Africa Built Environment Research (WABER) Conference*, 19-21 July 2011, Accra, Ghana, 529-539.

safety state of the industry (Loosemore *et al*. 2003; Petrovic – Lazarevic and Djordevic, 2002).

The global report given by (ILO / WHO, 2005) indicates that about 17 percent of all total workplace accidents occur in the construction sector. This is a very significant number which requires good measures by the stakeholders in the industry to reduce the extent of accident and to make the industry more attractive to job seekers.

The research conducted by (Boakye *et al*. 2010) indicated that not all construction accidents are reported by the National Labour Department. Notwithstanding the poor coverage and reporting systems facing the industry, the research further presented the following records to show the trend of accidents in the construction industry of Ghana. The report said in 2004 the number of accidents reported was 8 and it rose to 28 in 2009 (250%).

Boakye, Akomah and Coles

Table1: Recorded construction accidents 2004-2009

Year	Number of accidents	Index
2004	8	100
2005	21	262.5
2006	29	362.5
2007	20	250
2008	30	375
2009	28	350

Source: *National Labour Department, 2010 in Boakye et al, 2010.*

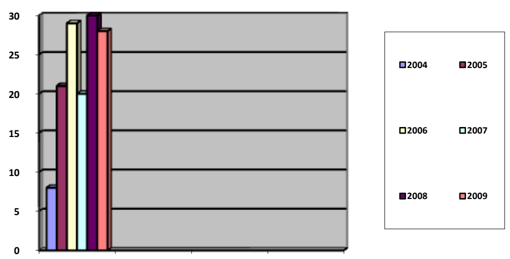


Figure 3: Trend of construction industry accidents

The trend of the accident statistics above indicates that construction related accidents are on the increase in the Ghanaian construction industry, though some laws and regulations are in place. The problem is whether the extent at which the laws and regulations spelt out the roles and responsibilities are enough and more so whether the stakeholders go by their health and safety responsibilities expected from them. Against the background that the research seeks to examine health and safety practice in the Ghanaian construction industry and how best it could be improved using the UK model.

VARIOUS INTERVENTIONS TO IMPROVE HEALTH AND SAFETY AND THE INVOLVEMENT OF STAKEHOLDERS

The factory, offices and shops Act (FOSA) 1970, (Act 328), Workmen's Compensation Law 1987, (Act 187) and Labour Act, 2003 (Act 651) are the main legislative instruments enacted by the government of Ghana to impose health and safety standards in the workplace(Adei and Kunfaa, 2007) . Other Acts such as Environmental Protection Agency Act, (Act 490) and Safety Commission Act (Act

567) and Mines Regulations (1970) also have some provisions related to health and safety on construction sites. However, these safety and health legislation have not been regularly revised to bring them up to date with the prevailing socio-economic conditions in the country (Kheni *et al,* 2008).

The Labour Act, 2008 (Act 651) as well as the Factories, Offices and Shop Act (FOSA) 1970 (Act 328) spells out the responsibilities of health and safety to the employers and employees in the industry. The employers are required to ensure that their employees work under satisfactory, safe and healthy conditions, provide and maintain workplace plant and system of work that are safe and without risks to health, personal protective equipment (PPE's) among others. While the workers are also required to use all the safety appliances, fire-fighting equipment and personal protection equipment provided by the employer in compliance with the employer's instructions.

Health and Safety and Procurement of Construction Works

Currently, the common procedure for awarding construction contracts in the developing countries is open competitive tender with tenders evaluated mainly on the basis of price. Therefore the winning tender could be the one which does not provide safety equipment, welfare facilities and safe working environment (ICE). Lubega (2002) cited in Awodele and Ayoola (2005) stated that cost, time, quality and safety have been identified as important characteristics of every project. However, Ghanaian construction industry lays emphasis on the first three aspects at the expense of safety, even in the determination of contractors' competency through tendering things that would have improve health and safety conditions such as contractor's health and safety plans, contractor's safety records and other similar information is not given much attention.

Sometimes the consultants allow the contractors to charge some fees for safety and welfare facilities, but as to whether they check for compliance by the contractor is another matter. Kheni *et al*, (2008) stated that the consultant's involvement in safety and welfare facilities within SME's often follows the dictates of the client and funding bodies. The report further stated that, consultant's involvement in health and safety issues is far better on projects funded by international donor agencies and clients who aspire to implement health and safety standard that meet ILO guideline on construction health and safety.

Current Health and Safety Situation in Ghana

Kheni *et al,* (2008) conducted a study which critically examines health and safety management of developing countries conducted by researchers such as "Suazo and Jaselskis, 1993 ; Koehn *et al*. 1995 ; Peckitt *et al*. 2002; Small Wood, 2002" and found ample evidence of lapses in the management of safety and health at construction sites. The paper stated that the construction industry of Ghana shares in many of these features of safety and health management in the construction industry of developing countries. Touching on the safety culture of the industry, the paper stated in its conclusion that the national culture of Ghana has influenced on workers attitudes and behaviour at the workplace and even recommended a further research on the impact culture has on health and safety in the construction industry. Hughes and Ferret (2008) discusses the effect of health and safety culture of an organisation and stated that management should be at the forefront to have effective health and safety culture through the formulation of health and safety policy statement outlining short term and long term health and safety objectives and be highly committed to the implementation of health and safety policy. All managers, supervisors and members of the governing body (e.g. directors) should received training in health and safety and be made familiar during training session with the health and safety target of the organisations. Commenting on the factors affecting health and safety culture, Hughes and Ferret (2008) stated that, the most important factor affecting the culture is the commitment to health and safety from the top of organisation. The above information shows how management leadership and commitment promote health and safety culture in an organisation.

Parties Responsible for Construction Health and Safety

The main parties responsible for construction health and safety in Ghana are the clients (i.e. Public Sector clients, corporate clients and individual clients) main contractors, regulatory agencies and Employees.(Laryea and Mensah, 2010). The above stakeholder's responsibilities on construction health and safety stem on the Acts such as factories, Offices and shop Act (1970) Labour Act, 203 and Workmen's Compensation Law 1987 (Adei and Kunfaa, 2007; Laryea and Mensah, 2010).

The Health and Safety Situation in the UK Construction Industry

As part of an effort to improve health and safety of construction industry of the UK and to reduce injuries and related problems resulting from accidents, the government has focused on revising legislations. Taking Construction (Design and Management) Regulations 1994 (CDM 94) for example after it came into force in 1995, the regulations have been amended a number of times by regulations such as the management of health and safety at work regulations 1999, the construction (health, safety and welfare) regulations 1996 and the construction (design and management) (amendment) regulations 2000. These successive amendments came as a result of health and safety commission commitment to maintain the health and safety of construction workers and the general public. (Hackett *et al*, 2007). The current legislation as revised was the Construction (Design and Management) Regulations 1994 (CDM 1994) which came into force in March 1995. The construction (Design and Management) Regulations 2007(CDM 2007) and its approved code of practice came to replace CDM 1994. This new regulations seeks to involve and place duties on all the stakeholders in the industry including clients, designers (Architects and Engineers) contractors (principal contractors, sub-contractors and suppliers), users of the building or the facility and the CDM Co-ordinator in case of (notifiable project – a notifiable project is one where the construction work is likely to take more than 30 days or involve more than 500 person days).

Pre-Construction Information – It is the client's duty under the new regulations to provide the pre-production information. This information should reach designers and contractors who may be bidding for the work. The pre-production information covers project-specific health and safety information needed to identify hazards and risks associated with the design and construction work.

Construction Phase Health and Safety Plan - The regulations require the principal contractor to produce a construction phase health and safety plan outlining the key arrangements to ensure that the work is carried out safely. Clients need to ensure that adequate plan is in place before allowing work to start on site. In addition, the principal contractor is required to work with contractors to identify the hazards and assess the risks related to their work, including the risks they may create for others.

Health and Safety File - The CDM Co-ordinator also under the regulation is required to prepare Health and Safety file for (notifiable projects – a notifiable project is one where the construction work is likely to take more than 30 days or involve more than 500 person days) only. The file should contain information needed to allow future construction work including cleaning, maintenance, alterations, refurbishment and demolition to be carried out safely. Information in the file should alert those carrying out such work to risks and should help them to decide how to work safely. Responsibilities of other duty holders as given by CDM 2007 and ACoP are too detailed to be considered in this paper.

The introduction of the new health and safety regulations including Corporate Manslaughter and Corporate Homicide Act (Act 2008) which implicates the whole organization in the case of the death of an employee on a construction site might contribute to the reduction of accident rates in the UK. According to Johnson (2010) there were 41 fatal injuries of the whole UK construction industry in 2009/10 (2 per 100,000) and represents a reduction of 37% which compared against the average 3.2 per 100,000 for the previous five years.

Assessment and Evaluation of Contractor's Competency

Assessment of contractor's competency and tender evaluation processes are key operations in contract procurement and it enables the client to trust the selected contractor to execute the project satisfactorily. It is a period at which the client makes an important decision and it is an event for the project success (Alarcon and Mourgues 2002; Holt *et al.* 1995) cited in Ajayi (2010). The correct choice of the competent contractor is a function of either client consultant or the project manager (Kumarasway, 1996) cited in Ajayi (2010). In determining the competency of organization (including principal contractor, contractors etc) CDM 2007 emphasised that the company's organization and arrangements for health and safety are to be assessed to determine whether the company provisions are competent and sufficient to enable them carry out the work safely and without risk to health.

Rating Health and Safety Equally To Traditional Cost, Time and Quality

One of the recommendations made by Kheni (2008) as cited in Laryea and Mensah (2010) suggested that one of the mechanisms to improve health and safety in the construction industry of Ghana is to tighten health and safety requirements using contractual frame works. Lubga (2002) also rated safety high and therefore added it to cost, time and quality and consider them as the important characteristics of project. Traditional tendering criterion are most often designed to meet the client's primary project objective of cost, time and quality which Hackett et al. (2007) termed it as "The Eternal Triangle". But looking at the emphasis place on health and safety and effort being made by Health and Safety Executive (HSE) and the International Labour Organisation (ILO) couple with ineffective management of health and safety at construction sites in developing countries including Ghana (Kheni *et al*, 2008), it would be ideal to consider health and safety as important as cost, time and quality of project so that it could be incorporated into tender evaluation criteria for the selection of suitable contractors for the award of construction contracts.

The diagram below illustrates the shifting from traditional Golden triangle to proposed Golden Square (Sayeed, 2006).

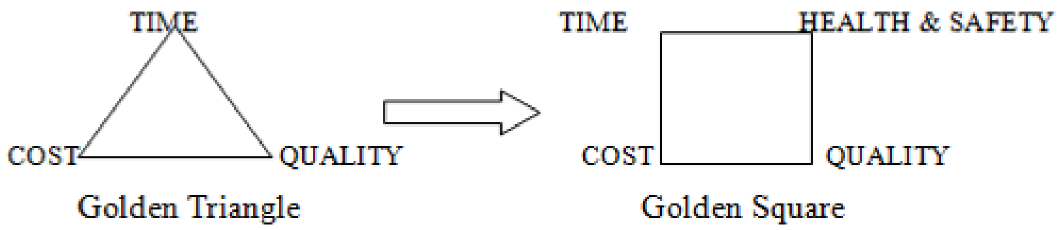


Fig. 1.0 Shifting from Golden Triangle to Golden Square

Source: Sayeed 2006 – University College of London.

MAIN OBJECTIVES

- To identify the state of health and safety practices in the Ghanaian Construction Industry.
- To identify areas of improvement by comparing it with the best practices in the UK.

RESEARCH QUESTIONS

The above objectives were answered through the following research questions:

- What is the state of the health and safety practice in the construction industry of Ghana and the UK?
- How can the current Ghanaian Health and Safety issues or practices be improved based on the best practices from the UK?

RESEARCH METHOD

Structured questionnaire were administered to professionals in the industry who were the target group for the research. The questionnaire was personally handed to the respondents and that open the chance of informal interviews during the interactions. Thirty-five (35) professionals working on behalf of clients and contractors were conveniently selected for the research. Architects, quantity surveyors and structural engineers were mostly the respondents. They were drawn from six consultancy firms of which three were public owned consultancy firms and the other three private owned firms. Five (5) Personnel serving in the capacity as Site Engineer/Project manager for five constructing firms were also contacted. In addition, ten practising lecturers from four tertiary institutions were also involved in the research. Out of the thirty-five questionnaire distributed, twenty-nine (29) were received given the response level of 83%. The obtained data were analysed using both quantitative and qualitative data analysis approach.

DATA PRESENTATION, ANALYSIS AND DISCUSSION OF RESULTS

The table 1 – 7 present the data obtained from the field survey. The questions are analysed and discussed making reference to the table concerned.

Table 2: State of Health and Safety in the Ghanaian Construction Industry

Question /statement	Response in percentage (%)			
	Strongly agree	Agree	Disagree	Strongly disagree
Adequacy of the current laws and regulations	61	37	-	-
Leadership commitment on health and safety and the influence on their workers	59	39	2	-
Leadership commitment and promotion of culture and safety in organisation	53	37	-	9

Source: Researcher field survey, 2010.

Table 3: Current safety culture in Ghanaian construction industry

Question /statement	Response in percentage (%)		
	Satisfactory	Not satisfactory	Either satisfactory
Current safety culture in Ghanaian Construction Industry	7	86	7

Source: Researcher field survey, 2010

Table 4: Rating health and safety high and its impact on Ghanaian construction industry

Question /statement	Response in percentage (%)			
	Strongly agree	Agree	Disagree	Strongly disagree
Rating health and safety high and its impact on Ghanaian Construction Industry	41	45	7	-
Incorporating health and safety issues in assessing Contractors' Competency	66	34	-	-

Source: Researcher field survey, 2010

Table 5: Knowledge of CDM 2007 regs and its possible impact to Ghanaian construction industry

Question /statement	Response in percentage (%)		
	Heard about it	Never heard of it	Not quite sure
Knowledge about Construction (Design and Management) Regulation 2007 (CDM, 2007)	59	34	7

Source: Researcher field survey, 2010.

Table 6: First learnt / heard about CDM 2007 Regulations

Question /statement	Response in percentage (%)			
	College/ university	At seminar/ conference	Internet	Other source
Where (CDM 2007 Regulations) first learnt/heard about.	45	10	7	-

Source: Researcher field survey, 2010

Table 7: Impact of CDM 2007 Regulations on Ghanaian construction industry

Question /statement	Response in percentage (%)	
	Yes	Not sure / somehow
Do you agree that adoption of CDM 2007 regulation and modify to suit local conditions can improve health and safety?	90	10

Source: Researcher field survey, 2010

Adequacy of the current laws and regulations

It could be read from the table 2 that, the large number of respondents of 59% stated that the extent to which current laws and regulations spells out health and safety duties on the stakeholders in the construction industry are not enough. Three percent (3%) of the respondents did not answer that question. However, 38% agreed that the extent to which the current laws and regulations spells out duties on the stakeholders are enough.

Leadership commitment and promotion of culture and safety in organisation

Fifty-five (55%) of the respondents strongly agreed that leadership commitment can promote safety culture in an organisation. Supported by additional 38% of the respondents who also stated that, they agreed to the statement. Only a fraction of the respondents representing 7% stated what is contrary to what 93% (total of strongly agree and agreed) respondents said. Refer to table 2.

Leadership commitment on health and safety and the influence on their workers

Fifty-two (52%) of the respondents strongly agree that leadership commitment on health and safety can influence the worker's attitude to health and safety; 34% only agreed while 10% disagreed to the statement.

Respondents assessment on current safety culture in Ghanaian Construction Industry

Respondents were given the opportunity to comment how satisfactory or other wise of safety culture in the Ghanaian construction industry. Majority of the respondents, 86% confirmed that current health and safety culture was not satisfactory. Seven percent (7%) stated that it was satisfactory. The remaining 7% stated that they were not sure of the situation. See table 3 for detailed responses.

The response to the above questions indicate that management commitment to health and safety is not the best in the Ghanaian construction industry and not reflecting what Hughes and Ferret (2008) suggested as discussed in the literature. They were with the view that management should be at the forefront in ensuring positive health and safety culture through formulation of safety policy and be committed to the implementation of the policy. Some of the respondents were in managerial position, their response indicate that they are not effectively injecting health and safety culture into the Ghanaian construction industry.

Rating health and safety high and its impact on Ghanaian Construction Industry

Almost all the respondents were in an agreement with the statement that rating health and safety as equal to conventional cost, time and quality of projects will improve health and safety conditions in the Ghanaian construction industry as could be seen from table 4. Forty-five (45%) closer to the half of the respondents strongly agree to the statement, while 41% confirmed that they agree to the statement. With regard to the disagreement to the statement, 7% said they disagree and the remaining 7% also stated that they are not sure whether such equal rating of health and safety to the conventional project objectives would improve health and safety condition as by the statement. It is confirmed by the majority of the respondents that incorporating health and safety into criteria for contractor selection through tendering with equal rating of health and safety to conventional cost, time and quality as a primary client's project objective would be in the right direction as proposed by Sayeed (2006) discussed in the literature.

Incorporating health and safety issues in assessing Contractors' Competency

Assessment of contractor's competency and the tender evaluation processes are key operations in contract procurement as the selection of qualified contract will give the client assurance that the selected contractor can achieve the project objective (El-Sawalhi et al. 2007 cited in Ajayi, 2010) one of the effective ways the proposed concept would deal with health and safety is to incorporate them in the criteria for determining the competences of the potential contractors. The respondents gave overwhelming support as 66% strongly agreed to the statement while the remaining 34% confirmed that they also agreed to the statement.

Knowledge about Construction (Design and Management) Regulation 2007 (CDM, 2007)

Prior to the questions at this section, a proposal for the possible adoption of CDM 2007 Regulations was put forward and in order for the respondents to get fair idea or knowledge of the Model, a brief description of how the model works was given as the preamble to the questions related to the model.
The first question enquired about the knowledge of the current regulations of the respondents since it changes or differs from CDM 94. The respondents were asked whether they have heard about Construction (Design and Management) Regulations 2007, and these were the percentage responses as indicated from the table. Quite a number of respondents (59%) have heard about the CDM 2007 Regulations. On the other hand 34% confirmed that they have not heard about it, while 7% stated that they were not sure.

Where first learnt/heard about CDM 2007 Regulations.

This question was also a follow up question to the preceding question enquiring the knowledge of respondents on the CDM 2007 and these were the responses as shown in table 6 (j).
Quite appreciable number of respondents, 45% has heard about CDM 2007 Regulations at College/University or other similar institution. Forty percent (40%) did not answer the question at all. It could be noted that, it is the same percentage of respondents who stated earlier that they have not heard about the new regulations, therefore their staying away from the question is not surprising. However, 10% stated that they had heard about the new regulations at a seminar or conference they attended. The remaining 7% were part of the respondents who initially stated that they had heard about the regulations, but through the internet.

Respondents' opinion about how CDM Regulations -2007 will impact Ghanaian Construction Industry

The question in table 7 was one of the key questions of the study and various responses came out from the respondents. From the table, it is clear that the majority of the respondents 90% support the proposal put forward, while 10% stated that they are not sure whether its adoption will help improve health and safety situations. The overwhelming support of the majority of the respondents regarding possible future adoption of CDM 2007 model indicates that the brief explanation to how the model works to the question giving in the preamble was able to communicate well to the respondents despite the fact that quite number of the respondents had not heard about the new CDM regulations.

CONCLUSION AND RECOMMENDATION

It can be concluded that in terms of promulgation and enactment of laws and regulations to control accident rate and improve health and safety condition in the construction industry, UK is doing more than their counterpart in Ghana. The literature showed the successive revision or amendment even to the CDM 94 before CDM 2007 came into being. Corporate Homicide Act 2008 which implicates the whole organization in the case of the death of an employee on a construction sites is another evidence of the effort being made by the UK government to bring sanity into the construction industry. Possible future adoption of CDM 2007 regulations in Ghana received massive support from the respondents. This includes making health and safety part of tender evaluation and contractor selection criteria with equal rating to cost, time and quality of project. This will factor health and safety issues from the outset of the project. It also came to light that management commitment to health and safety in Ghanaian construction industry is not encouraging and the industry safety culture is at the lower side since less emphasis is made on health and safety issue when determining the competency of a contractor and the subsequent evaluation of tenders.

The paper suggests that the professional bodies within the industry should acquaint themselves with how the CDM 2007 model works and permission from the UK government, adopt it. This will require some adaptations to suit local conditions by dwelling much on how the roles and responsibilities concerning health and safety of stakeholders in the industry are spelt out.

The paper also suggests that government of Ghana should task the organisations like the Department of Factory Inspectorate (DFI) and the professional bodies preferably Ghana Institution of Surveyors, Ghana Institute of Architect, Chartered Institute of Builders and others to develop health and safety Code of Practice to supplement the current safety laws and regulations so that roles and responsibilities of each stakeholder would be clearly spelt out. After the Code of Practice has been developed, the stakeholders would then be required to serve as watchdog for effective implementation/usage of the code.

Lastly, the paper suggests that further research should be carried out to identify the strategies and modalities that could be put in place such that health and safety become integral part of the criteria used to select suitable contractor through tendering.

REFERENCES

Adei, D and Kanfaa, E. Y. (2007), “Occupational Health and Safety Policy in the Operation of the Wood Processing Industry in Kumasi, Ghana”. Journal of Science and Technology volume 27, Number 2 August, 2007, 171.

Ajayi, O.M (2010) Multi – Criteria Decision Model for Contractor Selection in Construction Project in Nigeria. Proceeding of West Africa Built Environment Research (WABER) Conference, 27 – 28 July, 2010, Ghana. 423 – 433.

Akomah B. B., Boakye A. N. and Fugar F.D.K (2010), Safety on Ghanaian Construction Sites: The Role of the Employer and the Employee. Proceeding of West Africa Built Environment Research (WABER) Conference, 27 – 28 July, 2010, Ghana, 477 – 487.

Awodele, O. A and Ayoola, M.C. (2005). An Assessment of Safety Programmes on Construction site. Journal of Land Use and Development Studies. Vol.1No1, 2005.

Boakye A. N., Akomah B. B. and Fugar F.D.K (2010), Ensuring the Health and Safety of Ghanaian Construction Workers By Decentralised Government Agencies: An Exploratory Study Proceeding of West Africa Built Environment Research (WABER) Conference, 27 – 28 July, 2010, Ghana. 295 – 304

Global Workplace Deaths Vastly under Reported (ILO), (http://www.ilo.org/global/about-the-

ilo/press-and-media-centre/press-releases/WMCS-00516/Lang-en/index.ht). (Assessed on 5th December 2010).

Ghana Economy. (http:www.traveldocs.com/gh/economy.htm). (Accessed on 4th Dec 2010).

Hackett, M., Robinson, I. and Statham, G. (Ed.), (2007). The Aquah Group Guide to Procurement, Tendering and contract Administration. Blackwell publishing Ltd, HSC, Managing Health and Safety in Construction, Construction (Design and Management) Regulations 2007. Approved Code of Practice. HSE Books.

Housing Deficit in Ghana Hits, 1 million (Public Agenda September 2009) (http://www.traveldocs.com/gh/economy.htm.) . (http://kppbumediacomms.com/HousingDeficitGhanaArts1million.asx). (Assessed on 4th December, 2010)

Hughes, P. and Ferret, E (2008) Introduction to Health and Safety in Construction, 3rd Edition. Butterworth - Heinemann, UK

ICE, Promoting Construction Health and Safety through Procurement: A Briefing Note for Developing Countries. Engineer Against Poverty Briefing Note. (http://engineeragainstpoverty.org_db_/documents/EAP-ICE_HS_Briefing - Note- pdf). (Accessed on 3rd December 2010).

ILO/WHO (2005), Number of work related Accidents and Illness continues to Increase, Joint Press Release. (http://www.ILO.org/global/about-the- ilo/ press-and-media-entre/press-release/WCMS_00516/Lang-en/index.ht). (Assessed 3rd Dec 2010)

Johnson M. (2010), Why doesn't a drop in Accidents Statistics Result in Lower Employers Liability. (http:www.jltgroup.com/jlt-limited /blogs/construction/2010/08/why-doesn't-a-drop-in-accident-statistics result). (Accessed on 5th December 2010)

Khan R. I. (2008), Role of Construction Sector in Economic Growth: Empirical Evidence from Pakistan Economy Conference Paper, Karachi, Pakistan.

Kheni, N. A., Gibb, A. G. F. and Dainty, A. R. J., (2008), Institutional and Economic Challenges To Health and Safety Management within SMEs in developing countries: A Case Study of Ghana. (www.irbdirekt.de/claten/konda/CIB10336.pdf). (Accessed on 16th July, 2010).

Laryea, S and Mensah, S (2010) Health and Safety on Construction sites in Ghana. RICS International Conference, Paris. (http://reading.academia.edu/Sam Laryea/313582/Health_and_Safety_on_construction_site). (Accessed on 10th May, 2010).

Petrovic – Lazarevic, S and Djordjevic, Z. (2002). "Influence of Social Protection Program on Senior Management styles in the Serbian Construction Industry". Manadzment u novom okruzeju (Management in New Environment), Fakulet Organizacionih nauka (Faculty of Org. Science), Belgrade, Serbia, pp. 576.

Rowlinson, S. (2004) Construction Safety Management Systems. London: Spon Press.

Sayeed, S. (2006) The Shift from The Golden Triangle to The Golden Square. Dissertation for Bsc. (Hons) in Project Management for Construction. University College of London, London: The Bartlett.

HISTORICAL OVERVIEW OF HOUSING PROVISION IN PRE AND POST INDEPENDENCE GHANA

T. E. Kwofie[1] E. Adinyira[2] and E. Botchway[3]

[1,3]*Department of Architecture, Kwame Nkrumah University of Science and Technology, Kumasi Ghana*

[2] *Department of Building Technology, Kwame Nkrumah University of Science and Technology, Kumasi Ghana*

Housing undoubtedly remains one of the essential needs of man among food and clothing from creation. Meeting this essential need has witnessed different interventions that span several centuries from individuals, community self help, corporate organisations, NGO's to governments. From the Palaeolithic era interventions have taken the forms of caves, make shift tents, nomadic artefacts, traditional mud houses, wooden houses etc. These efforts to meet the housing needs have been greatly influenced by nature of requirement, ethnicity, geographical location, colonial impact and national policy direction. In Ghana, the rate of housing delivery has been erratic and often fallen short of the demand. This has culminated into several developmental problems such as high unaffordable rent, development of slumps and ghettos and huge housing deficits that will take sustained efforts over long periods to correct. In Ghana, diverse efforts have been expounded by many key players before and after independence to provide this need of man. Until recently, housing provision was the responsibility of the government and few individuals who could afford. A critical analysis of the situation from pre independence to date posits interesting features- (1. In 2005, Ghana had an estimated 5.4 million slum dwellers, 2. Current statistics rate Ghana's housing deficit over one million as against an annual estimated delivery of 37,000 and 3. Besides less than 15% of the population can afford house ownership by mortgage and less than 8% without mortgage) -which give a solid background for future national policy direction on housing provision. Historically, housing provision in Ghana has evolved through several paradigm and fragmented unsustained interventions due to several factors. This paper presents a historical overview of housing provision in Ghana. It attempts to systematically bring to bare the challenges of housing delivery by reviewing past and present housing schemes and also collect the views of various key actors through semi-structured interviews

Keywords: Ghana, housing, mortgage.

INTRODUCTION

Housing the low to moderate or average majority of the population of developing countries remains one of the greatest socio-economic challenges which several efforts/interventions in the form of housing projects schemes have been evolved to address [Fergusson, 2008]. Despite the universally acknowledged importance of housing for the physical and social well-being of mankind, its provision, affordability and accessibility remains a seemly insurmountable problem for the nations in Sub-

[1] teeagk@yahoo.co.uk
[2] rasadii@yahoo.com
[3] edbotchway@yahoo.co.uk

Kwofie, T.E., Adinyira, E. and Botchway, E. (2011) Historical overview of housing provision in pre and post independence Ghana *In:* Laryea, S., Leiringer, R. and Hughes, W. (Eds) *Procs West Africa Built Environment Research (WABER) Conference,* 19-21 July 2011, Accra, Ghana, 541-557.

Saharan Africa [Werna, 1998]. A full supply of proper decent housing for the low/average-income people is still an unresolved issue in many notable cities throughout the world [Werna, 1998].

Housing is one of the three basic needs of mankind, a pre-requisite to survival of man [Onibokun, 1983; UN, 1992] and remains the most in short supply or deprived to demand in many countries in the world. It remains the essential element of the physical survival of mankind and contributes to the attainment of physical and moral health of a nation and stimulates the social stability, work efficiency and the development of the individual. It is also one of the best indicators of a person's standard of living and of his place in society [Adeniyi, 1974]. In-spite of the fundamental role of housing in the life of an individual, society or nation and in-spite of the United Nation's realization of the need to globally attain adequate shelter/housing for all, the housing situation in the world is at a crisis level and remains one of the global problems. It is a grave and a rising challenge facing urban, peri-urban and rural residents, particularly in most developing economies [Ademiluyi, 2009]. The situation seems worst than thought given the current trends in population dynamism in major cities in the world especially in developing countries. According to the United Nations Population Fund, the world's population passed 6.1 billion in 2001 and is expected to reach between 7.9 and 10.9 billion by 2050 and with this over 90% of this growth during the next two decades is forecast to occur in developing countries [Wilkipedia, 2009].Currently, one-sixth of the world's population – one billion people – live in urban slums in emerging countries. In addition, virtually all net growth of 2.6 billion in world population between now and 2050 is projected to occur in these cities [Fergusson, 2008].

The ever mounting crisis in the housing sector in the world is evident in the fact that there is absolute housing unit shortage, growing emergence and proliferation of slum and squatter settlements, rising cost of housing rent and growing inability of the average citizens to own their own houses or procure decent accommodation of their taste in the housing market [Ademiluyi, 2009].It is estimated that the number of people considered to be homeless are estimated to be in excess of 100 million in the world [UNCHS, 1999]. In cities such as Mumbai, Lagos, Accra, Abidjan Shanghai, Mexico City, Moscow, an estimated 40 to 50% of their population live in slums, dilapidated chawls and on pavements [Yuen, 2007]. Figure 1 below gives an indication of the situation of housing shortage in the various part of the world.

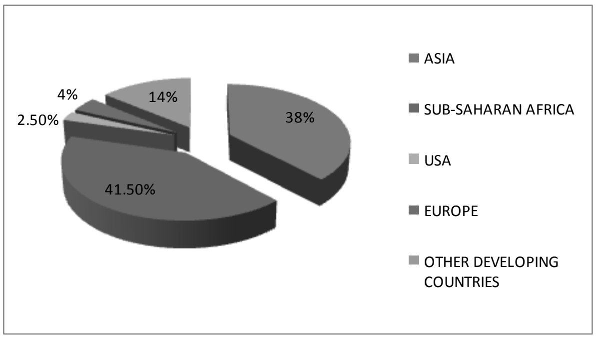


Figure 1: Distribution of Housing Shortages in the World.

In Ghana, Housing situation is said to be at a crisis level [Ghana National Housing Policy and Action Plan, 1987-1990]. In a 2006 Housing Conference in Accra, it was revealed by the then president, J.A. Kuffour that Ghana's population was at 20 million and was set to increase by 50% by 2025 with a growth rate of 2.7-3%. Ghana's urban centres are at bursting seams from rural-urban drifts and bear the brunt of rapid urbanisation. It is estimated that Ghana's urban population will be about 52% of the national total growth and central to this rapid urban growth are serious housing shortages and poor sanitation [UN-HABITAT, 2006].In 2005, as a result of acute shortage of housing and poor conditions of housing, sub-Saharan Africa had 199 million slum dwellers constituting 20% of the worlds total slum population and had the highest urban growth rate of 4.58% and the high annual slum growth rate of 4.53%. Ghana in the same year had 5.4 million slum dwellers and is anticipated to reach 7.1 million by 2020. The worse hit cities are Accra, Kumasi and Sekondi-Takoradi [UN-HABITAT, 2006].

Provision of affordable housing for the mass of the population has remained a major challenge for many countries. Several interventions have been seen as the way to remedy the ever growing demands which far outstrip the supply creating an acute shortage leading to creation of slums, insanitary conditions and overcrowding especially in the major cities of the world. This paper attempts to recount or offer a historical overview of Ghana's housing situation. It presents a historical overview of housing delivery in Ghana from pre to post independence era and reveals the emerging developments in the Ghanaian housing industry. Information for the paper was gathered through an extensive and exhaustive assessment of various housing reports, a review of published literature on Ghana's housing situation and also through semi-structured interviews with various stakeholders like the Ministry of Water Resources Works and Housing (MWRWH), Centre for Scientific and Industrial Research/ Building and Road Research Institute (CSIR/BRRI), Ghana Statistical Services (GSS), Real Estate Developers, and Building Professionals.

HISTORY OF PUBLIC HOUSING IN GHANA

Ghana's housing delivery and access to decent accommodation in any part of the country is at crisis level [Agyemang, 2001]. Provision of housing in Ghana has witnessed fragmented and unsustained effort from individuals, private developers and the government. This situation has contributed to the huge housing deficit we encounter today. The shortage of housing continues to be one of the most critical socio-economic challenges facing the country [Ghana National Development Plan 2008]. Statistics show that, the country's housing deficit is projected to be around 1.2 million house-units as against an annual purported delivery of 37,000 house units which is dominated by individual self house projects [Amoa-Mensah, 2008].

The 2000 Population and Housing Census reports that there were 2,181,975 houses countrywide even though a total of 3,877,418 dwelling units were recorded. This implies that about 1,695,443 'houses' are unconventional houses. Records show uneven distribution of houses across the country as indicated in Table 1and Figure 2 with an arithmetic increase in housing provision as against a geometric rate increase in the population.

Table 1: Regional Distribution of Stocks of Houses and Households(HH)

	2000 Population	No. of Houses	No. of HH	% Distribution of Housing Stock	Urban Share of Housing Stock	Pop. per House	Avg. HH size	HH per House
All Regions	**18,912,079**	**2,181,975**	**3,701,241**	**100**	**34.1**	**8.7**	**5.1**	**1.7**
Greater Accra	2,905,726	287,840	626,613	13.2	80.4	10.1	4.6	2.2
Ashanti	3,612,950	328,751	682,759	15.1	37.1	11	5.3	2.1
Western	1,924,577	259,874	410,142	11.9	27.1	7.4	4.7	1.6
Eastern	2,106,696	283,461	456,683	13	26.6	7.4	4.6	1.6
Volta	1,635,421	264,451	345,821	12	27.0	6.2	4.7	1.3
Nortern	1,820,806	177,785	245,617	8.1	24.4	10.2	7.4	1.4
Brong Ahafo	1,815,408	216,275	342,808	9.9	28.9	8.4	5.3	1.6
Central	1,593,823	223,239	365,777	10.2	26.8	7.1	4.4	1.6
Upper East	920,089	88,401	144,386	4.1	14.6	10.4	6.4	1.6
Upper West	576,583	51,898	80,635	2.4	17.4	11.1	7.2	1.6

Source: GSS Census Report and author's own calcculations

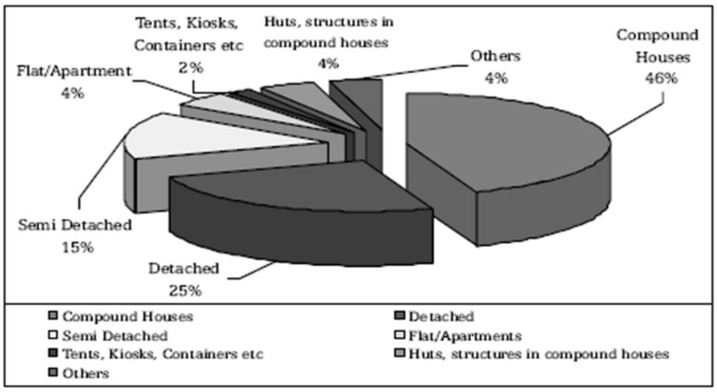


Figure 2: Distribution of Housing in Ghana

Source: Bank of Ghana Report, 2007

Table 2: Selected Housing Conditions of Occupied Units by Region-2000 Population and Housing Census, 2002

Housing Facility	All Regions		Western	Central	Gt. Accra	Volta	Eastern	Ashanti	Brong Ahafo	Northern	Upper East	Upper West
	Pct	Number										
Sleeping Rooms Used	**100.0**	**3,698,337**	**409,282**	**365,605**	**625,744**	**345,722**	**456,475**	**682,337**	**342,695**	**245,531**	**144,358**	80,588
One room	49.9	1,844,327	233,077	219,110	393,576	135,306	221,649	415,258	152,829	38,603	21,377	13,542
Two rooms	21.5	793,579	94,528	74,796	113,005	100,155	108,541	120,596	77,189	50,347	34,678	19,744
Three rooms	11.3	416,248	38,876	29,348	48,140	51,484	52,538	58,454	42,711	45,990	31,395	17,309
Four rooms	6.6	242,306	18,559	15,360	32,392	25,827	28,437	30,861	23,639	33,788	21,421	11,647
Five rooms	3.7	135,533	9,102	8,307	15,360	12,188	15,512	18,779	13,737	23,525	12,325	6,698
Six rooms	2.4	88,946	5,299	5,957	8,660	8,427	10,293	12,270	9,565	15,911	8,156	4,408
Seven rooms	1.4	52,393	3,520	3,520	4,440	4,111	6,081	7,410	6,418	10,300	4,423	2,180
Eight rooms	1.0	38.101	2,264	2,691	3,388	3,038	4,389	5,528	4,836	7,391	2,991	1,585
Nine or more rooms	2.3	86,904	4,064	6,141	6,783	5,186	9,035	13,181	11,771	19,676	7,592	3,475

Table 3: Housing Deficit Growth

YEAR	DEFICIT	DELIVERY	% OF DELIVERY	NEED
1980's	250,000	70,000	22%	133,000
1998	300,000	30,000	25%	140,000
2000	700,000	25,000-30,000	21%	199,000
2008	1,000,000	37,000	22%	150,000
2010	1,200,000	199,000	23%	300,000

Source: Authors compilation from several literatures

The purported delivery of 37,000 units in 2008 as indicated on Table 3 is very much inconsistent. For this period (2001-2008), only 5092 houses were initiated by government and remain incomplete after five years of pre contract planning [ISSER, 2007]. This also include projections of 'self-build houses' which in reality can take several years to complete through lock up capital process [Ahadzie et al, 2010]. Anecdotal evidence suggests that it takes between 5-15 years for an individual household to build a house [Bank of Ghana, 2007].

Ghana's public housing constituted about 10% of the total housing stock by 1982 as against over 80% from private individuals. The relative absence of a well developed real estate market/industry accounted for about 3-8% of the housing stock delivered then [Barnes, 1982].From the late 1980s to 2010, no single unit of housing has been added by the government from purely public housing provision as many initiated schemes within this periods remain incomplete. In 2006, from the annual purported delivery requirement of 199,000 the annual contribution of delivery from Ghana Real Estate Developers Association's (GREDA) peaked at 2,500 units, (less than 8%) with the informal sector (private individuals) which has formed the bulk of the contribution to be about 90%. From the past three decades, contribution from the public sector has been non existence as seen in the numerous uncompleted government housing projects [Akuffo, 2006].This is coupled by the fact that only 8% of Ghanaians can afford to buy house without a mortgage and 15% can access mortgages [BRRI, 2006; City Properties, 2010]. The private sector has been bashed for making their housing units targeted at the rich and prominent persons of the society at the neglected of the average and the poor. The Building and Road Research Institute (BRRI), established in 2004 that out of the total housing supply of 40,000, supply from the private individuals amounted to 38,200 (95.5%) [Akuffo, 2006; BRRI, 2006]. The GREDA's accumulated contribution accounts for less than 5% of the total housing stock.

Table 4: Estimated Housing Stock and Deficit

	Population	Households	Estimated Housing Requirement	Yearly Requirement
2001	19,422,705	3,808,374	2,240,220	58,896
2002	19,947,118	3,911,200	2,300,706	60,486
2003	20,485,690	4,016,802	2,362,825	62,119
2004	21,038,804	4,125,256	2,426,621	63,796
2005	21,606,852	4,236,638	2,492,140	65,519
2006	22,190,237	4,351,027	2,559,428	67,288
2007	22,789,373	4,468,505	2,628,532	69,105
2008	23,404,686	4,589,154	2,699,502	70,970
2009	24,036,613	4,713,061	2,772,389	72,887
2010	24,685,601	4,840,314	2,847,244	74,855

Source: 1960, 1970 and 2000 Population Census and projected calculations

Given the estimated and projected delivery and deficit in Table 4, as against the actual delivery, it should be of great concern to demand immediate action from all parties since housing promotes economic growth through the expansion of the construction industry and contributes to reducing poverty by increasing the demand for low-skilled labour [Bank of Ghana, 2007].

GHANA'S PUBLIC HOUSING POLICIES OVER THE YEARS

The foregoing reviews suggest a continuous effort by private individuals and the real estate sectors over and above that of the public sector. Ghana's serious housing deficit is a problem which spawned and fuelled by host of factors notably, ever increasing cost of building materials, rapid population growth, urbanization, deterioration of fabric of existing structures, absence of clear sustainable delivery policy framework and poor managerial system. It is however not for lack of effort on the part of successive governments to address the problem of shortages. Verifiable records confirm concerted efforts have been made by all governments, even before and after independence towards the provision of affordable social/public housing in Ghana [Daily graphic, 2011].

IMPLEMENTATION

Pre-independence witnessed the direct involvement of government in public housing. The emphasis on developing the housing industry gained prominence in Ghana probably from the late 50s to the early 60s as it attained independence from colonial rule [Bank of Ghana, 2007]. It is worth noting as stated by [Ayeh, 2009; Agyemang, 2001] that all housing schemes initiated by various governments from pre to post independence era were unsuccessful due to a host of factors. The history of housing delivery in Ghana is a de-facto, a tale of failed economic policies [Akuffo, 2006].

The housing interventions during the pre-independence era took the form of provision of staff bungalows for the senior public officer of the colonial governments in many parts of the country especially in regional capitals, towns and mining areas through direct funding by the colonial government [Agyemang, 2001]. It must be noted that literature on housing provision during pre-independence era is scanty and its statistics are almost unavailable but the notable ones give account of housing schemes initiated by major companies in the then Gold Coast to provide accommodation for their expatriates, senior officers and junior worker. It is worth noting that this housing was mainly provided for the working class. No consideration was made for the average, poor and non working class until1920s and after the occurrence of the 1939 earthquake in Ghana[Agyemang, 2001; Ayeh, 2009]. Ghana's Public housing constituted about 10% of the total housing stock by 1982 as against over 80% from private individuals. The relative absence of a well developed real estate market/industry accounted for about 3-8% of the housing stock delivered then [Barnes, 1982].

Gordon Guggisberg (9th October 1919-24th April 1927)

The Gold Coast government's first recorded direct involvement in native housing was in 1920s when Dispossessed Person's Housing Scheme was introduced to provide housing for the natives dispossessed as a result of government development programs. Under the scheme, which begun in 1923, affected persons were advanced with building material loans to commence their own houses. By 1933, 118 loans involving a total of £9,280 had been approved and given. The scheme was discontinued in 1933 because it was perceived by the government to be very expensive. This was during

Governor G. Guggisberg's reign [Agyemang, 2001]. From this time onwards, little attention was paid to housing until the 1939 earthquake.

The 22nd June, 1939 earthquake in the now capital city of Ghana, called for the direct intervention of the then government in the provision of affordable housing for the affected population. The government provided funding to build 1000 two (2) - bedroom unit houses at Osu, Mamprobi, Chorkor, North-West Korle Gonno, , Kaneshie and Abbosey-Okai. By 1955, 1250 units were completed and they exist up to date occupied by civil and public servants and the Armed Forces. The rental units were subsidized and tenants given the opportunity to acquire them through hire-purchase [BRRI, 1970].

Alan Burns (29th June 1942-2nd August 1947)

The Alan Burns government also introduced a four (4) year Development Plan in 1943 of which housing was a top priority. The plan sought to implement the construction of inexpensive but well built houses' with as much local material content as possible on a budget of £0.8 million [Agyemang, 2001].

In 1946, two (2) housing schemes under the government' plan and policies were published. Scheme A was under the direction of Department of Social Welfare. Under this scheme 3, 2, and 1 bedroom dwellings were to be constructed and rented to all people at economic cost. Only labourers were required to pay non economic rents. The Scheme B was termed Town and Council Housing to be concentrated in Accra, Kumasi and Sekondi-Takoradi. Under this scheme, a person could apply for financial assistance to build within the Municipal on his own design or pro-forma building plan from the Department of Social Welfare which both the plan and contractor must be approved by the Town Council.

Kwame Nkrumah (6th March 1957-24th February, 1966)

In the post independence era, several interventions were undertaken but considered unsuccessful by experts and stakeholders. Under the reign of Dr. Kwame Nkrumah, the first president of Ghana, three (3) Development plans were formulated aimed at the provision of adequate housing. The first was the five year plan from 1951-1956. This plan saw the establishment of the Tema Development Corporation (TDC) and the State Housing Corporation (SHC) [Bank of Ghana, 2007; Benjamin, 2007; Agyemang, 2001]. The main objective of the TDC was to provide affordable housing for the low income workers of the newly created Tema. The activities of TDC led to the creation of the Communities of Tema, i.e. Communities 1 to 8 etc contributing over 2255 units. The Schockbeton Housing scheme was also established targeted to provide 168 houses in Accra, Kumasi, and Sekondi-Takoradi. This scheme under the consultancy of a Dutch firm introduced pre cast members perceived to be cheaper but became more expensive than estimated and hence the whole scheme was abandoned. The Roof Loan Scheme which sought to grant loans and assistance to public sector workers under the recommendation of the United Nation also made contribution to the a total housing units. However, due to its inefficiencies, only 2517 units out of the proposed 6700 from the 2million pound fund were realized [Nelson and Ayeh, 2009]. The SHC was also established to provide housing for the workers in the civil and public service class and also provide long term housing finance. Their activities were expanded to all the nine (9) regions in the country. Their activities were monitored under the Ministry of Works and Housing with direct funding of their projects from the central governments and in 1995, it was converted into a limited liability company and operated as a commercial enterprise. Their schemes operated with the flexibility of workers owning their home through years of gradual monthly payment from salary deduction [Gyabah, 2009; Agyemang, 2001].

The second Development Plan which was instituted to continue provision of housing was from 1959-1964. This was to support the UN commission's recommendations and initiated programmes to put up housing units. It sought to continue and expand the 'Roof Loan' scheme which focused on assistance from employers to employees through housing loans and self-help housing sites and services [Ayeh, 2011]. The shortfall of this plan was that there was no needs assessment and as a result, there was no indication of projected targets and outputs in the development plan [Gyabah, 2009; Agyemang, 2001]. Nkrumah's vision on housing was to house particularly those in urban areas where shortage was at its peak due to uncontrolled urbanisation. He was not able to see to the end of this plan and was kicked out in a coup d'tact in 1966.

Joseph Ankrah (24th February, 1966-3rd April 1969)

The National Liberation Council (NLC) which booted out the Nkrumah government in 1966 implemented a two (2) year Development plan. The NLC's plan through the TDC and the SHC was to produce2,000 housing units annually. Only a total of 1000 units were realized. Out of this only 2.7% were one room. By location, 63.6% were in Accra, 9% in Kumasi, 7.5 in Sekondi-Takoradi and 11.3% inCape Coast. The main objective of this scheme was to ensure that housing was generated by the productive sectors of the economy through rational and balanced approach [BRRI, 1970; Ayeh, 2011]. It also targeted clearance and slowing down of the growth of slums in urban areas.

Kofi Busia (1st October 1969-13th January 1972)

The Busia administration showed commitment to alleviating the housing crisis confronting the nation especially in the major cities by introducing a one year development plan. The one year Development plan (1970-1971) of the second republic under Busia proceeded the seven year Development Plan. The main objective of this plan was aimed at a house occupancy rate of 10 persons per house as against a housing need estimated at 26,000 units per year. This plan failed to specify the housing units with their associated cost involved. His scheme added just 25% (764-SHC, 1012-TDC=1776) of the targeted 8,000 units mainly due to lack of funds [S-Ayeh, 2011; K-Agyemang, 2001].

I. K. Acheampong (13th January 1972-9th October 1975)

The National Redemption Council under I. K. Acheampong took over government in 1972 and established the National Low Cost Housing Committee under the auspices of the Ministry of Works and Housing. This plan received a capital injection of 10 million cedis ($9,803,921.77, $1=¢1.02, 1970) to construct low cost housing for low-income households in urban areas across the ten regions. It had an annual projected delivery of 2,300 units [BRRI, 1972; Ayeh, 2011]. The scheme by June, 1975 had realized 5,466 units at a cost of 47,602,678 cedis. It was however abandoned in 1976 because of its failure to serve the targeted population due to its high cost [Nelson and Ayeh, 2009]. The original estimates indicated a cost of 2,000-4,000 cedis depending on the size. Upon completion of 5,466 units average per unit stood at 10,000 cedis ($9,803.92). Further, 6,000 units cost a total sum of 62.6 million cedis, thus increasing the average cost to over 12,000 cedis. The government acknowledging its limitation with funding sought to encourage the private sector to complement her effort [K-Agyemang, 2001].

Hilla Liman (24th September 1979-31st December 1981)

The Liman government also recognized the enormity of the housing problems and thus contributed to the building of 1990 rental units through SHC and 228 by the TDC [Nelson and Ayeh, 2009; Benjamin, 2007]. The 1970s, however, brought a period of very poor economic performance for Ghana. There was the energy crisis, rising cost of oil, excessive high rise in imported building materials, decline in external funding etc. This extended recession brought the construction industry to a halt. It was against this background that the Liman government sought to invest in the development of the use of local materials leading through the establishment of the Tile and Brick factory [Nelson &Ayeh, 2009; Benjamin, 2007; Gyabah, 2009; Agyemang, 2001].

Jerry J. Rawlings 4th June 1979-24th September 1979, 31st December, 1981-7th January, 1993, 7th January, 1993-7th January, 2001)

The PNDC/NDC era under J. J. Rawlings saw the implementation of many schemes in an attempt to solve the housing problems. These were the National Shelter Strategy (NSS), Ghana Vision 2020 and the Structural Adjustment Programme (SAP) and Economic Recovery Programme (SAP/ERP).

The National Shelter Strategy was initiated in 1986 by forming a National Housing Policy Committee by the Ministry of Works and Housing (MOWH) to examine the housing situation in the country. This was to establish a government policy and action plan that seeks to provide adequate and decent housing unit in order to improve the quality of life of people in the urban areas. The main focus of the committee was on the constraints of housing delivery either than any other contributing factor to the sector. It focused on housing finance, land, physical planning, infrastructure, building materials, management effort towards delivery. This policy and plan covered the period 1987 to 1990. This was coined from the MOWH's need to enhance its planning capacity to implement housing policies. The focus of the policy was to create an enabling environment and framework to enhance housing provision rather than the full participation of the government to deliver housing [Bank of Ghana, 2007; Agyemang, 2001]. It sought to promote use of local materials, improve rural housing strategy, improve monitoring, managing and coordination of shelter programmes, improve land acquisition and increase access to finance and participation of women in the sector.

The Ghana Vision 2020 scheme had the First Medium-Term Development plan from 1997-2000 target the provision of low-income housing as reported by [Bank of Ghana, 2007 ; MOWH, 2001]. It sought to bring housing within the purview of the poor to improve their living conditions. The plan introduced a new facility under the Social Security scheme which permitted contributors to withdraw part of their contributions to purchase a house. Unfortunately, due to lack of funds, private sector participation and political will, none of the housing strategies under this plan were implemented [Bank of Ghana, 2007].

When the financial crisis had peaked in the 1980s. Ghana signed onto the infamous Structural Adjustment Programmes (SAP) of the World Bank and the IMF in order to secure much needed cash flows for the housing construction industry. This required the country's participation in trade liberalization initiatives which opened its market to imported building materials and necessitated the loosening of rent controls [Benjamin, 2007]. This brought in its wake high inflation translating into high cost of building, high cost of construction, high rent and loosening the government's grip on the housing market. This increased the creation of slums and ghettoes in many cities and urban areas due to high unaffordable rents. In addition due to the lucrative commercial rents being charged, many toilets and bathrooms were converted into rental units leading to overcrowding and creating serious sanitation problems in the cities [Gyabaah, 2009].

John A. Kuffour (7th January, 2001-7th January, 2009)

No considerable additions had been made to public housing from 1985 to 2000 and the NPP government sought to reduce the crisis situation of the housing sector through the initiation of about 20,000 affordable housing units in 2001. In 2007 about 4,500 units from bed sitter, single and two bedroom apartment had started at Borteyman and Kpone in Accra, Asokore Mampong in Kumasi in the Ashanti region, Akwadum site Koforidua in the Eastern region, Tamale, to be completed by June, 2009 [GOG, 2007]. This was the new government's effort to ease the housing problems in the country. The main target group of this scheme was the civil and public servants. Unfortunately not a single unit remains completed up to date and most have been taken over by squatters. This scheme was discontinued by the new NDC government in 2009. [Ahadzie et al, 2010; Nelson and Ayeh, 2009; Ayeh, 2011].

QUASI-GOVERNMENT APPROACH

The involvement of the quasi-government institutions in housing delivery can not be overlooked. Towards the end of the decade (1980-'90), the Social Security and National Insurance Trust (SSNIT) expanded on its programs to build housing for its staff across the country. Though this was originally targeted at its staff, it was expanded in 1988 in a significant investment in housing at 'social' and not market prices, providing a lower option for the general public. However, SSNIT could not attain its objective for the poor and low-income. The project benefited the middle and upper class [Agyemang, 2001; Benjamin, 2007].

SSNIT's notable schemes were the 1637 units at Sakumono, where its success led to it being repeated across the country in Anaji- Takoradi, Koforidua, Wa, Adenta-Accra, Kumasi etc. [Amoa-Mensah, 1999]. In 1999, Ghana's financial crisis had hit its peak. In that year, SSNIT was unable to continue operating its social rental units at a loss and that even its reduced rents were higher than what most Ghanaians could afford. Being saddled with huge operational and maintenance cost, the Trust began the process of divesting most of its real estate assets. Today they have sold out almost more than 92% of its housing units [Benjamin, 2007; Kielson, 2010,]

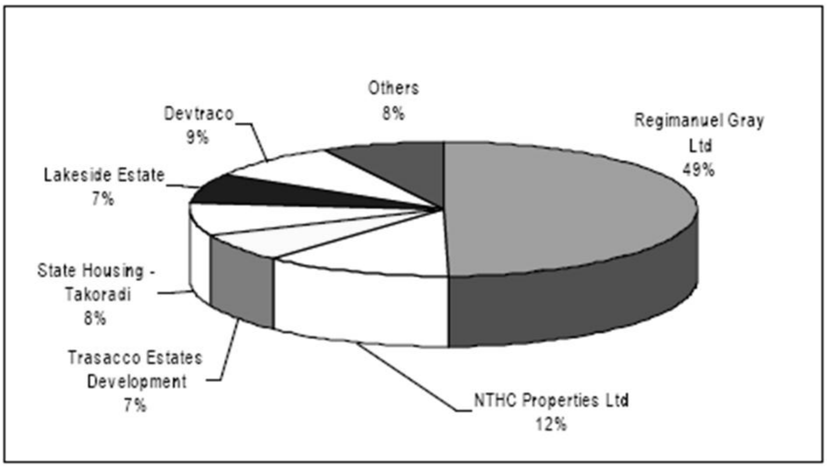
The SHC, after its recapitalization in 1995, adapted a new approach to housing delivery. Under this scheme, prospective home owners are given the opportunity to finance their own home bit by bit after making a down payment of about 20-25% of the cost of the building. This has come with little success as many of the units are over run in time and cost. That is, it takes along time of fragmented funding to complete the homes. This was carried out in all the regions where SHC operate [SHC, 2010]

The Ghana Real Estate Development Association (GREDA) as argued by [Gyabaah, 2009; Ahadzie et al, 2010] was formed among other key objective to help ameliorate the dismal housing deficit especially through the adoption of best practices in construction and management. Notwithstanding the expansive role of the GREDA in recent times, housing supply has not increased any better[Ahadzie et al, 2010; Bank of Ghana, 2007]. Since it formation in 1988, the association has delivered a total of 10,954 housing units [Mahama, 2004]. Selected private estate developers contributions are shown in Table 4 and Figure 5.

Table 4: Housing Units Provided by Selected Real Estate Developers

	2000	2001	2002	2003	2004	2005	2006
Regimanuel Gray Ltd	105	170	180	160	150	155	126
NTHC Properties Ltd	40	45	12	20	22	70	42
Trasacco Estates Development Co. Ltd	--	18	27	20	20	20	36
State Housing Co.Ltd-Takoradi	15	20	20	25	30	30	30
Lakeside Estate	--	--	6	10	20	63	54
Devtraco Ltd	10	14	20	22	32	40	46
Salem Investment Ltd	--	3	6	6	15	30	20
Flexcon Ltd	5	5	10		5	4	10
Civil Masters Co.Ltd	4	4	3	8	6	8	10

Source: Survey Result, March 2007



Source: Bank of Ghana

Figure 5: Shares of Houses Built by Selected Real Estate Developers (2000-2006)

The delivery from formal Real Estate Developers (GREDA) annually at its peak averaged 2,500 units constituting less than 10% of the total annual delivery. This is a drop in the ocean, compared to the annual housing requirement of 199,000 units [Akuffo, 2006]. Actual delivery is purported to be between 25,000 to 30,000 units and is mostly through informal efforts. The BRRI, established in 2004 that out of the total housing supply of 40,000, supply from the private individuals amounted to 38,200 (95.5%) [Akuffo, 2006; BRRI, 2006]. The GREDA scheme allows prospective homeowners to own their home through mortgage or outright purchase. In spite of so many available information through research to make the sector sensitive to the average income and the poor in society, no achievement has been recorded in this direction. This is coupled by the fact that only 8% of Ghanaians can afford to buy a house without a mortgage and 15% can access mortgage [BRRI, 2006; City Properties, 2010]. This sector has been bashed for making their housing units targeted at the rich and prominent persons of the society at the neglected of the average and the poor. Arguments have been leveled for them to adopt more innovative and cost saving approach to make their schemes affordable [Dapaah, 2006; Abongo and Mahama, 2009].

The forgoing discussions and findings reveal that the housing industry in Ghana is inundated/plagued with an army of challenges with the notable ones being:

- absence of clearly defined national housing policy,
- managerial inefficiencies,
- high cost of building materials,
- lack of access to sustainable capital/finance,
- land acquisition/litigation, and
- Lack of control and Regulatory Policy framework for rent [Bank of Ghana, 2007; Ahadzie et al, 2010; Akuffo, 2006 ; Benjamin, 2007].

HOUSING FINANCE

Housing finance remains the greatest and highest challenge to the smooth delivery of schemes the world over. Housing is usually the largest expenditure item in a family budget either as rent, personal building initiatives or mortgage financing. High housing cost can strain a family budget, constrain available resources for other household needs such as utilities, education, health care, transportation, savings for retirement and emergencies [Bank of Ghana, 2007]. Finding a reliable and sustainable constant source of finance for housing either for individuals, private real estate developers (GREDA), central government, NGOs and quasi-government institution has remained the greatest challenge from pre-independence era.

Access to decent affordable house/home is the biggest challenge facing a greater proportion of the population. The situation is worse in the major cities. A typical Ghanaian household is faced with three choices in the acquisition of shelter. These are by rent, self built and mortgage.

Financing by any of these means has not come easy and at great cost and sacrifice. Individual ‘Self Built’ housing finance comes through:

- Self accumulated income
- Remittances from relatives and friends
- Access to home loans from non banking institution (SHC, FGBSL, SSNIT etc)
- Access to credit from Banks.

Unstable economy and evolving impact of world economy downturn and unfavourable economic policies set to have negative impact on these sources of income reducing ability to save as against other competing needs, high cost of borrowing, high cost of building materials and inability to sustain home loan fund schemes such as FGBS, BHC, SSNIT. This is evident in the long years taken for individuals to complete their homes [Bank of Ghana, 2007; Agyemang, 2001]

Government from pre and post independence era undertook direct injection of capital to fund building projects as well as offer home loans at low interest to workers to build their homes. When SHC and TDC were formed in 1955, they enjoyed a sustained funding for building projects aimed at providing houses for the workers in the cities and other urban centres. This chalked a considerable impact until the mid 1970s when Government could no longer sustain his effort due to the oil crisis and economic decline, coupled with the offer of fixed rate long-term loans to borrowers. With these the SHC and TDC’s impact on housing delivery declined. The TDC and SHC under went a recapitalisation in 1995 and has since not been able to get back again as a force[Akuffo, 2006; Bank of Ghana, 2007].

The First Ghana Building Society (FGBS) was also established in 1956 under an ordinance as a typical building society to lend affordable loans to members from a pooled savings for prospective home ownership. The economic downturn of the 1970s with its associated high inflation levels, over valued currency, poor and reduced savings of members caused a severe shortfall in its funding and eventual collapse. The FGBS offered loans and its interest rates were way lower than the prevailing commercial bank rates. It become unattractive to borrowers and main funding from the government dried up under the SAP. Several attempts to resuscitate it have not materialised. Between 1980 and 1988, it granted 549 original and 418 supplementary loans. The total loans in 1988 did not exceed 500,000 cedis ($181,818- $1=¢2.75 cedis, 1980). The BHC was established with a core function of providing funds for the housing and construction sector. Unfortunately, it could not maintain it focus on housing but rather shifted to commercial banking and unfortunately liquidated in 2000. In 1990, only 17% of its total portfolio of three billion cedis ($9,316,770.19, $1=¢322, 1990) was spent on housing. In its 14 year operation, BHC granted only 363 residential mortgage loans [Agyemang, 2001]. Governments' effort in funding housing through state agencies culminates in the table below.

Table 6: Various Government Funding Support to Housing Schemes in Ghana

S/No.	GOV'T	AMOUNT	REMARKS
1	G Guggisberg	£9,280	Benefitted only high rank people
2	Alan Burns	£0.8million	Rising prices of materials
3	Kwame Nkrumah	£2.5 million-TDC £2.0 million- SHC £1,600 loans scheme £500,000 £216,000 Mortgage loans £50,000-Research into LM £20million- Coup detact £24.5million private sector	Rising prices of materials and labour
4	E. A. Ankra	£20million- Coup detact £24.5million private sector	Continue from Nkrumah
5	I. K. Acheampong	¢47,602,678 ¢15,000,000 ¢62,000,000	Rising prices of materials
6	Liman		Rising prices of materials
7	J. J. Rawlings	Through Quasi-Gov't Inst. SSNIT, SHC, TDC, HFC	Rising prices of materials
8	J.A. Kuffour	GH¢270,000,000	Incomplete
9	J. E. A. Mills	$10 billion	Proposed STX

* Busia and Liman no recorded capital injection

Source: Author's compilation from several literatures

Corporate Housing Financing

The corporate financial institutions have made immense contribution towards housing provision in Ghana but these efforts have not come cheap but at a cost often unaffordable by greater percentage of Ghanaian. Up to the early 1980s, all commercial banks in the country (BBG, SCBG, GCB etc) did not provide any mortgage loans towards housing. It was from 1986, that the GCB through its newly established mortgage department, started granting mortgage loans at as high as 35-38% interest rate [Akuffo, 2006; Agyemang, 2001].

Given the deprivation of the housing sector in the early 1990s couple with rising cost of borrowing and building, the ruling government with the intervention of the World Bank (IDA) established the Home Finance Company (HFC) in 1991 with the sole mandate of creating a sustainable housing Finance System. It initial capital was provided by SSNIT and the IDA and was enlisted on the Ghana Stock Exchange in 1995 to raise funds and others from bonds issued. It granted a 15-20 year mortgage at a rate of 35-45%.

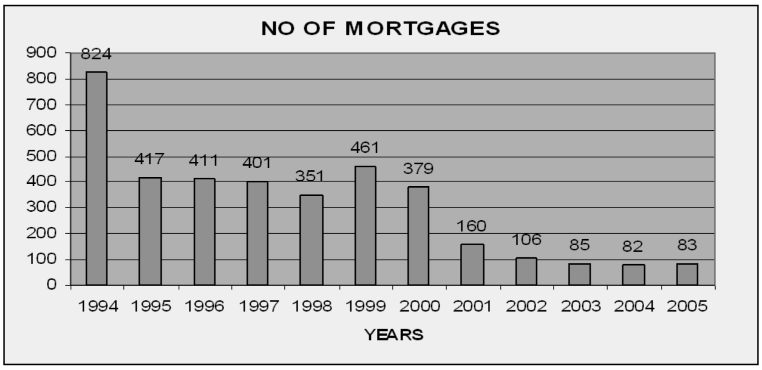


Figure 6: Mortgage Performance by HFC

Source: World Bank/IMF Housing Conference Report

The highest annual origination was in 1994. On the average the company did 350 mortgages per annum. The mortgage business has been slow since 1999 when the local currency -the cedi depreciated by 90%. House prices almost doubled thereby worsening the affordability situation. The significant reduction in originations over the past 5 years was an indication that the company's role as a private specialised mortgage lender needed to be reviewed. Recent economic performance however, gives hope that the mortgage business will pick up again. It is worth noting that in November, 2003, HFC could not go on with its mandate and as such *converted* to a commercial bank [Akuffo, 2006; Agyemang, 2001].

BUILDING MATERIAL INDUSTRY

Before Ghana's contact with the European and influence of capitalism, building in Ghana was predominantly locally based materials in the form of *Thatch, Mud, Wood, Earth and Bricks.*

The paradigm changed when formal trading started under colonisation in the 1870s. The trading allowed for the introduction of foreign building materials in the Gold Coast which were later perceived to be better and 'elites' above the cheaper local materials[Agyemang, 2001]. As Ghana advanced in age, with trading activities growing above expectation and coupled with certain government policies, the situation grew worse and foreign materials were at all cost preferred above all local materials. This development choked certain housing programmes introduced by certain colonial and successive governments. For example the rising cost of imported materials such as cement, roofing sheets etc had to redirect the housing scheme of 1920 by the Guggisberg regime. This trend went on and successive governments did little to control or curtail it. What is witnessed today in the building material industry is an inheritance from the colonial to early independence Ghana [Agyemang, 2001; Akuffo, 2006].

In the rural Ghana, the local materials constitute about 95% of housing stock whilst foreign materials form about 98% of urban housing stock [Atiemo, 2009]. In recent times greater percentage of the national expenditure is on importation of foreign building materials at the expense of cheap local materials. It is estimated that 70% of all building materials in Ghana are imported and more than 180, million dollars are spent on importation of clinker and gypsum [Ayittey, 2009]. It is also recorded that the construction industry utilizes more than 90% of the cement and residential construction account for 75% [Atiemo, 2009]. Table 5 shows the relative composition of building material usage in Ghana.

Table 7: Extent of usage of various building materials for housing in Ghana

Section	Material	Percentage Usage
Floor	Cement/concrete	72
	Earth	23.8
	Terrazzo	1.4
	Timber/wood	1
	Stone	0.6
	PVC	0.4
	Ceramic/Marble	0.3
Roof Carcass	Timber/wood	>97.0
Roof Cover	Metal sheets	60.3
	Thatch/Palm leaf	18.6
	Slate/Asbestos	12.9
	Cement/Concrete	2.4
	Bamboo	2.1
	Timber/wood	0.9
	Roofing tiles	0.5

This worsening development led to several interventions to remedy the situation but little has been attained. For example the establishment of Department of Rural Housing (DRH), CSIR/BRRI, KNUST, Brick and Tile Factory- Liman era etc. all in an attempt to reduce the component of foreign material in the construction industry and promote the locally made materials through appropriate locally dominated technology and methodology, skill and know-how, research and manufacturing. Unfortunately little success has been recorded [Nelson and Ayeh, 2009].

The main set back of the Affordable Housing Scheme in 2006 was rising cost of materials and high inflation against planned budget. Cement for example rose from GH¢3.20-$4.5 (2001) to GH¢8-$6.9(2008) and about GH¢10- GH¢14 ($7.6-$10.8) in 2009[Atiemo, 2009]. Cement and it related products alone constitute about 60% of total cost of construction and the average increase in the price of cement between 2005 and 2008 was 140% [Boadi et al, 2009]. From Table 6, it is anticipated that with so many indicators in the world, market/economy beyond our control, the several calls for extensive use of local materials should be encouraged. The local building material industry should be developed and entrenched so as to harness it related benefits.

From 1984-1998, through the IMF and the World Bank’s ERP and SAPs, worsening inflation and devaluation of the cedi resulted in prices of building materials increasing by 5,000-20,000% [K-Agyemang, 2001]. From the above table it is clear that the cedi in a period of 15 years (1983-1998) was devalued over 80,000%. With this in mind one is tempted to ask if the STX housing project will at all be successful.

There is the readily available local materials such as clay, wood, limestone, thatch, bauxite waste, bamboo etc and as such further studies should be conducted into develop them further to boost the industry as being suggested in many government policies. Extensive studies by BRRI, DRH and Geological Survey indicate that these materials are comparable to cement product and are cheaper in cost [Atiemo, 2009; Boadi et al, 2009].

Table 8:Inflation and Exchange Rates for the Period 1991 – 2008

Year	Rate of Inflation (IR) (%)	Exchange (ER)$ -¢ (Average)	Remarks
1983		2.75	
1986		90	
1990		322	
1991	25.00	370.00	
1992	27.00	450.00	
1993	52.00	790.00	
1994	24.18	1000.00	
1995	41.35	1290.00	
1996	59.38	1688.00	
1997	34.41	2115.00	
1998	37.00	2350.00	
1999	20.80	2706.00	IR at the end of 2000 was 51% and the
2000	40.50	5300.00	ER ¢7000.00 IR was 41.9% in March
2001	27.10	7170.00	and 21.3% in December
2002	14.92	7870	
2003	26.71	8820	
2004	12.74	9360	
2005	15.08	9550	
2006	10.96	9555	
2007	10.69	GH0.9397 (9397)	
2008	17.30	GH1.1521 (11,521)	As at October

Sources: Quarterly Digest of Statistics (Sept. 1998) of the Statistical Services, BRRI (2000) and ISSER (1998), Ghana Statistical Service (2008)

CONCLUSION AND RECOMMENDATIONS FOR FUTURE PUBLIC HOUSING POLICIES

In conclusion, it is worth noting, that governments, elected officials and stakeholders who create policies have to look beyond the coming elections, fulfilling political manifesto, scoring points in the form news paper headlines. For this reason, affordable housing delivery is most effective when the commitment is along-term policy bedrock so solid its support is bipartisan and non-partisan'. We ought to learn from the success stories of Singapore and the United Kingdom.

In order to chalk notable success on any future housing policy meant to arrest our ever widening housing deficit, we will have to change our perception towards the use of local materials, Adopt sound efficient and sustainable cost effective architectural design and constructional methodology. Also we will have to set up non political

National Housing Authority with the mandate to implement policies devoid of political interferences, develop an effective Housing Policy in line with all acclaimed recommendations from experts, and equip research institutions to develop good acceptable local material industry. Last but not the least we will have to create a National Housing Fund and help develop the capacities of building professionals and workmen in the local material technology.

ACKNOWLEDGEMENT

I want to extend a heart of gratitude to the following personalities for their contribution and assistance towards this piece. Deputy Director of Housing-MWRWH, Arc. Yemofio FGIA, Isaac Afranie, Arc. S. O. Afram, Department of Architecture-KNUST

REFERENCE

Fergusson, B. (2008) A Value Chain Framework For Affordable Housing In Emerging Countries, Global Urban Development Magazine, Vol. 4, pp 1-5
Ankrah M.N. A(2009) The IDEM Social Housing and Anti-Poverty Strategies pp 6-8
UN-HABITAT (2006) Innovative Financing for Affordable Housing, www.unhabitat.org (accessed, 20th August, 2010)
Ghana Statistical Service Report, (GLSS) 2008
Ghana National Development plan 2008
Mr, Abongo, General News, www.ghanaweb.com (accessed 23rd August, 2010)
Home Finance Company report, 2001
Amoa-Mensah, K. Housing in Ghana: A Search for Sustainable Options as the Way Forward for Enhanced Output- Year 2003 and Beyond, A paper presented at the International Building Exhibition Seminar, Accra 27th-28 August
Ahadzie, D. K., (2008) Management Practices in Ghanaian House Building Industry (unpublished), pp 1-4, 7-9.
Benjamin C. (2007) A Brief History of Housing in Ghana, www.the statesmanonline.com (accessed 20th August, 2010)
K. Konadu-Agyemang (2001), The Political Economy of Housing ans Urban Development in Africa- Ghana's Experience from Colonial Times to 1998. Praegers Publishers, Westport, UK
Institute of Statistical and Social Economic Research, ISSER, 2007, pp 23-31
SSNIT Magazine, 2006, pp 8 and 11
City Properties, August, 2010 pp 13 and 25
Interview with Ankrah M. N. A. –CEO, State Housing Company (SHC) on 8th September, 2010
Mr. Alban Bagbin, Ministry signs MOU for Affordable Housing, www.accra-mail.com (accessed 20th August, 2010)
Interview with Mr. Kielson , Regional Estate Officer, SSNIT-Koforidua on 8th February, 2011
K. Nsiah- Gyabaah, Urban Housing Challenge and Prospects for Meeting the Housing Needs of the Urban Poor in Ghana. Proceedings at the 2009 National Housing Conference, pp 15-21, 24
D-Nelson, S-Ayeh, Provision of Affordable Housing in Ghana; the Realities. Proceedings at the 2009 National Housing Conference, pp 36-37
O-Tutu, A-Kumi, An Evaluation of Housing Cost Trends in Ghana for the Period 1991-2008. Proceedings at the 2009 National Housing Conference, pp 166-170
Interview with S. Kielson-Regional Estate Manager of SSNIT, Koforidua
Wikipedia, Affordable Housing, 2009 pg1-8. www.wikipedia.com (accessed, January, 2011)
Wikipedia, Public Housing, 2009 pg 1-3. www.wikipedia.com(accessed, January, 2011).

HOUSE OWNERS' PARTICIPATION IN MASS HOUSING PROVISION IN NIGER STATE NIGERIA: A NEED FOR CHANGE FROM SPECULATIVE TO SPECIFIC HOUSING

Adedayo Olatunde Folaranmi[1]

Department of Architecture, Federal University of Technology, Minna, Niger State, Nigeria

Urbanisation in Nigeria has brought about an increase in population and housing demand in the urban areas. In order to meet the demand for housing, State governments in Nigeria have adopted mass housing provision. The mass housing schemes adopted have and are speculative in nature. In Niger state Nigeria, mass housing provision between the years 2007-2010 has been through public private partnership. The houses built had the end-users involved at the sales stage of the process. The aim of the research is to show that the house owners in mass housing estates in Niger state would like to participate in the design of their future houses. In carrying out this research two housing estates were selected and a questionnaire was administered to selected households. The respondents were required to respond to questions with regards to what aspects of housing unit design they considered important participating in. An analysis of the data generated showed that majority of the house owners would like to have houses that meet their specific requirement. The research concludes that for any house to meet the requirements of each house owner there is a need for a conscious shift towards specific housing design in mass housing.

Keywords: design, house-owner, mass housing.

INTRODUCTION

A trip around many cities in Nigeria particularly the state capitals will reveal the high rate of housing construction that is taking place, either at the individual level or at the mass housing level. The aim of mass housing is the production of large quantity of houses, an examination of the housing estates already being occupied will show some degree of changes on the houses within the estates. In many cities in Nigeria increase in human population has led to an increase in the demand for more housing units for the populace. In response to this demand many state governments and private developers see mass housing provision as the solution to the problem. According to Ademiluyi and Raji (2008), there is an unimaginable high demand for housing in the urban centres and it cited inability of government to provide house for its populace as the reason for the high demand. While this assertion might be right, it failed to examine if the houses already provided got to the target people or even met the needs and aspiration of the people. Often times many housing providers be it the Federal government, State government or the private developer usually generalise the masses that require houses and assume their needs to be the same thereby providing same type

[1] arcadedayo@yahoo.com; o.adedayo@futminna.edu.ng

Folaranmi, A.O. (2011) House owners' participation in mass housing provision in Niger State Nigeria: a need for change from speculative to specific housing *In:* Laryea, S., Leiringer, R. and Hughes, W. (Eds) *Procs West Africa Built Environment Research (WABER) Conference,* 19-21 July 2011, Accra, Ghana, 559-569.

of house for all. In many cases where housing provision is discussed and the prospective house owner mentioned, it is often in terms of how they can afford it and not what they would want [see Dung-Gwom and Mallo (2009), Ajanlekoko (2001), Aribigbola (2008), Anugwom (2001)]. It is the need to produce as many possible housing units that has led many developers and designers to focus on quantity and quality of materials and not the need of the end-users. In the discussion of post constructional changes in housing estates in Minna, Adedayo (2010a) showed that the generalisation and provision of same house type is no longer the trend in mass housing.

TRANSFORMATION IN HOUSING ESTATES

Transformation in housing estates is a way by which house owners try to adapt the houses provided for them to meet their needs and aspiration and it is this transformation that results in post constructional changes on housing units. According to Tipple and Ameen (1999) the belief that transformation in housing estates provided by governments was developing slums was not correct as it was able to show that the transformations in selected housing estates in four countries were initiated to meet the needs of the house owners. It identified the need for additional space by the house owners as one of the major factors driving transformation in many housing estates. Natakun and O'Brien (2008) described transformation in housing as self-help modification and it said that it was a common trend in many developing countries. An examination of the researches carried out on housing transformation revealed two common issues which are:

i. Majority of the transformation are done on government provided housing estates.
ii. Transformations are carried out more in developing countries.

In the study conducted in Niger state by Adedayo (2010a) and shown in plates 1 to plate 4, the major characteristics of location and type of houses identified by Natakun & O'Brien (2008) and Tipple & Ameen (1999) are satisfied. The major reason that could be adjudged for this trend is that data about the prospective owners were either inadequate or not sought for. The sad story is that while majority of these government houses where transformations have occurred were built before the year 2000, the principle in practise as of 2011 is still the same with no attempt at change. Private developers who are now the driving force in mass housing provision also continue with the same principle of excluding the prospective owner and hence laying the foundation for housing transformation. In order to avoid the problems that occur when post-construction changes take place there is a need for the shift as proposed in the title of the paper.

MASS HOUSING DEVELOPMENT IN NIGER STATE

Mass housing development in Niger state like many other states in Nigeria has become what is referred to as dividends of democracy by many politicians. The location of these mass housing schemes in many states is common and is usually in the state capital. In Niger state the two mass housing scheme that were developed by the state government are in Minna the state capital and they are;

i. Gen. M.I. Wushishi housing estate
ii. Talba housing estate.

While the Gen. M.I. Wushishi estate has been completed and occupied the Talba estate is still under construction, despite both projects taking off in 2007. In 2011 these estates have now become a campaign tool for the government and not a social service that is expected of a government to its people. As a social service mass housing should be geared towards reduction of housing shortage as is the case in many countries. [see Ademuluyi and Raji (2008), Onder (2007) & Eger (2007)].

Figure1: Roof, Window changes & Fence 123 Qtrs. Minna
Source: Adedayo (2010a)

Figure 2: Elevation Modification & Fence 123 Qtrs. Minna
Source: Adedayo (2010a)

Figure 3: Constructed fence at Tunga Low cost Minna
Source: Adedayo (2010a)

Figure 4: Constructed gate house at Tunga Low cost Minna
Source: Adedayo (2010a)

The provision of mass housing through the Public Private Partnership (PPP) in Minna focussed more on the government and the private sector leaving out the prospective house owner. The adoption of the method of construction of staff quarters has ensured that the prospective house owners are left out. The principle behind the staff quarters approach is mass production which is purely speculative in nature as practiced in Niger state. If the housing developers had carried out case studies on existing housing estates they would have discovered that speculative design approach as practiced in mass housing development in Niger state might not be considered suitable from the end-users point.

SPECULATIVE MASS HOUSING PRINCIPLE

A case where there is no data in terms of prospective house owners backing the development of a mass housing scheme as is often the case in Niger state, Nigeria then this estate could be referred to as speculative mass housing. According to Larson, Intille, Mcleish, Beaudin and Williams (2004), a standard generic house produced by a speculative developer is considered as the choice of almost everyone that cannot afford to engage an architect. It goes to show that the mass housing schemes built without anyone particular in mind is referred to as speculative. It is based on the assumption that someone will need it and the designs are often generic in nature. This is what is visible and common to virtually majority if not all the mass housing schemes in Nigeria with special reference to Niger state.

Tipple (1994) referred to speculative housing as when a speculative builder, is constructing housing ahead of demand which it said was absent in sub-Saharan Africa. The key thing worth observing from the statement is that speculative housing should be ahead of demand and not behind as practiced in Niger state. Speculative housing works on the principle of mass production which is in turn centred around higher quantity of a product within a given limited resources of time and cost. According to Noguchi (2005) speculative housing is an established production process in housing. This view while it shows why mass housing is the way it is in many countries it runs against the views of Tipple (1994) and Larson et al (2004) which suggests it should be used for future demand. It can be assumed that since it is widely known and accepted that Nigeria is yet to meet the housing demand for its people, then it can be concluded that there is no need for speculative housing yet. The problem of speculative mass housing is that it allows for middle men and government agents to use their authority to acquire a large number of the housing units and either resell it to people at higher profits or give it out for rental purpose. This nullifies the aim of the project by the housing provider. In cases where the housing unit actually reaches the end-user, modification becomes an inevitable result because the house was generic and the house owner is not generic. The net effect of getting the house to meet the needs and aspirations of the house owner is increased cost of the building which could have been avoided. The fact that there is already a high demand for housing units in urban areas means the information about prospective house owners can be obtained and not assumed. In order to achieve this aim of meeting the needs of the end users in mass housing there is the need for the proposed principle of specific housing.

SPECIFIC HOUSING AND PROCESS

Specific housing could be viewed and explained to mean the direct opposite of speculative housing. It is a broad housing principle that seeks to ensure that houses are tailor made for the particular prospective owner. There are several concepts that could be employed ranging from mass customization to grow house concept to participatory design. The sole aim in specific housing is that prospective house owners should be given the opportunity to have a say in their future houses. In attempting to provide specific housing, the briefing stage in mass housing in Niger state needs to be re-examined to include the end-user. This is the basic aim and starting point of any given design process which is the accumulation of data. Jarvinen and Koshinen (2001) stated that architecture unlike other industrial design is not shifting towards collaborative approach that seeks to involve the end-users at the early stage of the process. This is the case in mass housing provision in Niger state as of 2011 where the house owner is brought into the process at the sales stage. There is therefore the need to get the house owner involved at the start of the mass housing process so as to begin collaborative design process. According to Barrow, Kumar and Arayedh (2007) the quest for workable solutions in mass housing by architects dates back to the 1920s and it is still ongoing. A reason that could be adjudge for not finding a solution that works for all is because in many cases house owners have been treated as groups or regions rather than specific individuals. The process proposed for achieving specific housing principle in mass housing is shown in figure 1.0.

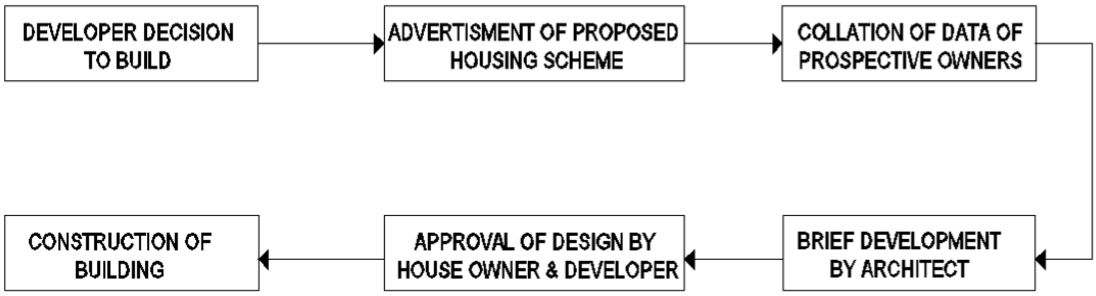


Figure 5.0 Proposed Specific Housing Process Source: Author (2011)

The proposed process in figure 1.0 shows the stage at which the prospective house owner should be involved. It can be observed that the collation of the data precedes the brief development by the architect and in essence ensures that the brief is focussed on the house owner. It can also be observed that the approval for the design is by both the house owner and the developer, thereby ensuring that the desires of the house owner are met and that the designs also falls within the overall plan of the housing developer. The process ends with the construction of the house which is expected to be specific since the house owner would have given his approval.

RESEARCH METHOD

The research is part of a PhD study on housing customization by the author and the paper discusses part of the findings of the trial test conducted in Minna, Niger state. The main question the researcher seeks to answer is which aspect of housing unit design is the house owner interested in participating in. The choice of a questionnaire survey was to allow for respondents to freely participate in the research and to ensure that the data generated are focussed and can be analysed. The questionnaire is better suited for this research as most respondents were not willing to spend time with the research assistant to document their answers for security purposes. The limitation with this method is the streamlining of answers; however this suits the research when compared with the interview method also an interview survey in Niger state would be time consuming because some house owners would require interpreters to speak their native language. The trial test covered two selected housing estates in Minna namely;

i. 123 quarters Minna, Niger state
ii. Bosso lowcost estate Minna, Niger state

The civil servants occupying government estates were chosen as respondents, the choice of the respondents was based on the focus on the middle income earners and the public service people by the state government in terms of mass housing provision. The respondents chosen are people already living in government built housing estates over a period of time and hence would have been able to give personal opinion about the house based on experience.

The research lasted a period of five weeks from the date the first copy of questionnaire was administered to a respondent. Thirty households were randomly selected in each of the estates and the questionnaire was administered by trained final year students of the Department of Architecture, Federal University of Technology Minna who served as research assistants. Respondents were allowed to fill the questionnaire at their leisure time and were collected by the students after they had finished filling it, pictures of some of the houses were taken in cases where some of the changes were visible from the outside. Due to concerns for security and some cultural beliefs some respondents refused to allow the research assistants to enter into their premises to observe the house and possibly take pictures. Questionnaire and observation techniques served as the major source of data collection for the research.

The data collected was collated and entered into a computer system by the author, the data was analysed using the cross tabulation in the SPSS software. The unit of analysis is based on household each number represents a household which is represented by the house owner. The results were produced in tables and selected few are chosen for discussion.

DISCUSSION OF RESULTS

This section examines a few aspect of housing unit design where the participation of the house owner could be a key in providing specific housing. The results would aid in determining the aspects that are considered important to the house owners.

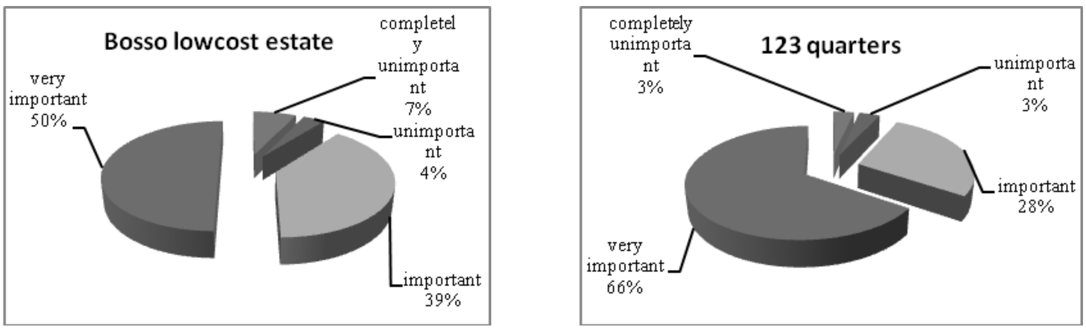


Fig.6.0 Participation in Type of Fence And Gate Source: Adedayo (2010b)

This is one aspect of design that many architects and housing developers in mass housing schemes leave out and assume that the provision of an overall fence around the estate will serve them. The respondents however feel different as shown in figure 6.0 where it can be observed that 89% and 94% of the respondents in Bosso lowcost estate and 123 quarters respectfully considered a personal fence and gate important. The nature of the fence and gate is usually an expression of the identity of the house owners which is a reflection specific housing. This is an expression of housing transformation as supported by Tipple, & Ameen, (1999) when it showed how house owners carried out changes on their houses along the fence.

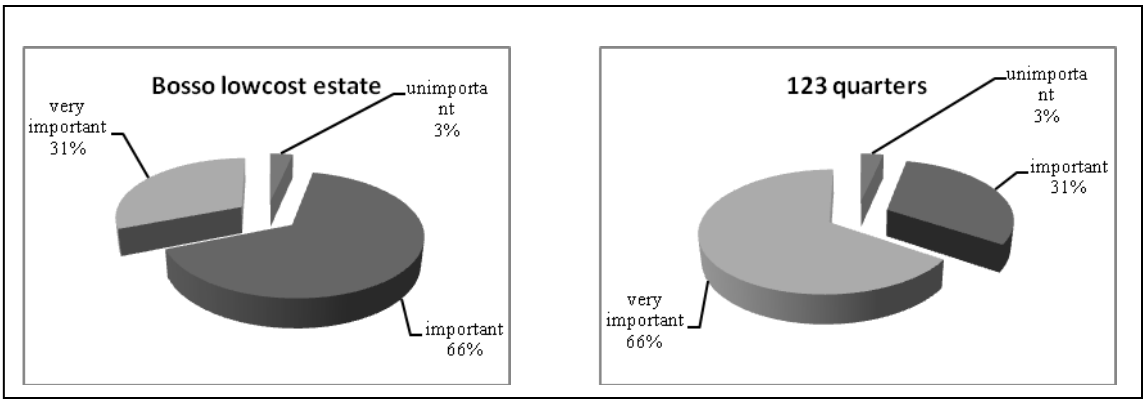


Fig.7.0 Participation in Space Sizes Source: Adedayo (2010b)

The size of spaces in the house is usually determined by the architect or the housing developer in the mass housing scheme and in many cases it is assumed that a given size would serve everyone. The size of space should be determined by the total number of possible occupants and this can only be achieved if the family size is known and not assumed. Figure 7.0 showed that participation in the determination of sizes of space is quite important because 97% of the respondents in Bosso lowcost estate and 123 quarters considered this option as being either important or very important. This shows a way of ensuring that housing units in the estate consider the socio-cultural values of the occupants as identified by Ajanlekoko, (2001) when it stated that housing designs should not be the same all through the country.

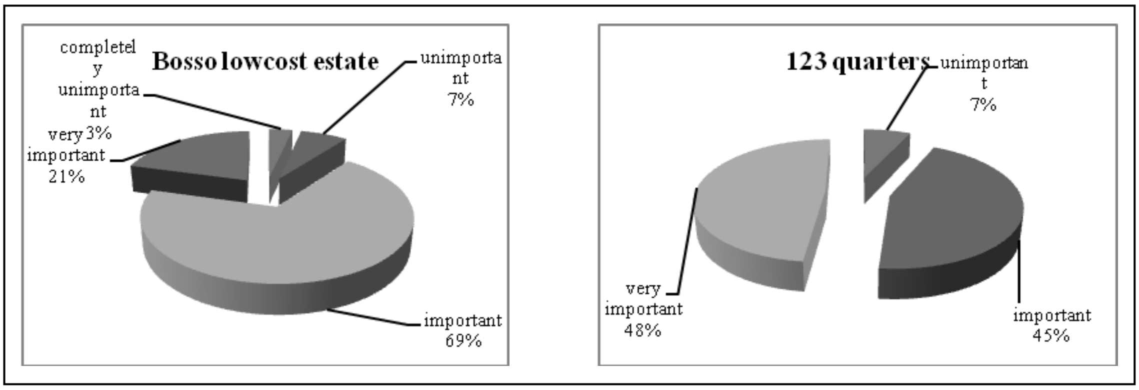


Fig.8.0 Participation in Number of Spaces Source: Adedayo (2010b)

When a generic design is provided it is assumed that the spaces provided in terms of number is adequate, however the house extension and conversion of space for other uses contradicts such assumptions. On the issue of the number of spaces to be provided in the design of their houses 90% of the respondents in Bosso lowcost estate and 93% of the respondents in 123 quarters as shown in figure 8.0 considered participation in this option as being important. The reason for such interest could be that the family sizes of household differ, likewise their cultural affiliations as discussed by Ajanlekoko, (2001).

A trip to any of the mass housing estates in Niger state will reveal that the finishes are the same with little variance in terms of the colour of the material used, it is often a case of see one seen all. This trend of making all the finishes the same simply assumes that the aspirations of the prospective owners are the same which is not the case. The result regarding this option in figure 9.0 shows that 83% and 90% of the respondents in Bosso lowcost estate and 123 quarters respectfully considered the option as quite important. The resultant effect when they are not considered in this option is changes on wall and floor finishes in an attempt to create a form of identity.

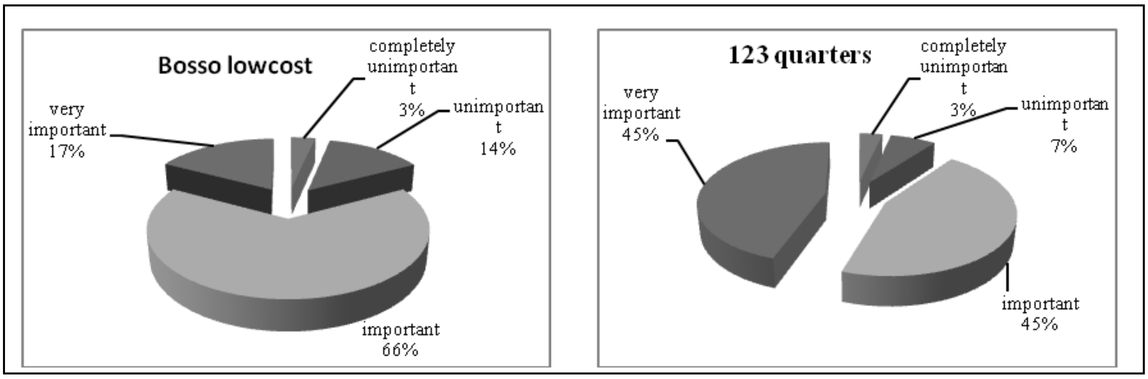


Fig.9.0 Participation in Interior Finishes Source: Adedayo (2010b)

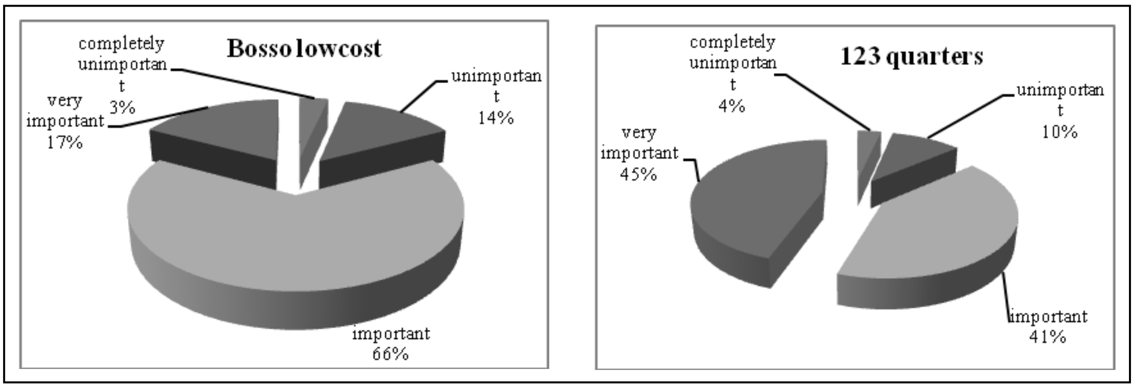
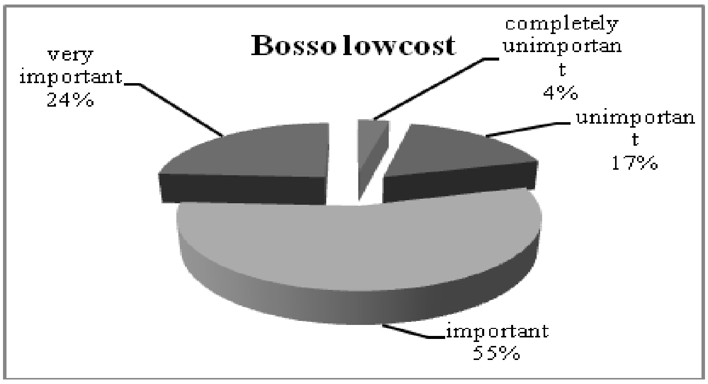


Fig.10.0 Participation in Exterior Finishes Source: Adedayo (2010b)

The case of external finishes is not too different from that of the internal finishes and in many of the housing units examined, the external finishes was done to reflect some form identity by the house owners. The response to this option by respondents as shown in figure 10.0 showed that 83% of the respondents in Bosso lowcost estate and 86% of the respondents in 123 quarters considered the option as either important or very important. The choices of the external finishes usually ranged from the type of roofing material to the colour of paint on the walls. The interesting thing about the finishes is that it is based on what the house owner considers as beautiful which is usually relative.

The surrounding of a building has to do with the landscaping of the plot and in many mass housing schemes this aspect of the design and construction is often left bare for the house owner. Majority of the house owners usually provide mass concrete on the plot and in some cases they provide some flowers or shrubs. An examination of the final work on the building surrounding usually shows a poorly executed attempt at beauty. This need to have a beautiful surrounding could probably be the reason why the respondents as shown in figure 11.0 consider participation in this option equally important.



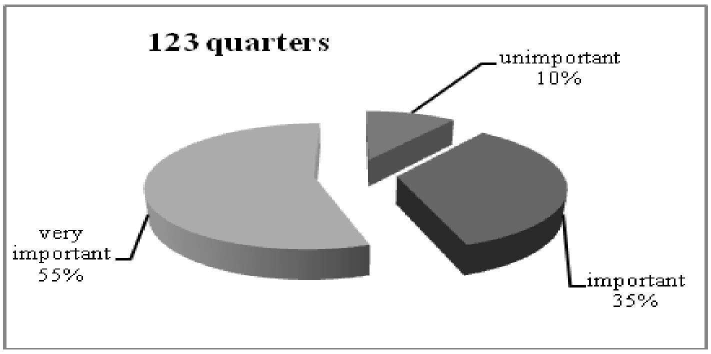


Fig.11.0 Participation in Surrounding Finishes
Source: Adedayo (2010b)

In summary from these results, it is evident that if each prospective house owner considered the six options of participating in housing design quite important or very important, then one is bound to provide specific housing for them. It also shows that if the views of the prospective house owner are sought on these issues the resultant house that meets their needs and aspiration would bring about a specific house. The issues of finishes are of concern to respondents which is in line with the study carried out by Hofman, & Halman, (2006) in Holland.

CONCLUSION

The traditional aim of architecture from its definition regarding the design of buildings of which housing is one is to meet the needs and aspirations of the client. In the case of mass housing the client has often time been taken as the housing developer which is true to some extent but in terms of needs and aspirations the end-user(house owner) should be the focus. It was stated during the discussion within the paper that the housing estates that have been built without the house owners participating in the design process have brought about modifications on the houses. These modifications cost money and it borne by the house owners and they could be avoided if the house owners are involved at the beginning of the design process thereby making the house specific. The paper showed aspects of housing design that house owner would like to participate in, this could be considered by architects and housing developers so as to achieve specific housing. The specific housing process was shown and discussed with the view of understanding when the house owner comes into the picture. It is therefore evident that specific housing in mass housing schemes should be encouraged and house owners made the focus of house design while doing away with speculative housing process which is currently being practiced.

REFERENCE

Adedayo, O.F. (2010a). Post-constructional changes in housing units in mass housing estates in Niger State: A case for housing customization. A paper presented at Architects Colloquium 2010 held at Shehu Musa Yar'adua Centre Abuja, Nigeria, 21st-22nd April 2010

Adedayo, O.F. (2010b). Customization of Housing Units on Mass Housing Estates on Nigeria: A Case Study of Kwara State. An unpublished PhD research proposal submitted to the Department of Architecture Federal University of Technology Minna, Niger State.

Ademiluyi, A.I. & Raji, B.A. (2008). Public and Private Developers as Agents in Urban Housing Delivery in Sub-Saharan Africa: The Situation in Lagos State. Humanity & Social Sciences Journal, 3(2), 143-150.

Ajanlekoko, J.S. (2001). Sustainable Housing Development in Nigeria – The Financial and Infrastructural Implication International Conference on Spatial Information for Sustainable Development Nairobi, Kenya. 2–5 October 2001.

Anugwom, E.E. (2001). Privatization of workers' housing provision: the National Housing Fund (NHF) Scheme in Nigeria. An article Centre Africain de Formation et de Recherche Administratives pour le Developpement. Retrieved from http://www.unpan1.un.org/intradoc/groups/public/documents/CAFRAD/UNPAN017696.pdf on 24th February 2009, 21:35pm.

Aribigbola, A. (2008), Housing Policy Formulation in Developing Countries: Evidence of Programme Impliementation from Akure, Ondo State, Nigeria. Journal of Human Ecology, 23(2), 125-134.

Barrow, L. Kumar, S. & Al Arayedh, S. (2007). Emerging Technology- Dilemma and Opportunities in Housing. Retrieved from http://www.shilpikumar.com/CAADRIA_2007.pdf on 14th February 2010, 13:24pm

Dung-Gwom, J.Y.and Mallo, D.M. (2009), An Appraisal of the Challenges of Accessing Credit for Home Acquisition by Low Income Earners in Nigeria. Retrieved from http://www.gla.ac.uk/media/media_129707_en.pdf on 2nd March 2011

Eger, A.O. (2007). Evolutionary Product Development in Working-Class Housing. Lemma Publishers. Den Haag. Retrieved From http://www.evolutionaryproductdevelopment.org/2008%2008%2026%20Evolutionary%20Product%20Development%20in%20Working-Class%20Housing.pdf on 13th November 2009, 4:21pm

Hofman, E. & Halman, J.I.M. (2006). Variation in housing design: Identifying Customerpreferences.351-368. Retrieved from http:/www.irddirekt.de/daten/iconda/CIB8977.pdf on 24th November 2009, 2:43 pm.

Jarvinen, J. & Koskinen, L. (2001), Industrial Design as a Culturally Reflexive Activity in Manufacturing, University of Art and Design, Helsinki. Retrieved From http://webmail.faac.unesp.br/~paula/Paula/industrial_design.pdf on 14th January 2010, 2:28 pm.

Larson, K. Intille, S. Mcleish, T.J. Beaudin, J. & Williams R.E. (2004). Open Source Building: Reinventing Places of Living. Retrieved from http://www.media.mit.edu/~intille/papers-files/LarsonETAL04.pdf on 30th July 2010 12:08pm

Natakun, B. & O'Brien, D. (2008). Extending the house / Extending the dream: Modifications to Government-built Housing in Bangkok Metropolitan Region. Journal of Architectural/Planning Research and Studies, 6(1), 1-18.

Noguchi, M. (2005), Japanese Manufacturers' 'Cost-Performance' Marketing Strategy for the Delivery of Solar Photovoltaic Homes. Proceedings ISES 2005, Solar World Congress, Aug. 6-12, 2005, Orlando, USA.

Onder, D.E. (2007). A Criteria for Increasing Quality in Housing Area: User Participation. ENHR 2007 International Conference 'Sustainable Urban Areas' Rotterdam, 5th – 28th June.

Tipple, A.G. (1994), The Need for New Urban Housing in Sub-Saharan Africa: Problem or Opportunity. African Affairs, 93(373), 587-608. Retrieved from http://www.jstor.org/stable/723668 on 31st October 2010, 10:03am

Tipple, A.G. & Ameen, M.S. (1999). User initiated extension activity in Bangladesh: "building slums" or area improvement? Environment and Urbanization, 11(1), 165-183.

HOW SHOULD HEALTH AND SAFETY BE MEASURED AS A TENDER EVALUATION CRITERION IN THE GHANAIAN CONSTRUCTION INDUSTRY?

Wise Akortsu[1]

School of Applied Science and Technology, Wa Polytechnic, Box 553, Wa, Upper West Region, Ghana

Occupational health and safety is said to be relevant to all branches of industry, business and commerce including traditional industries, information technology companies, universities, leisure facilities and offices. Furthermore, construction methods, procurement systems and project management systems keep changing, making it imperative to place more emphasis on the management of health and safety issues. The parties bidding for the award of contracts must also demonstrate their competence in the area of health and safety management. This research investigated the current tender evaluation and contractor selection criteria in use in Ghana. Consideration was given to the evolution of the traditional time, cost and quality triangle into the time, cost, quality, and health and safety square. A model was therefore proposed for the assessment of the health and safety competence of contractors. The findings revealed that price is the major determining factor and that health and safety have not been considered in the criteria for contractor selection. However, the proposal for the adoption of the Golden Square received an enormous level of acceptance, with many of the respondents describing it as a brilliant idea and 'long overdue'.

Key words: health and safety, golden triangle, golden square, tender evaluation.

INTRODUCTION

In the face of changing construction methods, procurement systems, contract administration and project management systems, health and safety (H and S) issues have become a very significant aspect of the total project arrangements. This is an addition to the traditional approach of tendering, procuring, construction, supervision and commissioning. To do a good assessment of the health and safety implications of a project, relevant and detailed information on the project must be provided for particularly those bidding for the work, and for the development of the construction phase health and safety plan.

Though the construction industry in Ghana has been growing at a very fast pace over years, there seems to be a neglect of issues like health, safety and welfare when contractors are being recommended for the award of contracts. The primary tender evaluation criteria currently used in Ghana for the award of contracts is the traditional time, cost and quality (i.e. the golden triangle). With these, the award criterion is dependent on either the least price or the most economically advantageous. This culture of the least price tender could be the major cause of many health and safety issues in construction. This is because clients will be looking for the least price tender

[1] waaklee@yahoo.com

Akortsu, W. (2011) How should health and safety be measured as a tender evaluation criterion in the Ghanaian construction industry? *In:* Laryea, S., Leiringer, R. and Hughes, W. (Eds) *Procs West Africa Built Environment Research (WABER) Conference,* 19-21 July 2011, Accra, Ghana, 571-583.

without proper regard to the health and safety of workers and others. However, the Government of Ghana has taken steps to promote a good health and safety culture in the construction industry. In this regard, the Labour Act 2003, Act 651 was enacted, in 2003, and it states, among others, that *"it is the duty of an employer to ensure that every worker employed by him or her works under satisfactory, safe and healthy conditions"*. The Act of Parliament further states in Section 118 (5) that *"an employer who, without reasonable excuse, fails to discharge any of the obligations under subsection (1) or (2) commits an offence and is liable on summary conviction to a fine not exceeding 1000 penalty units or to imprisonment for a term not exceeding three years or to both"*.

A model was proposed for the assessment of the health and safety competence of contractors (health and safety key areas and scoring matrix).

TENDERING AND CONTRACTOR SELECTION IN GHANA

Invitation and Submission of Bids

Under of the Public Procurement Act (PPA) of Ghana (Act 663, 2003), National Competitive Tendering (NCT) procedures are employed if only domestic suppliers or contractors are desired to submit tenders and International Competitive Tendering (ICT) is to be used where open competitive tendering is employed.

Bids are usually delivered to the premises of the relevant procurement entity, which in most cases is the address provided in the notice of invitation. Acceptance of bids close at the time and date specified in the bidding document and in the notice of invitation. Members of the relevant Tender Committee, the consultants and interested bidders or their representatives attend the tender opening. A record of bid prices as read out and endorsed at the opening is taken, a sample of which is shown in Table 1.

Table 1: Record of Bid Prices at Tender Opening as Read Out and Endorsed

ITEM	CONTRACTOR	BID PRICES (GH¢)	REMARKS
1	Contractor A	49,910.69	Complete
2	Contractor B	50,332.04	Complete
3	Contractor C	50,973.39	No Labour, IRS, SSNIT and MWH

(Source: Author's Fieldwork Study, 2009)

<u>Key</u>

Labour = Labour Clearance Certificate
IRS = Internal Revenue Service Tax Clearance Certificate
SSNIT = Social Security Clearance Certificate
MWH = Ministry of Water Resources, Works and Housing Registration Certificate

Bid Evaluation

The evaluation of bids received is normally carried out in three stages. These are preliminary examination, detailed examination and post-qualification evaluation.

Preliminary Examination

This is carried out to identify and reject bids that are incomplete, invalid or substantially non-responsive to the bid document and therefore would not be considered further. Under this section of the evaluation of tenders or bids, the following parameters are checked:

- ***Verification:*** Here, bids are scrutinised to establish whether they were signed by the appropriate authority within the firm (i.e. a Director or any other person given the Power of Attorney). Bids are also checked for the submission of Tax Clearance Certificate, Labour Clearance Certificate, Ministry of Water Resources, Works and Housing (MWH) Registration Certificate, District Assembly Registration Certificate/Renewal Receipt and Social Security Clearance Certificate.
- ***Eligibility:*** Bidders are checked to determine whether they are from eligible countries as per the instructions to bidders and whether they provide documentary information of their registration. In this case, a Certificate of Incorporation/Registration is looked out for.
- ***Bid Security:*** The PPA requires that all tenders are provided with tender or bid securities. Every Invitation for Tender (IFT), therefore captures this and specifies an amount or sum of Bid Security, or Bid Bond to be provided by all tenderers. This is therefore checked to ensure that all bidders provide the facility adequately. Bid Security Declarations are also accepted as an alternative.
- ***Completeness of Bid:*** In terms of the completeness of bids, tenders received are to ensure that they submit complete bidding documents and that all the items of the Bill of Quantities (BoQ) provided in the bidding document are wholly priced.
- ***Substantial Responsiveness:*** Bids that meet the above requirements are determined to be substantially responsive and are taken through detailed examination.

It must be noted that all these parameters discussed are set out in the bidding or tender documents.

Detailed Examination

Only bids that survive the preliminary examination are considered for further evaluation. There are two stages involved, the correction of arithmetic errors and evaluation and comparison of bids.

- ***Correction of Arithmetic Errors:*** The priced BoQs of the responsive bids are checked for arithmetic errors in extensions, summations, transfers and summaries. Errors detected are corrected in accordance with the bid guidelines provided by the Board of the PPA. A notice is sent to the affected bidder(s), giving details of the errors and the adjusted figure(s) which they have to either accept or decline.
- ***Evaluation and Comparison of Bids:*** The evaluated (corrected or discounted) bid prices are determined by subtracting provisional sums, discounts offered and contingencies in the summary of the BoQs. The evaluated bid prices of the responsive bids are then ranked in ascending order.

Post-Qualification Evaluation

This is usually done in cases where pre-qualification is not done prior to bidding. However, the norm in most consultancy firms is to take all responsive bidders that accept corrections (if any) through the post-qualification exercise. The choice of the route depends on the procurement entity. The exercise applies the following checks, as set out in the bidding documents:

- ***Experience in Similar Works:*** The experience of bidders, as Prime Contractor or Main Contractor, in works of similar nature and complexity are assessed. A minimum threshold established in the bidding document is used.

- ***Personnel Capability:*** The experience and qualification of key personnel (e.g. Quantity Surveyors, Site Supervisors and Site Managers) in the firm is also assessed. Minimum thresholds established earlier are used.
- ***Financial Capability:*** Bidders are required to submit certified Financial Statements and these are assessed to ascertain whether they have adequate financial capabilities to execute the contract. This coupled with undertakings or declarations from companies' bankers also indicate the adequacy of the lines of credit available to the bidders.
- ***Equipment Holding:*** Thresholds established are used to check the appropriateness of the equipment provided in documentary evidence by the contractors for the specified financial classes.
- ***History of Litigation:*** Bidders are also required to provide evidence of non-involvement in litigation, or the history and details of any such litigation.
- ***Annual Turnover:*** Qualified bidders must meet the minimum annual turnover thresholds specified for the particular financial class.
- ***Methodology/Works Programme:*** After the contract has been won it is important for the work to be completed on time and to the required standard (quality) and within budget, therefore bidders are required to provide method statements and programmes of work, which are compared with the Master Programme.

Contractor Selection

A successful bidder must meet all the minimum qualifying criteria stated in the bidding document and discussed earlier under bid evaluation. *"The lowest evaluated tender is selected and recommended for the award of the contract."* (PPA, 2003) In other words, the responsive bidder who satisfied the Post-Qualification Evaluation requirements and offered the least evaluated bid price is the first to be considered for the award of the contract.

THE GOLDEN TRIANGLE

The evaluation criteria discussed above can be broadly grouped into three main categories. These are Time (work to be completed on time, using works programmes), Cost (the project to be completed on budget by using a priced BoQs, cost estimates, etc.) and Quality (performance, where experience and personnel qualifications are used). The importance of each of these criteria is discussed briefly below.

Time

The Master Programme helps to determine the time frame for all aspects of the project (i.e. the design, tender and construction stages). In practice, the actual progress of works should be better than, or in the least meet the planned progress. Situations like lack or unavailability of funds or a delay in securing a building permit may lead to a late start of the project. On the part of the contractor, continual late completion can damage the company's reputation and may also affect subsequent projects. Time lost may be reclaimed by re-scheduling and re-sequencing of subsequent activities, but this is usually accompanied by comprising performance standards, or costs.

Cost

It is a general view that all companies in every industry exist first and foremost for the sole purpose of making money or profit and the construction industry is not left out. Everyone (including the client, the contractor and suppliers) therefore wants to make money, because success is measured by profit. Projects should therefore be completed within the authorised budget to ensure the desired profit is not reduced and that the return on capital expected is attained. It is very important to control costs and therefore cost control must be appreciated by all as an essential part of the project delivery.

Quality

Quality can sometimes be referred to as performance and is very difficult to measure, mainly because quality related to defaults can only be seen later on. It also means that the final product must be able to perform its functions efficiently, reliably and safely. The product should also be appealing to the client and meet all relevant legislation and building standards. In addition, quality can refer to the quality of the materials used, the quality of the workmanship or the quality of the design and specifications.

CONTRACTOR SELECTION REQUIREMENTS IN THE UK

Osei-Tutu (1999) recognises that the organisation and management of construction and construction related activities vary from country to country and that these have also developed from traditions and conventions laid down in the various countries over long periods of time. Ghana, however, has a peculiar link with her colonial masters, the United Kingdom (UK), hence construction practices in the country have been dominated by this relationship. Moreover, the colonial legacy left the nation with a very small number of indigenes who were professionally qualified, especially in the field technology. For example, at the time of independence *"there were five (5) architects, three (3) land economy surveyors, no quantity surveyor, etc."* (Owusu Addo, 1989 as reported in Osei-Tutu, 1999). Also, Kyei (2009) identifies that the procurement methods/systems in use in Ghana indicate a tilt towards those of the UK due to the colonial relationship discussed earlier. Furthermore, consultants, construction industry professionals, contractors and clients in Ghana have a vast knowledge of the various procurement systems in use. Based on these, the UK has been chosen to be a kind of benchmark.

Tendering in the UK

This is done in accordance with the UK's Public Contracts Regulations (2006). Sayeed (2006) stated that *"the expression of interest received from prospective companies is reviewed by the client"*. The experience of the contractors who submitted tenders is considered and a tender shortlist (which is to, as much as possible, comprise of both new contractors and previously appointed ones) of between three and six potential companies is produced. However, it is made clear that the submission of an expression of interest does not guarantee automatic invitation to tender but all expressions received must be considered in drawing up the tender shortlist. Notices are given out to contractors short listed and they have to confirm whether or not they still desire to tender. Formal invitation to tender is then sent out to them, including the requirements and the specifications of the project.

Tenders received are opened and signed to acknowledge receipt, after which copies are sent out to the tender board for evaluation. According to Sayeed (2006), the following (all of which are supposed to be clearly identified in the contractors' tenders) are used to evaluate the proposals:

- *"Relevant experience*
- *Suitability of their working arrangements*
- *Suitability of their proposed schedule and their likelihood to meet them*
- *The cost and value for money"* (Sayeed, 2006)

The proposals are evaluated by the tender board judges by completing an evaluation matrix to make sure that the assessment of the proposals has been carried out in a consistent manner, using fair methods. A typical evaluation matrix is shown in Table 2. The assessment is usually in the following areas and the successful tenderer is notified in writing:

- *"Suitable and complete documentation as specified in the invitation to tender document*
- *Adherence to the specifications*
- *Best value for money, in terms price and quality",* (Sayeed, 2006).

Table 2: A Typical Evaluation Matrix

Criteria	Assessment Team				
	A (PM)	B (aPM)	C (Arch.)	D (Eng.)	E (QS)
Health and Safety	4	5	2	3	3
Design	3	3	5	4	3

(Source: Adapted from Coles, 2009)

Key

PM ` = Project Manger
aPM = Assistant Project Manager
Arch. = Architect
Eng. = Engineer
QS = Quantity Surveyor

Key to the marks awarded in Table 2

0 = No information was submitted

1 = A poor response – severe difficulties in most areas of service delivery, overall
2 = A poor response – difficulties in some areas of service delivery
3 = A fair response – the basic requirements were met
4 = A very good response – exceeding the minimum requirements, in most areas
5 = An outstanding and complete response – exceeding requirements, in all areas
(Source: Adapted from Hannah and DeZoysa, 2005, as presented in Sayeed, 2006)

The following provides an example of how the UK's Public Contracts Regulations (2006) could be operated. (It should however be noted that this is not in the Regulations, itself, but is just an example of how the Regulations could be applied, and which could survive a Freedom of Information legal challenge). The weightings that are usually applied in quality/price criteria, according to Coles (2009), are:

- 50% weighting for Price and
- 50% weighting for Quality issues

The quality issues usually comprise (but not limited to) the following:

- *"Technical merit of design proposal*
- *Aesthetic and functional characteristics*
- *Quality management*
- *The management of health safety and welfare throughout the project*
- *Project programmes and the time required for project completion"*, Coles (2009).

In addition to the assessment areas above, tenderers are to produce documentary evidence of their promotion and management of health and safety, throughout their organisations. Contractors are to produce health and safety plans to support their proposals. The UK's Construction Design and Management Regulations (the CDM Regs, 2007) in Appendix 4 provides the key areas for the assessment of the health competence of contractors.

From Table 2, it is advised that to arrive at the final mark for a particular criterion it is important to argue out any major differences rather than averaging the marks awarded by the assessment panel as this may hide some problems or shortcomings. The agreed final mark is weighted with the criteria weighting and the quality criteria marks are added up to obtain total quality criteria weighting percentage. Price is kept separate and *"the price weighting percentage is determined by the pecking order of the competitive tender prices submitted, the lowest being given the highest percentage"*, Coles (2009).

The Successful Tender

According to Sayeed (2006), the method used in the selection of the contractor must be simple and transparent, to make it easier to explain why a particular contractor was unsuccessful. Sayeed (2006) further stated that in the selection of the best contractor (successful tender) *"the decision maker has a duty to use reasonable skill, care and judgement"* and provided the following list of key factors which should be considered:

- ***Experience Record:*** This can be represented by:-
  (1) The number of years of working in construction
  (2) The number of years of working on similar projects
  (3) Past experience in working in similar geographical conditions
  (4) Past experience in working in similar weather conditions
- ***Past Performance Record:*** This helps in analysing how the contractor has achieved the desired objectives in:-
  (1) Previous projects
  (2) Cost
  (3) Quality of work
  (4) On time
  (5) Safety
  (6) The client's ultimate satisfaction
  (7) Previous relationships with subcontractors, suppliers and insurance companies
- ***Financial Stability of the Contractor:*** This can be represented by the contractor's:-
  (1) Credit history
  (2) Quality of financial statements
  (3) Liquidity ratios

THE GOLDEN SQUARE

As mentioned earlier, clients traditionally place much emphasis on time, cost and quality issues in the award of contracts to contractors. However, time, cost, quality and health and safety are all interlinked. Therefore, the importance of the management of health and safety has to be discussed, linking it to time, cost and quality. Furthermore, the CDM Regs 2007 in Appendix 4 provide key areas for the assessment of the health and safety competence of contractors, justifying the need to incorporate H and S into the award criteria.

Health and Safety with Time

"Poor health and safety can result in a loss of productive work time while the remains and debris following an accident are being removed, and the restoration of the damaged part of the building is being undertaken." (Davies and Tomasin, 1996, cited by Sayeed, 2006). This may lead to a reduced work rate until such a time that the normal work rate of the employees is regained and their morale restored.

Health and Safety with Cost

As discussed earlier, the emphasis is on the least price, neglecting H and S issues in the evaluation of tenders by clients. However, poor H and S procedures, more often than not, lead to more costs to the company. *"Employees may suffer through loss of income and employers may have to endure increased insurance premiums and the economy suffers due to loss of production"* (Griffith and Howarth, 2001, cited in Sayeed, 2006). The affected company may also incur legal costs since it may be liable for prosecution costs. In addition, the contractor may also be liable to pay Liquidated and Ascertained Damages (LAD) to the client for failing to complete the project on time due to an accident. *"Accidents and deaths represent atrocious tragedies and result in the worst cost of all, human life"* (Sayeed, 2006).

Health and Safety with Quality

Sayeed (2006) suggested that the quality of the remainder of the building will be questioned should a part collapse, leading to an accident and/or death on site. *"Health and safety should therefore be developed alongside, or be a part of a quality system"* (Griffith and Howarth, 2001 and Lavender, 1996, cited in Sayeed, 2006). This is due to the fact that health and safety is inherent in all quality assurance procedures, according to Sayeed (2006). If an accident occurred, it could be as a result of quality standards not being adhered to and this could affect the reputation and public opinion of the company.

RESEARCH METHOD

This paper is an adaptation of part of the research conducted in partial fulfilment of the requirements for the award of a Master in Construction Project Management at the HAN University of Applied Sciences, Netherlands on the topic: 'Should Health and Safety be Tender Evaluation Criterion in the Ghanaian Construction Industry?' The researcher adopted a structured questionnaire in the study. This was based on the principle that the questionnaire allows the respondents to answer the questions when it is most convenient for them. The key issues arising from the literature review were converted into questions (i.e. the field work questionnaire). Northern Ghana (comprising the three northern regions, i.e. the Northern, Upper East and Upper West Regions) was chosen as the location of the research sample due to their proximity and ease of obtaining relevant information. A total of 65 questionnaires were administered (the distribution list is presented in Table 3), out of which 45 were returned. Statistical tools of tables, percentages, charts and graphs were employed for the data analysis. The results were presented (i.e. in summary), analysed, and discussed.

The consultants' category constitutes professionals who provide technical and professional services in the building industry such as drawings/designs, supervisions and general contract administration and management services. The kind and class of contraction firms chosen were those in the D1/K1 and D2/K2 categories (financial classes) because they have the capacity and requisite structure (responded to by their quantity surveyors and engineers). Respondents from the clients' category were chosen from professionals working in Tertiary Educational Institutions, District Assemblies/Ministries, Private organisations and individuals.

Table 3: The Distribution of Administered Questionnaires

Category	Number Administered	Number Returned	Percentage Returned
Consultants	25	21	84.0%
Clients	27	16	59.3%
Contractors	13	8	61.5%
Total	65	45	69.2%

(Source: Author's fieldwork study, 2009)

HEALTH AND SAFETY MEASUREMENT

The following key areas have been adapted and proposed for use in the assessment of the competence of prospective contractors in terms of health and safety in Ghana (each assigned a weighting of 25%, placing on them equal levels of importance):

- ***Policy: -***
  The company's health and safety policy
  The company's historic health and safety track record

- ***Training: -***
  The type of training that is available to new employees.
  Do employees go through regular training?
  Does training equip employees to recognise dangerous situations early?
  Are all employees are aware of basic yet important first aid?
- ***Health and Safety Awareness: -***
  Do employees have adequate Certification in construction? If not, are they being encouraged to study to get them?
  Are workers being encouraged to wear protective safety equipment?
  Is there enough equipment available to those who need it?
- ***Preventing Exposure to Health Hazards: -***
  Are there procedures in place to control workers' exposure to health hazards?
  Is there a systematic surveillance of workers' health?

In this regard, it is suggested that the golden triangle should evolve into the golden square, to give H and S a proper place in the assessment of the best contractor for the job. Therefore, the following weightings are adapted and suggested for the criteria:

- 25% weighting for health and safety
- 25% weighting for tender price
- 50% weighting for time and quality issues

In this case, the four key areas of H&S (25%) are to be scored as shown in Table 4.

Table 4: The Proposed Scoring Matrix for H and S (25%), being used in an example

Health and Safety Criteria	Weighting	Company		
		A	B	C
Policy	25%	5	5	5
Training	25%	5	3	4
Health and Safety Awareness	25%	3	3	3
Preventing Exposure to health hazards	25%	3	3	4
Total marks out of 100%		80%	70%	80%
Health and Safety Weighting out of 25%		20%	17.5%	20%

(Source: Adapted from Sayeed, 2006)

The tender with the largest total combined score (Table 5) is then recommended for the award of the contract. In other words, when the scores for the H and S weighting, the Price weighting and the Time and Quality weighting are summed, the contractor that obtains the best total score wins. However, minimum thresholds are to be set for the criteria above and also the total combined score. However, it is also suggested that there should be a minimum ideal percentage, below which contractors should not be appointed.

Table 5: A Typical Scoring Matrix for the Final Score (Combining the Weightings for H and S, Price and Time and Quality issues), being used in an example

Company	H and S Score (Out of 25%)	Price	Price Score (Out of 25%)	Time and Quality Score (Out of 50%)	Total Combined Score (Out of 100%)
A	20%	1.2m	20%	39.5%	79.5%
B	17.5%	1.0m	25%	35.5%	78%
C	20%	1.1m	22.5%	36.5%	79%

(Source: Adapted from Sayeed, 2006)

RESEARCH RESULTS

All the respondents agreed to the fact that the main criteria in place, currently, for the evaluation of tenders can be broadly grouped under cost (i.e. tender price) and time and quality issues (i.e. completion time, experience in similar works, qualification and experience of key personnel, among others). In addition to this, 80% of the respondents (Figure 1) replied yes to price as the major determining factor for selecting contractors in Ghana. The respondents are professionals working with consultant, client, or contractor organisations or firms; hence this can be accepted as the current practice in the industry. Figure 2 shows the distribution of the respondents.

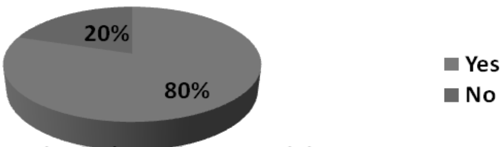


Figure 1: Price is the Main Determining Factor

(Source: Author's fieldwork study, 2009)

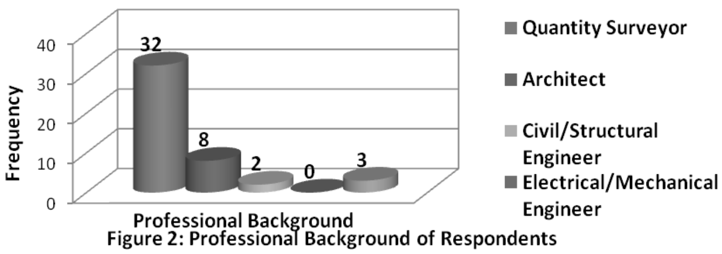


Figure 2: Professional Background of Respondents

(Source: Author's fieldwork study, 2009)

Furthermore, a great number of the respondents (34 out of 45) answered no to health and safety issues ever being considered (used) as a key criterion in contractor selection. As mentioned earlier, the current selection criteria (the golden triangle) place much emphasis on time, cost and quality, neglecting health and safety issues. This response affirms the position of the researcher further, on the neglect of H and S issues when contracts are being awarded to contractors in the construction industry in Ghana. However, 76% of the respondents believed that the incorporation of health and safety issues in the award criteria will ensure that health and safety issues will be properly considered at the contractor selection stage.

Furthermore, 82% of the professionals believed that the H and S provisions contained in the Labour Act of 2003 are not being adhered to in the construction industry. But, 42 of the professionals who responded thought that the inclusion of health and safety issues in the award criteria will address this.

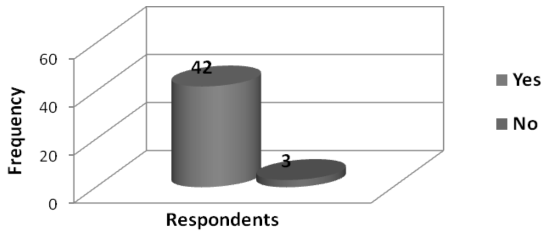


Figure 2: Enforcement of the Labour Act of Ghana

(Source: Author's fieldwork study, 2009)

On the four H and S key areas proposed by the researcher, 40 of the respondents (representing 89%) believed that the list was adequate for the assessment of the health and safety competence of contractors at the tender stage, whist 5 (representing 11%) disagreed. Some of those who said no suggested that issues like 'remedy and compensation' need to be captured. Also, 39 out of 45 of the respondents thought that the equal evaluation of the four key areas was sufficient, should health and safety issues be included as a tender evaluation criterion. Interestingly, all the respondents who thought that the weightings were not adequate were all from the category of consultants. They therefore provided alternatives, which are presented in Table 7.

Table 8: Alternative Weightings for Health and Safety Criteria

	Weighting (%)					
Health and Safety Criteria	A4	A9	A10	A11	A19	A20
Policy	20	20	25	25	15	50
Training	25	20	45	25	30	15
Health and Safety Awareness	30	30	15	30	25	15
Preventing Exposure to Health Hazards	25	30	15	20	30	20
Total Marks	100	100	100	100	100	100

(Source: Author's fieldwork study, 2009)

The contractor with the largest combined score for the weightings suggested in the golden square criteria is to be selected and recommended for the award of the contract. In this regard, 35 out of the 45 respondents agreed that the weightings were adequate, whereas the remaining 10 felt it was not sufficient. Also, 91% of the respondents (Figure 3) thought that the weightings to be applied in the evaluation of the time and quality issues within the assessment process was adequate. However, the professionals (again, all from the consultants' category) that did not agree to the weightings that were assigned to the time and quality issues went ahead and provided alternative ways for scoring time and quality issues.

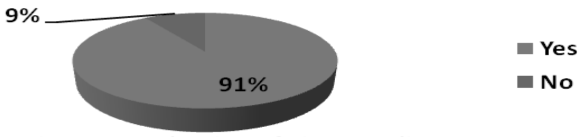


Figure 3: Evaluation of Time Quality Issues

(Source: Author's fieldwork study, 2009)

In assessing each selection criterion marks have to be awarded. All 45 respondents (100%) replied yes, implying that the suggested key for determining the marks to be awarded was perfectly alright. This means that if health and safety is incorporated, in order to ensure transparency in the evaluation of tenders, the above key to the marks awarded could come in handy. 37 of the respondents (representing 82%) also believed that the incorporation of health and safety issues into the contractor selection criteria will work in Ghana (Figure 4). Lastly, respondents were asked to provide some comments on the adoption and use of this criteria for selecting contractors. Many of the respondents said this was a laudable and brilliant idea. Others also said that it was long overdue. However, many stressed the need for a statutory/regulatory body to take charge. Majority praised it as a good criteria which must be embraced whole-heartedly.

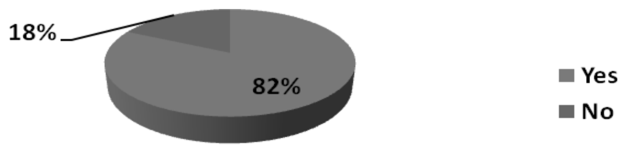


Figure 4: Health and Safety Incorporation will Work

(Source: Author's fieldwork study, 2009)

CONCLUSIONS

Based on the literature review and the analysis of the survey results, the findings of the study are summarised as follows. Price is indeed the major determining factor in the criteria for selecting contractors employed in Ghana. Health and safety issues have also not been considered as a key selection criterion for contractors. Also, the enforcement of the health and safety provisions contained in the Labour Act, 2003 (Act 651) of Ghana is lacking in the construction industry. However, the golden square has received a widespread acceptance and most of the respondents look forward to its adoption and use in the Ghanaian construction industry. It is very likely to get clients and contractors to accept the proposed assessment process. They are also ready to accept the additional responsibilities to be placed on them by the consideration of health and safety issues. Also, the inclusion of health and safety will help in the enforcement of the health and safety provision within the Labour Act of Ghana. Furthermore, the current award criteria in Ghana can be broadly grouped into time, cost and quality issues. Also, much emphasis is placed on time, cost and quality, neglecting the important role played by health and safety.

REFERENCES

Coles, D. (2009) Lecture Notes on Project Evaluation and Development. HAN University.

Coles, D. (2008) Lecture Notes on The Management of Health, Safety and Welfare in the Construction Industry. HAN University.

Hughes, P. and Ferret, E. (2008) Introduction to health and safety in construction (3rd Edition). Oxford: Butterworth Heinemann.

HSC. (2007) Managing Health and Safety in Construction, (Construction Design and Management Regulations 2007). London: HSE Books.

Kyei, A. K. (2009). Procurement Systems and Project Success in the Ghanaian Construction Industry. MSc Thesis, Department of Building Technology, Kwame Nkrumah University of Science and Technology-Kumasi.

Osei-Tutu, E. (1999). Construction Procurement Decision in Ghana. MSc Thesis, Department of Building Technology, Kwame Nkrumah University of Science and Technology-Kumasi.

Sayeed, S. (2006). The Golden Square. Dissertation for BSc. (Hons) in Project Management for Construction, University College of London. London: The Bartlett.

The Labour Act of Ghana, 2003, Act 651 (the LA, 2003).

The Public Procurement Act of Ghana, 2003, Act 663 (the PPA, 2003).

HYDROLOGICAL PERFORMANCE OF RAINWATER HARVESTING SYSTEM IN THE RESIDENTIAL SECTOR: A LITERATURE REVIEW OF MODELLING TECHNIQUES

Omolara Lade[1], David Oloke[2], Collin Booth[3], Michael Fullen[4] and David Proverbs[5]

[1,2,3,4]*School of Technology, University of Wolverhampton, West Midlands, City Campus, WV1 1LY, UK*

[5]*Faculty of Environment and Technology, University of the West of England, Frenchay Campus, Bristol BS 16 1 QY, UK*

There is a growing interest in reducing water consumption and the associated water wastages in every sector of the economy. The residential sector is a substantial consumer of water in every country and therefore constitutes a focus of water consumption efforts. Since the water consumption characteristics of the residential sector are complex and inter-related, comprehensive models are needed to assess the environmental engineering and socio-economic impacts of adopting rainwater harvesting (RWH) as a sustainable system suitable for residential applications in developing countries. This research seeks to develop a RWH decision support system (DSS) to assist decision makers and stake holders by indicating the suitability of RWH in any selected part of developing nations in general and Nigeria in particular. A review of the various modelling techniques used for assessing the performance of RWH systems in the residential sector (i.e. in terms of their water saving reliability) is thus presented. Numerous approaches are identified: these ranges from the relatively simple, "rule-of-thumb' approach to the more complex, statistical methods and sophisticated computer programs. The literature reviewed revealed, there are few RWHS models and there seems to be insufficient attention to Decision Support Tools (DST) for integrated urban water management. A GIS-based DST will be developed for evaluating rainwater by the combine use of RainCycle© model and mass balance-transfer model.

Keywords: modelling, rainwater system, water consumption, rainwater harvesting, residential sector.

INTRODUCTION

Reduction of water consumption and the associated water wastages in the residential sector is on a rapid increase. The residential sector is a substantial consumer of water in every country and therefore constitutes a focus of water consumption efforts. Since the water consumption characteristics of the residential sector are complex and inter-related, comprehensive models are needed to assess the environmental engineering and socio-economic impacts of adopting RWH as a sustainable system suitable for residential applications in developing countries.

[1] O.O.Lade@wlv.ac.uk

[2] D.A.Oloke@wlv.ac.uk

Lade, O., Oloke, D., Booth, C., Fullen, M. and Proverbs, D. (2011) Hydrological performance of rainwater harvesting system in the residential sector: A literature review of modelling techniques *In:* Laryea, S., Leiringer, R. and Hughes, W. (Eds) *Procs West Africa Built Environment Research (WABER) Conference,* 19-21 July 2011, Accra, Ghana, 585-592.

Water is one of the most precious natural resources that are indispensable for human beings and economic growth. Water consumption pattern can vary from house to house, depending on the occupants of the house, social and cultural condition as well as the type of water consuming appliances installed in the houses. Fig. 1 reveals 15-20% of in-house water demand is used for purposes requiring drinking water quality (including water used for drinking, cooking and cleaning dishes).

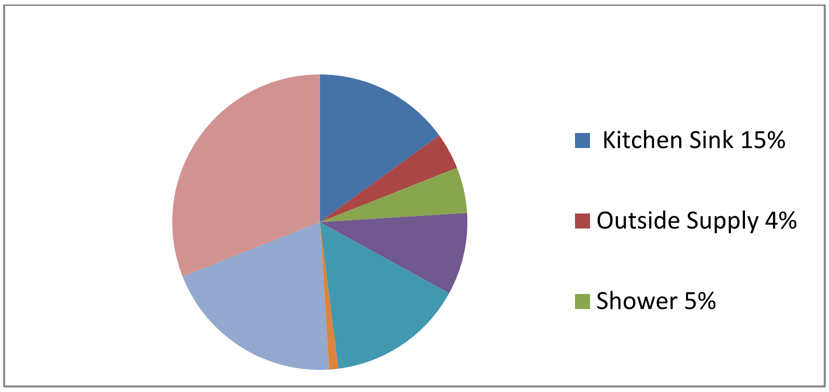


Fig.1. Water consumption share of different micro-components of the household in the industrialised world (Source: Memon and Butler, 2006)

This paper thus presents a review of the various modelling techniques used for assessingthe performance of RWH systems in the residential sector (i.e. in terms of their water saving reliability). Numerous approaches are identified: these ranges from the relatively simple, "rule-of-thumb' approach to the more complex, statistical methods and sophisticated computer programs. Some techniques consider only a single building whilst others seek to investigate the impacts of wider implementation, such as at the development or catchment scale (Liu et al., 2005; Sakellari et al., 2005; Sekar and Ranhir, 2006), often with the aid of geographical information system (GIS), (Prakash and Abrol 2005). Some methodologies focus on assessment of system sustainability (Parkinson et al., 2001; Vleuten-Balkema, 2003; Anderson, 2005; Sakellari et al., 2005) while others on hydrological performance with the inclusion of additional elements such as economic/financial measures (Coombes et al., 2002; 2003b; Liaw and Tsai, 2004; Ghisi and Oliveira, 2007).

The literature revealed that few models exist on RWH system. These include:

RainCycle©: which is an Excel-based mass balance model using YAS (Yield after storage) algorithms and whole life costing approaches.
RSR: is a RWH tank- sizing procedure for storm water retention to reduce flood magnitudes. The city of Seoul is used as a case study.
RCSM: is a behavioural, continuous simulation, including detailed analysis of time-interval variation and yield both before and after spills.
REWAPUT: is a reservoir model and uses rainfall-intensity-duration-frequency relationships and triangular distribution.
DRHM: is a mass balance with stochastic elements for demand profiling. The model simulates quantity, quality and costs.

The purpose of the study is to appraise the various RWH models available, assess their performance in the residential sector in terms of water saving reliability and evaluate the potential for their sustainable application in Nigeria and adoption.

Objectives

The main objective of this paper is to review the various RWH models available nationally and internationally and evaluate the potential for their sustainable application in Nigeria and also the potential of their uptake/adoption. It is envisaged that the work will develop a RWH decision support system (DSS) to assist decision makers and stake holders by indicating the suitability of RWH in any selected part of Nigeria.

Research Questions

- What are the different types of modelling concepts available?
- What are the key components to be included in a comprehensive model?
- Which methods are available for modelling the behaviour of rainwater storage tanks?
- Which methods are available for predicting the future of non-potable water demand? how do we account for the impacts of environment and socio-economic factors?

Study Area

Lagos lies in the south-western Nigeria ($6^0 27^1$N, $3^0 24^1$E) and was selected due to her susceptibility to sea intrusion and prevalent industrial wastes resulting in groundwater pollution. These scenarios have made both groundwater and surface water resources to be expensive. Incidentally, rainfalls are usually torrential especially during the wet season leading to severe floods. Hence, tapping of rainwater will help alleviate this problem as well as providing potable water for the hugely populated city of Lagos. The city has an annual precipitation of about 2,000mm.

HYDROLOGIC MODELLING IN WATER RESOURCES MANAGEMENT

Water resource is crucial for human development and survival. However, with increasing demand there is an envisaged risk of scarcity of the resource (De Fraiture *et al*, 2001), there is therefore a necessity of finding alternative solutions to withdrawal rates (Handia *et al*, 2003)and reduction of unnecessary demand (Mulwafu *et al*, 2003). Modelling approaches provide management choices, used in addressing environmental problems that concerns resources, both as representation of the complex system and as a tool for decision support and management.

Gaur *et al*., 2011 developed a method for evaluating groundwater by the combined use of numerical model and spatial model using GIS. The groundwater model has been performed using MODFLOW based GMS 4.0. The groundwater model was used to generate future scenarios, for the duration of 10years (July 2006-June 2016) by increasing the discharge of wells and incorporating the recharge structures in the watershed on the sub-basin of the Banganga River, India. The study reveals the area falling in the potential zones can produce good amount of groundwater while the overall stress on the watershed can be reduced using the wells of these zones. The results concluded the construction of the structures reduces the overall decline of the groundwater level.

Global warming is considered a major threat to the natural environment. Ozaki *et al*., (2008) established a model for displaying water temperature and applied it to a small river basin at Yamanakatanigara river located in South west Japan. The mesh and multi-layer runoff model was applied to a stream and the behaviour of heat transfer was modelled in the water runoff model. The model was verified by measuring daily changes of streamflow and river water temperature, and the calculation with the model was conducted using meteorological data and compared to measured data. The model outputs agreed well with measured values and it showed that water temperature could be a good indicator for evaluating the performance of river hydrological models.

Water availability in semi-arid and dry Mediterranean regions can be improved through water harvesting and water shed management. Makhamreh Zeyad (2011) identified and optimized the potential water-harvesting sites in Jordan based on the characterization of surface landscape conditions using DEM and remote sensing techniques. A mathematical model was established in order to characterize the surface landscape conditions, by establishing a relationship between soil colour and soil surface property to derived indicators of landscape conditions from remote sensing data, combined with DEM and GIS hydrological analysis tool for optimizing delineation and selection of the water harvesting sites. This approach considers both physical and current landscape conditions. The landscape properties, the effect of built up areas and human construction objects (i.e. the effect of man made changes) on the surface drainage network and direction of water flow were considered while the traditional water shed management approaches considers only the physical landscape characteristics without considering the actual landscape conditions

A promising and successful water harvesting technology to ensure water and food security in semi-arid region like Kenya is the use of sand-storage dams. A measurement campaign of hydrological processes in the surrounding of a single dam in the Kitui district in Kenya reveals groundwater levels increase quickly after precipitation while there is recession of groundwater levels during the dry season following the rains. Quilis *et al*., (2009) developed a groundwater model for a single sand-storage dam. The model shows high sensitivity of parameters like thick and hydraulic conductor of the shallow aquifer on the riverbanks and thickness of the sand layer in the riverbed. A second model for a series of dams was also developed, which indicated that the inter-dam distance is an important parameter. The model results confirm that sand-storage dams can affect increase water availability throughout the dry season.

REVIEW OF EXISTING COMPUTER BASED MODEL IN RWH

The principle of mass-balance transfer was used by many researchers (Dixon 1999, Fewkes (1999); Fewkes & Butler (1999); Fewkes & warm 2001; Day (2002); Racticliffe (20002); Cobley (2004) and Roebuck 2006), as computer based assessment methods for RWH (Figure 2).

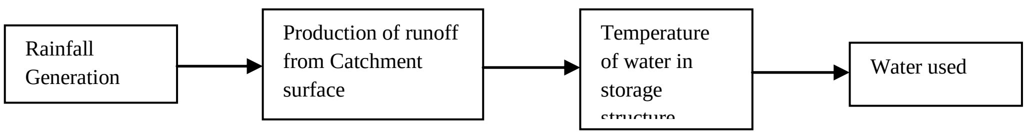


Figure 2: Typical mass-balance transfer model (Source: Roebuck and Ashley 2006)

Excel spreadsheets are used by many models and it contains algorithm replicating the processes shown in Fig. 2. Also review is the best practice methods for RWH in UK. The most relevant information was found in the Construction Industry Research & Information Association (CIRIA) best practice manuals (Leggett *et al*, 2001a; Leggett *et al*, 2001b; Shaffer et al., 2004). The literature review shows that although some variations exist between individual models there is a widespread use of the mass-balance transfer principle when predicting hydraulic performance.

Table 1: Selection of existing computer based hydraulic models for RWH

Reference	Description
Ward *et al* (2008)	Ward designed RWH systems in two district new-building developed in UK and was evaluated as a state -of-the art model than the two simpler methods. The results showed that the design methods based on the simplified AR/D (used by RWHS suppliers) and the EA approach generated tank sizes substantially larger than the state –of –the –art yield after spill (YAS) continuous simulation.
Roebuck et al. (2006)	Roebuck developed the RainCycle© model, which is based on the YAS model, as described by Jenkins *et al*., (1978). This is an accepted and widely used computer-based modelling tool to investigate the hydraulic and whole life cost performance of RWHS of a UK school. The results revealed that both water and monetary savings are possible in the long term. Although, the results were less favour, RWH was revealed as a viable way of reducing reliance on mains water and also capable of saving money in a long term. However, it has been revealed that the methodology used for the prediction of future performance by many RWHS supplier is inadequate in both scope and detail, leading to overestimating both the demand that can be met by harvested rainwater and level of financial savings.
Cobley (2004)	Describes a simple method for estimating the largest storage requirement based on the consumption rates and occupancy of a building. Similar in many aspects to the numerous basic models available from the Internet.
Day (2002); Ratcliffe (2002)	Rainwater harvesting project led by Telford and Wrekin Council, UK. Monitoring of domestic rainwater harvesting (DRWH) system water usage and water quality was conducted. Water consumption data was used to build a model of the system.
Fewkes (1999); Fewkes and Butler (1999); Fewkes and Warm (2001)	Fewkes developed a number of models based on the YAS method described by Jenkins *et al* (1978). Fewkes and Warm (2001) describe a method of modelling RWH systems at eleven different locations in the UK. Recorded daily rainfall statistics and a daily time step were used to predict water saving efficiencies.
Dixon (1999)	Model of DRWH system for predicting water quality and water saving efficiency. Also includes some stochastic elements for creating water demand profiles and a basic whole life costing element.
Jenkins *et al* (1978)	An early behavioural model identifying two fundamental algorithms that describe the operation of a rainwater storage structure: Yield After Storage (YAS) and Yield Before Storage (YBS). Jenkins *et al* used the YAS algorithm and a monthly time interval to investigate the performance of rainwater storage in North America.

Note: all the models described in table 1 are based on mass-balance transfer algorithms

A flow diagram is presented in Fig. 3 that shows the steps involved in the creation of a simulation model (after James 1984).

THE RAINCYCLE© RAINWATER HARVESTING MODELLING TOOL

Overview of main features

The following list highlights the main features of the modelling tool:

- Daily simulation of proposed design for up to 100 years of operation
- Compares the whole life costing (WLC) of a RWH system with that of an equivalent mains-only system
- Takes explicit account of all associated costs, including capital (to-build), operating/maintenance and decommissioning costs

- Multiple values allowed on 11 key parameters which enable performance under a range of conditions to be investigated. Sensitivity analysis and Monte Carlo simulation also available.
- Main results are output as: long-term savings, average yearly savings, pay-back period and percentage of demand met by harvested water.
- Uses standard accounting techniques to calculate the Net Present Value (NPV)

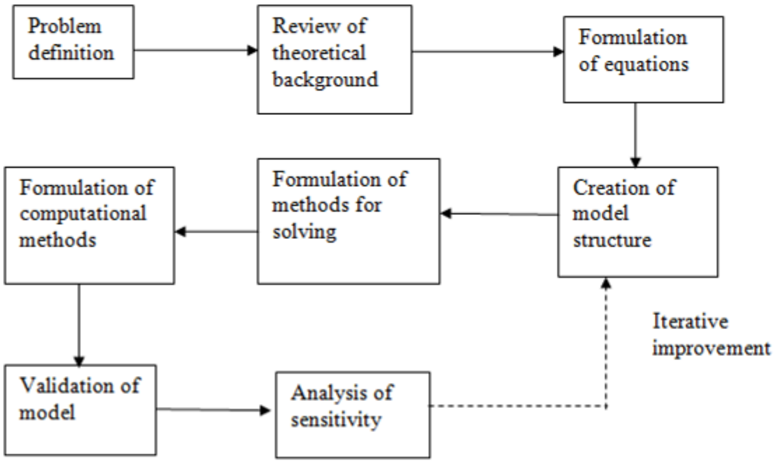


Figure 3 Diagrammatic representation of model development after James (1984)

CONCLUSION

The literature reviewed revealed, there are few RWHS models and there seems to be insufficient attention to Decision Support Tools (DST) for integrated urban water management. To integrate RWH into the development and management of water resources in Nigeria, there is a need to develop tools and methodologies that will not only assist planners with the identification of areas suitable for RWH but also quantify the associated hydrological impacts of its wide spread adoption.

A GIS-based DST will be developed for evaluating rainwater by the combine use of RainCycle© model and mass balance-transfer model. The RWH model will help justify location of potential zones for RWH and give more realistic appraisal for their use. Modelling of Economic assessment would also be performed to include relevant environmental and social costs as this largely underscores the failure or success of RWH systems. In order to achieve the objectives of these research, it was decided that the RainCycle© RWH modeling tool be adopted since this method is widely accepted and used.

REFERENCES

Anderson, J.M. 2005. *Blueprint for a Greener City: Growth Need not Cost the Earth*. Water, Science and Technology, volume 52, no.9, pp.61-67.

Coombes, P.J. 2002. *Rainwater Tanks Revisited: New Opportunities for Urban Water Cycle Management*. PhD thesis. Newcastle University, New South Wales, Australia.

Coombes, P. & Kuczera, G. 2003. *Analysis of the Performance of Rainwater Tanks in Australian Capital Cities.* The Institute of Engineers, Australia 28th International Hydrology and Water Resources Symposium. Wollongong, New South Wales.

Cobley, J.C. 2004. *SUDS: The Consultants Specification*. Proc. of 25th meeting of the Standing Conference on Stormwater Source Control: Quantity and Quality. Coventry University, Friday 20th February 2004.

Day M. 2002. *The Millennium Green Development Rainwater Project. Proc. of Standing Conference on Stormwater Source Control Quantity and Quality*. 13th February 2002, Coventry University UK, Vol. 22.

De Fraiture C., Molden, D., Amarasinghe, U., Makin, I., 2001. *PODIUM: Projecting Water Supply and Demand for Food Production in 2025*, Physics and Chemistry of the Earth 26, pp. 869-876.

Dixon A. 1999. *Simulation of Domestic Water Re-use Systems: Greywater and Rainwater in Combination*. Department of Civil and Environmental Engineering PhD Thesis. Imperial College of Science, Technology and Medicine, London, UK.

Fewkes, A.1999. *Modelling the Performance of Rainwater Collection Systems: Towards a Generalized Approach.* Urban Water, vol.1, pp. 323-333.

Fewkes, A. & Butler, D. 2000. *Simulating the Performance of Rainwater Collection Systems in the UK*. Building Services Engineering Research and Technology, Vol.2, pp. 257-263.

Fewkes, A. & Warm, P. 2001. *A Method of Modelling the Performance of Rainwater Collection Systems in the UK*. Building Services Enineering Research & Technology, Vol.2, pp.257-265.

Ghisi, E. & Oliveira, S.M. 2007. *Potential for Potable Water Savings by Combining the Use of Rainwater and Greywater in Houses in Southern Brazil*. Building and Environment, Vol. 42 (2007), pp.1731-1742.

Gaur, S., Chahar, B.R., Graillot Didier 2011. *Combined Use of Groundwater Modelling and Potential Zone Analysis for Management of Groundwater*. International Journal of Applied Earth Observation and Geoinformation 13, pp.127-139.

Handia, L., Tembo, J.M., Mwiindwa, C., 2003. *Potential of Rainwater Harvesting in Urban Zambia*, Physics and Chemistry of the Earth 28, pp. 893-896.

James, A. 1984. *An Introduction to Water Quality Modelling*. John Wiley & Sons, Chichester.

Jenkins, D., Pearson, F., Moore, E., Sun, J.K. & Valentine, R. 1978: *Feasibility of Rainwater Collection Systems in California*. Contribution No. 173, Californian Water Resources Centre, University of California USA.

Leggett D. J., Brown R., Brewer D., Stanfield G and Holliday E 2001a. *Rainwater and Greywater Use in Buildings: Best Practice Guidance*. CIRIA Report C539. Construction Information & Research Information Association, London, UK.

Leggett D., Brown R., Stanfield G., Brewer D. and Holliday E. 2001b. *Rainwater and Greywater Use in Buildings: Decision-making for Water Conservation*. CIRIA report PR080. Construction Information & Research Information Association, London, UK.

Liu, S., Butler, D., Makropoulos, C. & Memon, F. 2005. *An Excel-Matlab Based Decision Making Framework and its Application in Urban Water Management*. CWWI2005. Exeter, UK, pp. 21-26.

Liaw, C. & Tsai, Y. 2004. *Optimum Storage Volume of Rooftop Rainwater Harvesting Systems for Domestic Use*. Journal of the American Water Resources Association, August 2000, Vol. 40, no. 4, pp. 901-912.

Makhameh, Z., 2011. *Using Remote Sensing Approach and Surface Landscape Conditions for Optimization of Watershed Management in Mediterranean Regions*. Physics and Chemistry of the Earth 36, pp. 213-220.

Memon, F.A. & Butler D. 2006. *Water Consumption Trends and Demand Forecasting Techniques*. In: Water Demand Management, IWA Publishing, London.

Mulwafu, W., Chipeta, C., Chavula, G., Ferguson, A., Nkhoma, B.G., Chilima, G. , 2003. *Water Demand Management in Malawi: Problems and Prospects for its Promotion*, Physics and Chemistry of the Earth 28, pp. 787-796.

Ozaki N., Fukushima, T., Kojiri, T. 2008. *Simulation of the Effects of the Alteration of the River Basin Land Use on River Water Temperatur using the Multi-Layer Mesh-typed Runoff Model*. Ecological Modelling 215, pp. 159-169.

Parkinson, J., Schutze, M. & Butler, D. 2001. *Modelling the Impact of Source Control Strategies on the Sustainability of the Urban Wastewater System*. Proc. of 1st Nat. Conf. on Sustainable Drainage. 18th-19th June 2001, Coventry University, UK, pp. 255-267.

Prakash, S. & Abrol, Y.P. 2005. *The Possible Integration Of A GIS Based Metholodology with the Existing Community Rainwater Harvesting Plan of Hauz Khas Apartment, New Delhi (India).* Proc. of 12th International Rainwater Catchment Systems Conference, New Delhi, India, November 2005.

Quilis, R.O., Hoogmoed, M., Ersten, M., Foppen, J.W., Hut, R., Arjen de Vries 2009: *Measurement and Modelling Hydrologic Processes of Sand-storage Dams on Different Spatial Scales*. Physics and Chemistry of the Earth 34, pp. 289-298.

Ratcliffe, J. 2002. *Telford Rainwater Harvesting Project. Proc. of Standing Conference on Stormwater Source Control Quantity and Quality*. 13th February 2002, Coventry University, UK, Vol.22.

Roebuck, R. M. & Ashley, R. M. 2006. *Predicting the Hydraulic and Life-cycle Cost Performance of Rainwater Harvesting Systems Using a Computer Based Modelling Tool*. In: Delectic, A. and Fletcher, T. (eds): Proc. of the 7th International Conference on Urban Drainage and 4th International Conference on Water Sensitive Urban Design, Melbourne, Australia, 2-7 April 2006, Vol. 2, pp. 699-706.

Sakellari, I., Makropoulos, C., Butler, D. & Memon, F.A. 2005. *Modelling Sustainable Urban Water Management Options*. Proc. of the Institution of Civil Engineers. Engineering Sustainability 158, September 2005, Issue ES3, pp143-153.

Shaffer, P., Elliott, C., Reed, J., Holmes, J. & Ward, M. 2004. *Model Agreements for Sustainable Water Management Systems: Model Agreements for Rainwater and Greywater Use Systems*. CIRIA report C626, London.

Sekar, I. & Randhir, T.O. 2006. *Spatial Assessment of Conjunctive Water Harvesting Potential in Watershed Systems*. Journal of Hydrology, 9(24), pp. 1-14.

Vleuten-Balkema, A.J. 2003. *Sustainable Wastewater Treatment: Developing a Methodology and Selecting Promising Systems*. PhD thesis, Eindhoven Technical University.

Ward, S., Memon, F.A., Butler, D., 2008. *Rainwater Harvesting: Model-based Design Evaluation*. Proc. of the 11th International Conference on Urban Drainage, Edinburgh, Scotland, UK.

IDENTIFICATION OF HEALTH AND SAFETY PERFORMANCE IMPROVEMENT MEASURING INDICATORS: A LITERATURE REVIEW

Justus N. Agumba[1], Wellington Thwala[2] and Theo Haupt[3]

Department of Construction Management and Quantity Surveying, University of Johannesburg, South Africa

Improvement to small and medium construction enterprises (SMEs) safety standards could inevitably be helped by continuous monitoring and review of their health and safety (H&S) performance. To achieve this objective safety performance improvement model is a prerequisite. Although various methods of health and safety performance improvement have been proposed, a more comprehensive health and safety performance improvement model is advocated which takes into account factors pertinent to SMEs projects. Studies have indicated there is no consensus of health and safety performance measuring indicators to be used in monitoring health and safety performance. This paper tries to fill this gap that is so contentious in the field of health and safety in the construction industry. An extensive literature review on health and safety literature identified 64 potential indicators that influence H&S performance, which may be incorporated in the health and safety SMEs questionnaire survey, after the Delphi survey. The measuring, indicators identified were leading indicators, categorized in 10 core elements depicting the health and safety culture characteristic i.e. management commitment, employees involvement and occupational health and safety management system i.e. what the organization does. These core elements and leading indicators will also depict the health and safety management of an organization.

Keywords: health and safety, literature review, measuring indicator, performance improvement.

INTRODUCTION

Improvement to small and medium construction enterprises (SMEs) safety standards could inevitably be helped by continuous monitoring and review of their H&S performance. According to Azimah et al., (2009) they indicated that legislation is inadequate to address those problems in managing H&S in the workplace. This is due to the “people” element having a tendency in engaging in unsafe or safe behavior according to their interpretation and the unsafe behavior that can lead to accidents. Mitchison and Papadakis (1999) demonstrated that effective safety management improves level of safety in an organization and thus can be seen to decrease damages and harms from incidents (cited from Bottani et al., 2009). Mearns et al., (2003), indicated that safety management refers to the tangible practices, responsibility and performance related to safety. They further indicated the association between safety

[1] jagumba@uj.ac.za
[2] didibhukut@uj.ac.za
[3] hauptt@cput.ac.za

Agumba, J.N., Thwala, W. and Haupt, T. (2011) Identification of health and safety performance improvement measuring indicators: A literature review *In:* Laryea, S., Leiringer, R. and Hughes, W. (Eds) *Procs West Africa Built Environment Research (WABER) Conference,* 19-21 July 2011, Accra, Ghana, 593-606.

management, safety climate and safety culture. They noted that safety climate is perceived as the precise indicator of overall safety culture while safety management practices display the safety culture of top management and as a result, good safety management practices are reflected in enhanced safety climate of all employees. For these reasons Azimah et al., (2009) for example, management in organizations will assist to resolve OHS problems successfully and is also a means to legal compliance. Unfortunately Fernandez Muniaz, et al., (2007) indicated in there study that there is no consensus of what elements and measuring indicators constitutes the health and safety management system.

This paper therefore describes research work that is in progress, the ultimate goal of this research is to identify proactive H&S elements and indicators that will be used to monitor the H&S performance of SMEs at project level in South Africa in order to reduce incidents and accidents such as injuries, illness and fatalities in their projects.

CHALLENGES FACING SMALL AND MEDIUM CONTRACTORS

Contractors can be distinguished from each other by various variables such as the amount of annual turnover, capacity, capability and their fixed assets. In South Africa the National Small Business Act amended in 2003 defines small contractors as those with a total annual turnover of between R3m and R6m, full time paid employees between 20 and 50 and a total gross asset value (fixed property) of between 0.5m and R1m, whereas medium contractors are defined as having a total annual turnover of between R6m and R26m, total full time paid employees between 50 and 200 and have a total gross asset value (fixed property) of between R1m and R5m (National Small Business Act, 2004). This definition will be adapted for this study.

The White Paper on Creating an Enabling Environment for the Construction Industry, describes the South African SMEs as largely underdeveloped and lacking the managerial and technical skills and sophistication enjoyed by larger well established contractors [Department of Public Works (DPW), 1999]. Dlungwana et al., (2003) asserts that SMEs are left on the periphery of the mainstream economy and do not participate fully in the economies of developing countries as large contractors dominate. They further indicate that conditions in developing countries such as lack of resources for training contractors, poor procurement systems, lack of management capacity and lack of available resources to equip managers to operate their business enterprise effectively, some of these factors have been supported in previous study of Agumba, et al., (2005), lack of awareness of what specific H&S legislation is relevant to SMEs (Vickers et al., 2003) is also a challenge. These challenges faced by SMEs are viewed as exacerbating the current state of poor H&S performance in SMEs, globally and in South Africa.

HEALTH AND SAFETY STATUS IN SOUTH AFRICA CONSTRUCTION INDUSTRY

Traditionally, cost, time and quality have constituted the parameters within which projects have been managed. However, there is a paradigm shift to the inclusion of H&S as a project performance measure by petro-chemical organizations (Smallwood, 2005). Based on the aforementioned challenges on construction SMEs, occupational accidents and diseases impose an enormous cost on South Africa. The Department of Labour (DoL), (2007) indicated that construction accidents account for 4% of the global gross domestic product (GDP). Occupational accidents and diseases in South

Africa account for approximately 3.5% of its GDP, which, translates to about R30 billion (about $4.2 billion). There are other aspects apart from the financial and economic impacts which cannot be measured in any accurate and tangible terms, namely the strain of the loss of a family member, particularly if the worker was the only family bread winner. According to the National Occupational Health and Safety Policy (2003) the absence of a consistent national reporting system means that there is no set of figures that reflects accurately the full extent of occupational accidents and diseases these has been supported by the Construction Industry Development Board, (CIDB, 2008) report. The statistics presented in this review does not separate the statistics into the size of organization. The most complete accident figures are compiled by the Compensation Commissioner. Construction H&S statistics provided by the DoL as cited in CIDB, (2008) report covering the period 2004/2005 to 2007/08 show a sharp rise in accidents up to 2007/08; to around 160 fatalities and around 400 non-fatal accidents (i.e. temporary or permanent disablement).

Despite isolated reports of improvement in (2003), there is very limited commitment to comply with basic requirements, let alone promote a culture of H&S. Employers view, H&S as a cost in the system. Small contractors can barely maintain tools and regard safety equipment as luxury items. Even where protective clothing and equipment are provided, workers often avoid their use, including the use of safety goggles and masks when working with grinders and asbestos. Aside from the direct compensation and medical costs associated with accidents the costs to the economy are immense and include rework, lost time, damage to plant and equipment, disruption, productivity loss and loss of skills to the economy (CIDB, 2004).

The continuing poor H&S performance of the construction industry in the form of fatalities, injuries, and diseases, the number of large-scale construction accidents, and the general non-participation by key project stakeholders such as clients and designers, provided the catalyst for promulgation of consolidated construction H&S legislation in the form of the Construction Regulations (Smallwood and Haupt, 2005). Compliance with this construction legislation, codes and standards such as the Construction Regulations (2003) in South Africa, present significant challenges involving cost, compliance, design and implementation capacity, clients such as the Department of Public Works (DPW) and consultants agree that implementation would require raised understanding on the implications and importance of H&S in the construction industry (CIDB, 2004).

Walters (2001) (cited in HSE, 2007) indicated that SMEs have shown to experience proportionately more accidents than large enterprises. It has also been indicated in various research projects that models for measuring H&S performance for large contractors will not be applicable to SMEs, this is a challenge as this is what is currently taking place. This can be reflected in a study conducted by Lin et al., (2001) in Australia. These authors concluded there is need to improve OHS within small enterprises. Based on the aforementioned challenges and poor H&S performance facing construction SMEs this study therefore aims to identify potential core elements and leading indicators that will be essential in influencing H&S performance at project level of SMEs. This will be achieved through extensive literature review.

MEASUREMENT OF CONSTRUCTION HEALTH AND SAFETY PERFORMANCE

Health and safety performance can be used by owners to compare H&S performance of different organizations to assess which organization has a better H&S record. It also allows comparison of H&S performance between projects and can also be used by organizations internally to maintain line accountability for H&S and pin point problem areas for improvement. Health and safety performance can be broadly classified into two groups which are lagging indicators like accident rates and leading indicators like measurement of H&S climate (Flin et al., 2000).

Teo and Fang (2006) research indicated that players in the construction industry are aware that historic and statistical data do not accurately reflect H&S performance. The results of their research have shown the importance of leading indicators over lagging indicators to measure construction organizations expected H&S performance. In view of Teo and Fang (2006) this research project through extensive literature review will determine the main H&S elements and the leading indicators that will influence H&S performance improvement in construction SMEs projects.

LITERATURE REVIEW

The Occupational Health and Safety Act (OS&H Act) 1993, mandates that the employer is the responsibility of the employee and reconfirmed in Construction Regulation 2003. The contractors commonly take, the lead role on a project, and are often the sole party, in addressing worker health and safety. Toole, (2000) studied the responsibility of contractors, subcontractors and designers involved in a project. The study revealed that there was not uniform agreement on the site safety responsibility that should be assumed by each of these groups. Most of the respondents placed responsibility for safety with the contractor. This indicates that the contractor needs to be able to manage health and safety in his projects. It is therefore essential to identify elements and leading indicators to assist SMEs in managing H&S.

Levitt and parker (1976) studied the role of top management in construction firm in reducing construction injuries. Some of the findings of the study are that: companies whose top managers, talked about safety when they visited jobsites had lower Experience Modification Rating (EMR’s) than companies in which safety was not mentioned during these events, they also found that companies with formal orientation programs had lower EMR’s compared to companies with no orientation programs.

Cooper (1998) indicated the importance of communication in influencing H&S performance improvement and categorized them into formal and informal verbal and written communication. Kheni et al., (2006) further indicated the need for verbal communication as good measure for safety management practice. Sawacha et al., (1999) established that the most important first level factors to improve H&S performance under organization safety policy are: management talk about safety, provision of safety booklets, provision of safety equipment, assuring a tidy site, appointing safety representatives and training of operatives on safety. Jaselskis et al., (1996) indicated to achieve better construction safety performance at company level the related factors/elements are; upper management support, time devoted to safety issues for company safety coordinator, number of informal safety inspections, made by the company coordinator, meetings with field safety representatives and craft workers, length and detail of company safety program, safety training for new foremen and safety coordinators, the authors also indicated that at project level, the factors/elements that are important for achieving better safety performance; increased project manager experience level, more supportive upper management attitude towards safety, reduced project team turnover, increased time devoted to safety representative, more formal meetings with supervisors and specialty contractors, more informal safety meetings with supervisors, a greater number of informal site safety meetings with supervisors, a greater number of informal site safety inspections, reduced craft worker penalties, and increased budget allocation to safety awards.

Toellner, (2001) established leading indicators that are essential in improving safety performance viz. safety walkthrough by management, barricading a given place, tool box talk meeting and housekeeping. Jannadai et al., (2002) revealed that management involvement, personal protective equipment, and emergency planning and preparation were considered to be extremely important factors in influencing safety performance as they revealed the greatest impact. The authors had identified 20 main factors/elements and 135 sub-factors/indicators that affect health and safety performance from literature review. They developed a questionnaire to find the impact these health and safety factors and sub-factors have on H&S performance. They revealed 20 important main factors/elements and 85 important sub-factors/indicators from the contractors, this survey conducted on large contractors dealing with large volume of industrial construction. The factors and sub-factors were logically filtered to conform to the required elements and indicators.

In a study contacted by Fernandez Muniaz et al., (2007) they developed a positive safety culture model that consisted of management commitment, employee involvement and safety management system (SMS). The SMS included safety policy, incentives, training, communication, planning, and control, there model was generic to cover more than one industry of different sizes, their result indicated improvement when these elements are used and especially when managers and employees are involved. Aksorn et al., (2008) in a validated study indicated that the critical safety factors identified if emphasized on a project can contribute to a marked improvement of safety performance. They identified 16 factors/elements included management support, appropriate safety education and training, teamwork, clear and realistic goals these can be termed as policies, effective enforcement scheme, personnel attitude, program evaluation, personal motivation, delegation of authority and responsibility, appropriate supervision, safety equipment acquisition and maintenance, good communication, sufficient resources allocation, positive group norms and personnel competency. The factors were later categorized into four major dimensions namely; worker involvement, safety prevention and control system, safety arrangement and management commitment, Aksorn et al., (2008) study focused on validating these factors on large contractors, it is therefore crucial for this factors to be in cooperated in these present study matrix for small and medium contractors to find if these elements are appropriate to be implemented on there projects and if they are able to influence performance improvement.

In a recent study by Rajendran et al., (2009) they developed a sustainable construction safety rating system using a Delphi method of which literature and an expert panel was used in identifying the essential elements to be used by the project team which included; contractors, designers, owners and subcontractors. The authors identified 50 elements considered essential by experts. These elements were validated on real projects, the results indicated that 26 elements were considered to be mandatory to be used by all the four project team members while 24 were considered to be elective i.e. not mandatory. These elements were categorized into 14 categories i.e.; project team selection, safety and health professionals, safety commitment, safety planning, training and education, safety resources, drug and alcohol program, accident investigation and reporting, employee involvement, safety inspection, safety accountability and performance measurement, industrial hygiene practices. The authors indicated a variance of the elements with total recordable injury rate (TRIR). Based on this extensive literature synthesis research the result is tabulated in Table 1.

RESEARCH METHOD

A systematic literature review was conducted on relevant journal papers, conference papers, books and government regulations on H&S from 1976 to 2009, based on topics of health and safety (H&S) performance measurement, H&S culture tools developed, H&S climate tools developed, OHS management and H&S performance improvement. The elements and indicators identified from the literature were identified from the empirical studies of peer reviewed journal papers and conference papers. A matrix result Table 1 was developed to capture the elements and the measuring leading indicators of H&S.

A wealth of literature on construction H&S has accumulated over the past 35 years from 1976 to date when Levitt and Parker (1976) studied the role of top management of a construction firm in reducing construction injuries. Detailed review and analysis of all studies was not within the scope of this document. Only specific studies pertinent are extracted and reported in this section. The researchers used their best judgment to interpret the elements and leading indicators to the best of their understanding to accurately extract them. The main elements selected occurred in two empirical studies. This proposed cutoff is in line with Shannon et al., (1997).

This paper covers the first phase of a three phase PhD research project by identifying the potential H&S elements and leading indicators that are potential in influencing H&S performance improvement, the results of the literature review will be used to develop a three round Delphi survey questionnaire for validation in the second phase of this research project in order to attain consensus of the main elements and leading indicators identified.

RESULTS

Core elements and leading indicators synthesized from the literature review

Table 1: Core elements and leading indicators identified

Core elements	*Leading indicators/Positive performance indicators*	Source(s)
Appointment of H&S staff, Sawacha et al., (1999); Vredenburgh, (2002)	Employing at least one qualified manager with H&S training to oversee H&S [*on multiple projects]*	Findley et al., (2004) and researchers addition *italics*
	At least one staff member with H&S training is employed on each project	Ng. et al., (2005)
	Employing at least one H&S representative on each project	Sawacha et al., (1999) Rajendran, et al., (2009)
Formal and informal written Communication Cooper, (1998); HSE, (2008)	Provision of written information about H&S procedures	HSE, (2008); Fernandez-Muniz et al., (2007)
	Provision of written information about the correct way to perform tasks	HSE, (2008); Fernandez-Muniz et al., (2007)
	Written circular/brochure that informs workers about the risks associated with their work	Sawacha et al., (1999) Fernandez-Muniz et al., (2007)
	Written circular/brochure that inform workers about the preventive measures to reduce risk	Sawacha et al., (1999) Fernandez-Muniz et al., (2007)

The literature review aims to answer the following main research questions:

- What are the main health and safety performance elements to be implemented to improve H&S at project level?
- What are the main leading indicators for health and safety performance improvement to be implemented to improve H&S at project level?
- The main objectives of this research project are:
- To identify the health and safety performance elements which will lead to H&S performance improvement in SMEs project; and
- To identify the health and safety performance improvement leading indicators, which will lead to H&S performance improvement in SMEs projects;

Continued Table 1: Core elements and leading indicators identified

Core elements	*Leading indicators/Positive performance indicators*	Source(s)
Formal and informal verbal communication Cooper, (1998); HSE, (2008)	Provide clear verbal instructions to both literate and illiterate employees about H&S	Fernandez-Muniz et al., (2007)
	H&S information verbally communicated to workers before changes are made to the way their work activities are executed	HSE, (2008); Kheni et al., (2006) Fernandez-Muniz et al., (2007)
	Organize regular meetings to verbally inform workers about the risks associated with their work	Fernandez-Muniz et al., (2007)
	Organize regular meetings to verbally inform workers about the preventive H&S measures of risky work	Fernandez-Muniz et al., (2007)
H&S resources Abudayyeh et al., (2006); Rajendran et al., (2009)	Provision of personal protective equipment (PPE)	Kheni et al., (2006) Rajendran et al., (2009)
	Training in H&S through attending seminars/workshops	Fernandez-Muniz et al., (2007)
	Material schedule data sheets provided for all hazardous materials on site	Lingard et al., (2005)
	Employing technically skilled employees with H&S training	Rajendran et al., (2009)
	Adequate information brochures given on H&S	Sawacha et al., (1999) Fernandez-Muniz et al., (2007)
	Provision of a budget for H&S	Liska et al., (1993); Kheni et al. (2006)
	Provision of correct tools, equipment and plant to execute construction	Teo et al., (2005); Rajendran et al., (2009)
	Provision of good welfare facilities such as showers, canteens, toilets	Kheni et al., (2006) Rajendran et al., (2009)
Project supervision/inspection Fang et al., (2004); Rajendran et al., (2009)	Proper supervision by staff trained in H&S	Fang et al., (2004)
	Identification of hazards by at least (*one staff member trained in H&S)*	Mitchell, (2000); Jannadi et al., (2002)
	Results of inspections discussed at H&S meetings	Mitchell, (2000);
	H&S inspections done at least daily	Jaselskis et al., (1996); Jannadi et al., (2002);
	Local authorities and H&S enforcement agencies visit sites for inspection	Aksorn, et al., (2008);

	Ad hoc informal H&S inspections of work place	Jaselskis et al., (1996); Lin et al., (2001)
	Regular H&S audits of projects	Mitchell, (2000); Trewthewy, (2003)

Continued Table 1: Core elements and leading indicators identified

Core elements	*Leading indicators/Positive performance indicators*	Source(s)
Project planning of H&S Sawacha et al., (1999); Mitchell, (2000); Teo et. al., (2005); Rajendran et al., (2009)	Ergonomics is considered when deciding the method of construction	Shikdar et al., (2003); Rajendran et al., (2009)
	Reengineering is considered to reduce hazards	Vredenburgh.,(2002) Mitchell, (2000);
	When head office decides on the method of construction H&S is included in decision making process	Vredenburgh., (2002)
	Each project has a site-specific H&S plan	Fernandez-Muniz et al., (2007); Rajendran et al., (2009)
	Layout of the site considers H&S aspects	Mitchell, (2000); Rajendran et al., (2009)
	Use hazard identification procedures	Trewthewy, (2003); Teo et al., (2005)
	Use of risk assessment procedures	Trewthewy, (2003)
	Constructability of project is reviewed	Coble et al., (2000); Sawacha et al., (1999)
	Scheduling for H&S	Mitchell, (2000); Rajendran et al., (2009)
Training in H&S Sawacha et al., (1999); Kheni et al., (2006); Fernandez-Muniz et al., (2007)	Workers undergo induction on H&S before commencing work on a particular site	Trewthewy, (2003); Fernandez-Muniz et al., (2007)
	Workers trained in proper care and use of personal protective equipment	Sawacha et al., (1999) Shannon, et al., (1997); Fernandez-Muniz et al., (2007)
	Workers are regularly trained in H&S	Shannon, et al., (1997); Ng, et al., (2005); Rajendran et al., (2009)
	Instruction manuals or safe work procedures are used to aid in preventive action	Sawacha et al., (1999) Fernandez-Muniz et al., (2007)
	Workers are given time off for training	Findley et al., (2004); Fernandez-Muniz et al., (2007)
Worker/employee involvement in H&S Aksorn et al., (2008); Fernandez-Muniz et al., 2007)	Workers are involved in production of H&S policy	Fernandez-Muniz et al., (2007)
	Workers provide written suggestions on H&S	Kheni et al., (2006)
	Workers kept informed of provisions of H&S plan	Fernandez-Muniz et al., (2007);
	Workers are involved in H&S inspections	Jaselskis et al., (1996)
	Workers are consulted when the H&S plan is	Fernandez-Muniz et al., (2007);

	compiled	
	Workers are involved in development of H&S rules and safe work procedures	Fernandez-Muniz et al., (2007)
	Workers have the explicit right to refuse to work in potentially unsafe, unhealthy conditions	Sawacha et al., (1999) Rajendran et al., (2009);

Continued Table 1: Core elements and leading indicators identified

Core elements	*Leading indicators/Positive performance indicators*	Source(s)
Upper management commitment in H&S Levitt et al., (1976); Abudayyeh et al., (2004); Aksorn, et al., (2008)	Managers encourage and support worker participation, commitment and involvement in H&S activities	Abudayyeh et al., (2004); Fernandez-Muniz et al., (2007)
	Managers encourage and support training of employees in H&S	Abudayyeh et al., (2004); Fernandez-Muniz et al., (2007)
	Managers communicate regularly with workers about H&S	Abudayyeh et al., (2004); Fernandez-Muniz et al., (2007)
	Managers actively monitor the H&S performance of their projects and workers	Toellner (2001); Abudayyeh et al., (2004);
	Managers take responsibility for H&S	Shannon et al., (1996) Trethewy (2003); Teo et al., (2005)
	Managers actively and visibly lead in H&S matters	Aksorn et. al., (2008); Fernandez-Muniz et al., (2007)
	Managers regularly visit workplaces to check work conditions or communicate with workers about H&S	Findley et al., (2004); Toellner et. al., (2009)
	Managers encourage and arrange meetings with employees & other managers to discuss H&S matters	Findley et al., (2004); Fernandez-Muniz et al., (2007)
	Managers conduct toolbox talks themselves	Toellner (2009);
	Managers ensure that the H&S budget is adequate	Abudayyeh et al., (2004); Jaselskis et al., (1996)
	Managers recognize and reward outstanding H&S performance of workers	Teo et al., (2005)
H&S policy Shannon et al., (1997); Ng et al., (2005); Fernandez-Muniz et al., 2007)	Proper implementation of safety management system	Teo et al., (2005)
	Company has H&S policy	Ng et al., (2005); Teo et al., (2005)
	Written in-house H&S rules and regulations for all workers reflecting management concern for safety, principles of action and objectives of achievement	Teo, et al., (2006); Fernandez-Muniz et al., (2007)
	The firm coordinates its H&S policies with other human resource policies to ensure the well-being of workers	Fernandez-Muniz et al., (2007)

DISCUSSION

Table 1 indicates the results of the synthesized literature. The authors did not include drugs and alcohol testing as an element because Findley et al., (2004) found that small contractors do not undertake drug and alcohol testing despite being indicated as being essential by large contractors, a study conducted by Rajendran et al., (2009) indicated that this element was elective and not mandatory. Few of the indicators were not obtained from empirical research paper such as the material schedule data sheet.

In order to abate the high rise of poor performance of H&S, majority of studies have indicated that *upper management commitment* in H&S should be in place, according to (Levitt et al., 1976; Abudayyeh et al., 2004; Aksorn, et al., 2008). Various authors have also indicated the need to portray management commitment in an organization, they indicated that behavior and attitude has to be evident to influence employee H&S attitude and behavior. Upper management commitment is measured using eleven indicators, adapted from the scales developed by Abudayyeh et al., (2004), Fernandez-Muniz et al., (2007), Toellner (2001), Shannon et al., (1996), Trethewy (2003), Teo et al., (2005), Aksorn et al., (2008), Findley et al., (2004). The indicators are indicated in Table 1.

Upper management and *employee involvement* go hand in hand, according to Fernandez-Muniaz et al., (2007). In various projects as stated previously it’s about the people doing the work and these are the employees. Employee involvement and empowerment is an important element as per the literature review and for employees to reflect that they are empowered and involved are measured by seven indicators derived from the scales of OHSA, (1993), Fernandez-Muniz et al., (2007), Kheni et al., (2006), Sawacha et al., (1999), Rajendran et al., (2009). The indicators are tabulated in Table 1.

In order for SMEs to improve on H&S performance upper management and employees need to adhere to proper implementation of safety management system (SMS) elements, hence reflecting a better H&S culture. The literature review has identified the following essentials elements and there indicators;

Appointment of H&S staff has been indicated by Sawacha et al., (1999) and Vredenburgh, (2002) to be an important element to influence H&S performance. The need to employ quality H&S staff has been advocated (Findley et al., 2004). Three indicators measure this element, adapted from the scales developed by Findley et al., (2004), Ng. et al., (2005), Sawacha et al., (1999), Rajendran, et al., (2009).

Formal and informal written communication refers to the transfer of information to employees about the possible risks in the workplace and the correct way to combat them. This is done in writing. This element will be measured by four indicators i.e. provision of written information about H&S procedures, provision of written information about the correct way to perform tasks, written circular/brochure that informs workers about the risks associated with their work and written circular/brochure that inform workers about the preventive measures to reduce risk. The adapted scales references are indicated in Table 1.

Formal and informal verbal communication refers to the transfer of information to employees about the possible risks in the workplace and the correct way to combat them. This can either be formal or informal verbal communication. Four indicators measure this element they are; providing clear verbal instructions to both literate and illiterate employees about H&S, H&S information verbally communicated to workers before changes are made to the way their work activities are executed, organizing regular meetings to verbally inform workers about the risks associated with their work and organizing regular meetings to verbally inform workers about the preventive H&S measures of risky work. The adapted scales references are indicated in Table 1.

H&S resources are important in a project they enable the outcome of the project to be achieved. In this review Abudayyeh et al., (2006) and Rajendran et al., (2009) have indicated the importance of H&S resources. This element will be measured using eight indicators, the scales adapted from; Mitchell., (2000), Jannadi et al., (2002), Fang et al. (2004), Jaselskis et al., (1996), Aksorn, et al., (2008), Lin et al., (2001) and Trewthewy, (2003) These indicators are indicated in Table 1.

Project planning of H&S captures the existence of procedures to evaluate risks and establish necessary health and safety measures to avoid accidents and includes organized planning in case of emergencies (Fernandez-Muniaz et al., 2007). This element will be measured using nine indicators and the scale are adapted from studies of; Shikdar et al, (2003) Vredenburgh., (2002), Mitchell, (2000), Trewthewy, (2003), Teo et al., (2005), Coble et al., (2000), Sawacha et al., (1999), Fernandez-Muniaz et al., (2007) and Rajendran et al., (2009). These indicators are indicated in Table 1.

Project supervision is an internal concept H&S performance improvement, it captures the existence of mechanisms to verify the extent to which goals have been fulfilled, as well as compliance with internal norms or work procedures (Fernandez-Muniaz et al., 2007). It has also been advocated in the Construction Regulation (2003). This construct will be measured by the indicators adpted from, Fang et al., (2004), Mitchell, (2000), Jannadi et al., (2002), Jaselskis et al., (1996), Aksorn, et al., (2008), Lin et al., (2001) and Trewthewy, (2003). These indicators are indicated in Table 1.

Training in H&S is fundamental to any organization and especially in H&S as asserted by (Sawacha et al., 1999; Kheni et al., 2006; Fernandez-Muniz et al., 2007). Five indicators will measure this element as depicted from the scales of Trewthewy, (2003) and Fernandez-Muniz et al., (2007). These indicators are indicated in Table 1.

There is consistency in studies reviewed of the importance of *H&S policy*, according to Ng et al., (2005) and Fernandez-Muniz et al., (2007) they assert that employers should formulate safety policies this is also a requirement in the OS&H Act in South Africa. The indicators to measure policy are: Proper implementation of safety management system; company has H&S policy, written in-house H&S rules and regulations for all workers reflecting management concern for safety, principles of action and objectives of achievement and the firm coordinates its H&S policies with other human resource policies to ensure the well-being of workers

CONCLUSIONS

The identified elements and measuring indicators were *upper management commitment* with 11 measuring indicators, *worker/employee involvement* with seven measuring indicators, *appointment of H&S staff* with three measuring indicators, *formal and informal written communication*, with four measuring indicators, *formal and informal verbal communication*, with four measuring indicators, *project planning* of H&S, with nine measuring indicators, *H&S resources*, with eight measuring indicators, *H&S policy*, with four measuring indicators, *training in H&S*, with seven measuring indicators and *project supervision*, with seven measuring indicators. These elements and leading indicators can be formulated to be a framework for measuring health and safety culture or management.

There were problems in synthesizing the data such as the different sets of elements and indicators obtained had different terms but meant the same thing e.g. allocation of resources and H&S resources, the interpretation was purely on how the researchers understood the terms used. Further the range of industries included varied from study to study. The essence of this literature review was to help in populating relevant H&S elements and indicators to be formulated for Delphi questionnaire survey.

FUTURE STUDY

The main elements and the measuring performance improvement indicators identified is the first phase of a PhD study to develop a health and safety performance improvement model at project level of SMEs. The second phase is to use a three round Delphi method to validate the identified leading indicators.

REFERENCES

Abudayyeh, O., Fredericks K.T., Butt, E.S. and Shaar, A. (2006) "An Investigation of Management's Commitment to Construction Safety". International Journal of Project Management, 24,167-174.

Agumba, J.N., Adegoke, I.O., and Otieno, F.A.O. (2005) "Evaluating Project Management Techniques in Small and Medium Enterprises Delivering Infrastructure in South Africa Construction Industry". Proceedings of 3rd Postgraduate Conference 2005, Construction Industry Development, Eskom Convention Center, Midrand, Johannesburg, South Africa, 9th-11th October, pp. 52-65.

Aksorn, T. and Hadisukumo, B.H.W., (2008) "Critical success factors influencing safety performance program in Thai construction projects". Safety Science, 4, 707-727.

Azimah, N., Abdullah C., Spickett T.J., Rumchev, B.K. and Dhaliwal S.S. (2009) "Assessing Employees Perception on Health and Safety Management in Public Hospitals". International review of research papers, 5:3,54-72.

Bottani, E., Monica, L., and Vignali, G., (2009) "Safety management systems: performance differences between adopters and non-adopters". Safety Science, 47,155-162.

Cadieux, J., Roy, M. and Desmarais, L. (2006) "Preliminary Validation of a New Measure of Occupational Health and Safety". Journal of Safety Research, 37, 413-419.

Coble, R.J. and Haupt, T.C. (2000) Potential Contribution of Construction Foremen in Designing for Safety, Designing for Safety and Health Conference, CIB Working Commission W99 and European Construction Institute London.

Cooper, D. (1998) Improving Safety Culture: A Practical Guide, Published by John Wiley & Sons Ltd.

Construction Industry Development Board, (2004) SA Construction Industry Status Report, synthesis review on the South African construction industry and its development, discussion document, April, Pretoria, South Africa.

Construction Industry Development Board (2008) Construction Health and Safety in South Africa, Status and Recommendations.

Department of Labour, (2007) Minister of Labour Mdladlana speech of safety and health at work commemoration, Republic of South Africa.

Department of Public Works, (1999) White paper on "Creating an Enabling Environment for Reconstruction Growth and Development in the Construction Industry", Republic of South Africa. (http://www.info.gov.za/whitepaper/1999/environment.htm) last viewed on the 28/05/2010.

Dlungwana D.W. and Rwelamila P.D. (2003) "The role of performance assessment tools in improving contractor performance in developing countries" CSIR Boutek: Pretoria.

Fernandez-muniz, B., Montes-Peon M.J. and Vazquez-Ordas, J.C. (2007) "Safety culture: Analysis of the causal relationships between its key dimensions". Journal of Safety Research, 38, 627-641.

Findley, M., Smith, S., Tyler K., Petty G. and Enoch K. (2004) "Injury and cost control safety program elements in construction. Which ones best prevent injuries and control related workers' compensation costs?". Professional Safety 14-21.

Flin, R. Mearns, K., O'Connor, P. and Bryden, R. (2000) "Measuring health and safety climate: identifying the common features". Safety Science, 34, 177-192.

Health and Safety Executive (2007) Health and safety in the small to medium-sized enterprise, Psychological opportunities for intervention, Heriot Watt University.

Health and Safety Executive (2008) Successful health and safety, published by HSE books. Kew, Richmond, Surrey, TW9 4DU.

Kheni, A.N. Gibb, G.A. and Dainty, A. (2006) "Health and Safety Management Practices of Small and Medium Sized Construction Business". Proceedings of CIB W99 International Conference on Global Unity for Safety and Health in Construction pp91-101, 27th- 30th June, Bejing China.

Jannadai, A.O. and Bu-Khamsin, S.M. (2002) "Safety Factors Considered by Industrial Contractors in Saudi Arabia". Building and Environment, 37, 537-547.

Jaselskis, E.J., Anderson S.D. and Russell, J.S. (1996) "Strategies for Achieving Excellence in Construction Safety Performance". Journal of Construction Engineering and Management, 122:1, 61-70.

Levitt, R.E. and Parker, H.W. (1976) "Reducing construction accidents - top management's role". Journal of construction division ASCE, 102:3, 465-478.

Lin, J. and Mills, A. (2001) "Measuring the occupational health and safety performance of construction companies in Australia". Facilities, 19: ¾,131-138.

Lingard, H. and Rowlison S. (2005) Occupational Health and Safety in Construction Project Management, Spon Press 2 Park Square, Milton Park Abington, Oxon OX 14 4rn

Mearns K., Whitaker, M.S. and Flin, R. (2003) "Safety Climate, Safety Management Practice and Safety Performance in Offshore Environments". Safety Science, 41,641-680.

Mitchell, R., (2000) "Development of PPIs to monitor OHS performance in Australian construction industry", Journal Occupational Health and Safety Australia-NZ, 16: 4, 325-331.

National Small Business Act, (2004) Number 29 of 2004 Republic of South Africa. (http://www.seda.org.za/print.asp?subID=573) last viewed on the 18/04/2010.

National Occupational Health and Safety Policy (2003).

Ng, T.S., Cheng, P.K. and Skitmore, R.M. (2005) "A framework for evaluating the safety performance of construction contractors" Built and Environment, 40, 1347-1355.

Occupational Health and Safety Act, (1993) Republic of South Africa Government Gazette vol. 337, Cape Town July 1993.

Occupational Health and Safety Act, (1993) Draft amendment to the Construction Regulation 2003, www.polity.org.za accessed 13/09/2010.

O'Toole, M. (2002) "The relationship employees' perceptions of safety and organizational culture". Journal of Safety Research, 33, 231-243.

Rajendran, S. and Gambatese, A.J. (2009) Development and initial validation of sustainable construction safety and health rating system; Journal of Construction Engineering and Management, 135: 10, 1067-1075.

Sawacha, E., Naoum, S. and Fong, D. (1999) "Factors affecting safety performance on construction sites". International Journal of Project Management, 17:5,309-315.

Shannon, H.S., Mayr, J. and Haines, T. (1997) "Overview of the relationship between organizational and workplace factors and injury rates", Safety Science, 26:3, 201-217.

Shikdar, A., and Sawqed, M.N., (2003) "Worker productivity and occupational health and safety issues in selected industries". Computers and Industrial Engineering, 45: 4, 563-572.

Smallwood, J. and Haupt, T. (2005) "The need for construction health and safety (H&S) and the Construction Regulations: Engineers' perceptions". Journal of the South African Institution of Civil Engineering, 47: 2, 2-8 paper 581.

Smallwood, (2005) "Health and safety in housing". Proceeding of the XXXIII IAHS, World Congress in Housing, Transforming Housing Environments through Design September 27-30, Pretoria South Africa.

Teo A.L. and Fang, D.P. (2006) "Measurement of Health and Safety Climate in Construction Industry; Studies in Singapore and Hong Kong". Proceedings of CIB W99 International Conference on Global Unity for Safety and Health in Construction pp157-164, 27^{th-} 30th June, Bejing China.

Teo, A. L. E., Ling Y.Y.F. and Chong W.F.A. (2005) "Framework for project managers to manage construction safety". International Journal of Project Management, 23, 329-341.

Toellner, J. (2001) "Improving safety and health performance: Identifying and measuring leading indicators". Professional Safety, 46: 9, 42-47.

Trethewy, W.R. (2001) Improved OHS management of contractors in the construction industry, Sydney, School of Safety Science University of New South Wales.

Trethewy, W.R. (2003) "OHS performance improved indicators for construction contractors". Journal of Construction Research, 4: 1, 17-27.

Vickers, I., Baldock, R., Smallbone, D., Philips, J., and Ekanem, I. (2003) "Cultural influences on health and safety attitudes and behavior in small businesses". (Contract Research Report No. 150): HSE.

Vredenburgh G.H. (2002) "Organizational Safety: Which Management Practices are most effective in Reducing Employee Injury Rates?" Journal of Safety Research, 33, 259-276.

IMPACT OF IMPROPER SOLID WASTE DISPOSAL ON URBAN HOUSING IN AKURE, NIGERIA

Alexander A. Fakere[1] and Olaniyi O. Aluko[2]
Department of Architecture, Federal University of Technology, Akure, Nigeria

Solid wastes are solid or semisolid materials resulting from human and animal activities that are useless, unwanted, or hazardous. Poor consciousness of the inhabitants on the environment and inadequate information on hazards that can result from wastes has also contributed to disease breakouts and deterioration of the built environment. This paper seeks to assess the significance of the dangers posed by indiscriminate disposal of solid waste on the built environment by examining its impacts on the inhabitants of the building structures with particular reference to selected neighbourhoods in Akure, Ondo State, Nigeria. The study summarizes and interprets findings from empirical survey of some residential buildings randomly selected within the study area through the use of questionnaire, direct observations, housing demographic and facility survey to elicit relevant data relating to social, economic and environmental variables. Data obtained were collated and presented in the single factor descriptive analysis while health records were obtained from the few available health institutions. Findings show that health of individuals cannot be considered in isolation without considering the building and the environment in which they live. The paper recommends public enlightenment, environmental and health education, enforcement of environmental and waste disposal protection laws and re-introduction of old sanitary inspectors with corresponding policy statements.

Keywords: building structure, solid waste, urban housing.

INTRODUCTION

Waste is concomitant with virtually all human activities. Encarta Dictionary, 2008 describes it as remains, byproducts, unwanted or unusable materials or household garbage. Huang, (2008) described solid wastes as solid or semisolid materials resulting from human and animal activities that are useless, unwanted, or hazardous. Ogedengbe and Oyedele (2006) defined waste as any unwanted materials intentionally thrown away for disposal. Waste is inseparable from life because as long as man is alive, he stores, uses and disposes off materials and the complexities of waste which modern civilization produce is directly related to the living standards, socio-economic and cultural attributes of that particular environment. (Hoornweg, 1999). Hoornweg, (1999) also asserted the following:

i. Solid waste streams should be characterized by their sources, type of waste produced as well as generation rate and composition.
ii. Waste can be classified in terms of state; solid, liquid, or gaseous states.

[1]favoured517@yahoo.com
[2]allan2k5@yahoo.com

Fakere, A.A. and Aluko, O.O. (2011) Impact of improper solid waste disposal on urban housing in Akure, Nigeria *In:* Laryea, S., Leiringer, R. and Hughes, W. (Eds) *Procs West Africa Built Environment Research (WABER) Conference,* 19-21 July 2011, Accra, Ghana, 607-616.

iii. There are eight major classifications of solid waste generation; residential, industrial, commercial, institutional, constructional and demolition, municipal services, process and agriculture.

As countries become richer and more urbanized, their waste composition changes (Freeman III, 1979 and Lietman, 1995). A study carried out by Ogedengbe and Oyedele, (2006) showed that the rate of change in municipal solid waste quantities and composition in developing and developed countries is unprecedented. It further opined that generally the greater the economic prosperity and the higher percentage of urban population, the greater the amount of solid waste generated and as lifestyles rapidly change, the related conveniences and products-mobile phones, electronics, polyvinyl chloride plastics (PVC plastics), disposable diapers pose special waste disposal challenges. Even more problematic is the fact that in most low and middle income countries, development of waste management systems woefully lags behind the realities of a quickly changing waste streams. In addition, it observed that newly mobilized consumers and their market-survey suppliers rarely consider the potential waste management problems that go hand in hand with changing lifestyles.

Waste management in any city is of paramount importance due to the risk posed to human beings and to the environment. Encarta Dictionary, 2008 describes it as the activities that deal with waste before and after it is produced, including its minimization, transfer, storage, separation, recovery, recycling, and final disposal. Knowledge of the sources of waste and type in an area is required in order to design and operate appropriate solid waste management systems (Gumbo 1996, Famuyigbo 1998). Waste management is a labour and capital-intensive function that often consumes 20 to 50 percent of municipal operating budget (Oyinlola, 1998 and Thomas, 2000).

Residential waste, which is the major type of waste concerned in this paper, has a direct bearing on housing standard of an urban area. It is different from other types of waste because it is directly related to households. The contents of household wastes are majorly food materials. Others are papers, broken furniture, plastic materials, disposable diapers, worn-out fabrics, etc. Most household wastes are biodegradable, hence attract organisms, insects and rodents that can transmit diseases to humans and this spreads very fast when in close proximity to residences. (Ogedengbe and Oyedele, 2006). When residents dump wastes behind their houses, as is the case with some residents in the study area, the organisms concomitant with such refuse can act as agent of degradation. This will make the residential environment to be of poor quality, hence, the buildings will require renovation or maintenance more frequently. The quality of man's environment is an integral contributor to the overall quality of families and individuals quality of life (Adedeji, 2005). It is expected that when the environmental sanitation standards of a city improves, there will be an upliftment in the living condition and health security for the inhabitants as well as improvement in the quality and aesthetics of the environment at large. Although trends of solid waste have been examined, much has not been done in the area of housing quality. This paper therefore attempts to examine the effects of waste disposal on the housing and health condition of urban dwellers in Nigeria with a particular reference to the study area.

PREVIOUS STUDIES ON URBAN HOUSING QUALITY AND WASTE MANAGEMENT

Domeniq (1995) studied the trend of waste in Austria and laws guiding the management of waste. He examined the Austrian Federal Environmental Agency and elaborated on the generation of waste, treatment and the utilization of such wastes generated and the goals, which could be achieved in years to come. Oreyomi (1998) maintained that improper disposal of solid waste poses serious danger to the handlers and the people living around the wastes as disposal sites carry along rodents, insects and other vermin, which could transmit diseases such as typhoid fever, dysentery, diarrhea, cholera, yaws, onchocerciasis, salmonellas, and other diseases. Also Hoornweg (1999), examined the trend of waste produced in Asia and used his study to make a forecast of waste that would probably be produced in the year 2025. He emphasized that waste is inseparable from life because as long as man is alive, he stores up, uses, and disposes off materials and the complexity of waste which modern civilization produced is directly related to the living standard, socio-economic and cultural attributes of that particular environment. In pursuit of expansion, multinational corporations with global marketing programs, no doubt have changed and increased the overall waste stream.

According to Akinola and Salami (2001), waste disposal is one of the important aspects of urban management crises in Nigeria. The study noticed that management of solid waste generated within the urban centers has become one of the most intractable problems of development. In the last two decades, there has been a phenomenal increase in the volume and range of waste generated in many developing countries of the world, Nigeria inclusive. The rapidly growing metropolis in developing countries has been identified as one of the major factors responsible for solid waste problems. For quite some time, the management of solid waste has been the responsibility of public authorities, which has not produced, expected results. The central problem of such public agencies is that their basic approach is not managerial and business-like but administrative and bureaucratic; this explains the need to adopt the privatization approach to solid waste management. Akinola and Salami (2001) are of the view that private sector participation in waste management would be more effective in waste management and that the local government should review its strategy by withdrawal of poor operators from the services, set monitoring team, get rid of cart pushers and make trucks and other equipment available to the operators at subsidized rate.

Akaninyere and Atser (2001) examined the typology, characteristics and future trends of solid waste and asserted that the major components of waste are degradable materials (food remnants, paper, and rags) and non-biodegradable plastics, tins, metals, bottles, glass, and bones. Food remnants contributes substantially more than other components, this could be explained by the fact that most activities which affect the environment stem from the need for food; its production, processing and preparation. Moreover, the high proportion of food remnants could be viewed from the fact that this component of waste embraces all forms of food waste from both domestic and commercial sources.

Ogedengbe and Oyedele (2006) studied the effects of waste management on property values in Ibadan and found a relationship between the closeness of dump sites and the value of rental properties in the area. The study discovered that the rental values placed on such properties were reduced as a result of the presence waste dumps. It then became palpable that most of the landlords lived in other parts of the town and rented out their apartments in the area.

A study carried out by Olotuah, (2006) in Oba-Ile, Nigeria shows that frequency of collection refuse is a predictor variable for housing quality. The study also discovered that the quality of housing in the study area would improve significantly with an increase in the collection of refuse.

URBAN HOUSING QUALITY

Housing quality is a matter of great concern, especially in less developed countries. The magnitude of the housing needs of the populace in these countries rises phenomenally by the day. This is on account of rapid growth and urbanization occurring there, and the lack of a commensurate increase in housing stock (Lewin, 1981). Housing quality is often evaluated in terms of the quality of design, building materials, standard of construction, and the provision and performance of public amenities. A study carried out by Olotuah (2006) affirmed that 75% of the dwelling units in urban centres in Nigeria are substandard and the dwellings are sited in slums. The inadequacy of the quality of most urban housing stems mainly from the poor physical state of the buildings. They are often unsafe and insecure and do not provide adequate shelter from the element of weather. The environment in which the buildings are located is squalid in most cases, and this generally leads to slum conditions.

When waste disposal sites are in close proximity to residential structures, such environment is adversely affected as organisms that thrive in such dirty places are also agents of disease outbreak. Therefore, the aim of shelter as a place where people live and play in a hygienic manner is defeated when the stench from the nearby dump sites is a constant occurrence. In addition, these dump sites can contaminate ground water which in turn affects the purity of the water fetched from wells, hence, if residents of a city are devoid of access to portable water, it will take its turn on their health.

RESEARCH METHOD

The research design follows a multistage description framework covering survey, analysis and interpretation. Primary data for the research were obtained in a field survey conducted in the study areas of Oke Aro and Isolo both in Akure, Nigeria. The research instrument used is a well structured questionnaire to elicit required information relating to socioeconomic and environmental conditions of the households as well as the characteristics of the dwellings in which the people live. A sampling frame of 1041 was considered and a sample size of 300 cases representing 30% spread over the study area through random sampling in order to ensure that it was fully representative of the population of the audience of the study. Secondary data include; records obtained from available health institutions within the area, analogue base maps of the study area, population data, household data and direct observation of the buildings and the environment. The neighbourhoods were sampled through the base maps by the use of stratified sampling method. The analysis focused on the physical conditions as well as the general environmental conditions of the dwelling units.

RESEARCH FINDINGS

Analysis of data in table 1 below shows the home ownership status of the respondents in both areas. It reveals that an average of 69% of the respondents rented the apartments they live while 30.5% of them are landlords in Isolo and Oke Aro respectively.

Table 1: Respondents home ownership type

Item	Isolo Area (%)	Oke Aro Area (%)	Average (%)
Owner occupier Rented apartment	44.0 56.0	17.0 83.0	30.5 69.5
Total	100%	100%	100%

Source: Field Survey, 2011

The analysis of the average monthly income of household heads in table 2 shows that 14.39% of the household heads earn below ₦7, 500.00 monthly, 58.16% earn between ₦7, 500.00 and ₦25, 000.00, 13.34% earn between ₦25, 000.00 and ₦40, 000.00 while 9.55% earn ₦40, 000.00 monthly and above. Also the analysis of average monthly income of the household heads reveals that more than 50% of the people earn less than N25, 000per month. This is in fact a testimony that the low-income group and the less privileged in the society occupy the two communities.

Table 2: percentage of average monthly income of head of households

Income level	ISOLO (%)	Oke Aro Area (%)	Average (%)
Below N7, 500	18.0	14.5	16.25
N7, 500-N25, 000	56.0	58.5	57.25
N25, 000-N40, 000	14.0	12.5	13.25
N40, 000- above	12.0	14.5	13.25
Total	100%	100%	100

Source: Field Survey 2011

Analysis in table 3 shows the proximity of the dump sites to the residences. An average of 58% of the respondents in Isolo and Oke Aro areas respectively responded that the dumps sites in the area are within 50 meters from their residences, yet, majority of them dump their refuse in the surrounding of their buildings. This reveals the level of their ignorance on the dangers posed by improper disposal of wastes.

Table 3: Distance of residences to dump sites

	Isolo Area (%)	Oke Aro Area (%)	Average (%)
Below 50m 51m – 100m Above 100m	56.0 33.0 11.0	61.0 22.0 17.0	58.5 27.5 14.0
Total	100	100	100

Source: Field Survey, 2011

The analysis of the state of buildings in table 4 shows that 12.4% is in sound state, 20.2% requires minor repairs while 67.4% needs major repairs. Findings show that most of the buildings in the two neighborhoods are in very poor state as only about 12.4% of them are in sound condition. A greater proportion of the buildings require minor or major repairs to bring them to good quality. The state of repairs of the buildings takes into consideration the soundness of the roofs, walls, floors and foundations. The soundness of wall and floor means there is absence of cracks, surface wear, tearing or peeling off of surface plaster and paints. Socio-economic characteristics of the inhabitants of the buildings such as household size, income classification significantly contribute to the poor state of repair of the buildings.

The state of refuse disposal as revealed in table 5 is generally absurd which emanates from the laissez-faire approach of the people towards indiscriminate dumping of refuse and delay in evacuation by the waste management authority. Refuse dumps littered the environment which were an eyesore. 68.5% dispose their refuse indiscriminately out of which 41.2% dump theirs in open spaces. Such constitute breeding grounds for rodents, flies, mosquitoes, snake and harbour for other dangerous animals as well as hindering the free flow of run-off.

Table 4: State of buildings in the two neighbourhoods

State	Isolo (%)	Oke Aro Area (%)	Average (%)
Sound	13.6	11.2	12.4
Require minor repair	21.9	18.5	20.2
Require major repairs	64.5	70.3	67.4
Total	100%	100%	100%

Source: Field Survey 2011

11.7% burnt theirs within the residential environment thereby causing air pollution, while 19.8% dispose theirs in controlled tipping. However, interview conducted with the waste management board revealed that they do not visit some of those streets due to bad roads that hinder access to such streets and the insufficient number of waste disposal vehicles.

Table 5: Methods of Refuse Disposal

	Isolo Area (%)	Oke Aro Area (%)	Average (%)
Free Range – Road side / Drainages	26.7	27.9	27.3
Open Spaces	43.2	39.2	41.2
Controlled Tipping	20.5	19.1	19.8
Incinerating / Burning	11.5	11.9	11.7
Total	100	100	100

Source: Field Survey, 2011

Table 6 shows the underlying reasons for improper refuse disposal in the study area. Majority of the respondents dumped their waste as a result of closeness of dump site to their residences. This shows that they are ignorant of environmental and health impacts of such actions. An average of 19% responded that they do so because the waste management authority does not visit their streets to collect their refuse.

Table 6: Reasons for dumping refuse indiscriminately

	Isolo Area (%)	Oke Aro Area (%)	Average (%)
Proximity to residence	45.0	48.0	46.5
No affordable alternative	20.0	21.0	20.5
No response	15.0	13.0	14.0
The waste management authority does not come to my street	20.0	18.0	19.0
Total	100	100	100

Source: Field Survey, 2011

Table 7 shows the main sources of water supply in the area. An average of 83% sourced their water from hand-dug well, most of which are located in unkempt environment without covers and rings, while an average of 17% get theirs through the boreholes sunk within the area. This prevailing situation does not guarantee quality water supply in the area as the water sources are not treated before use; hence, the people stand a greater risk of contacting serious water borne diseases.

In table 8, it is observed that an average of 58.5% of the respondents maintained that dump sites are within 50 meters from their wells/boreholes, while an average of 27.5% in responded that the dump sites are between 51 meters to 100 meters from the wells/boreholes. This shows that the ground water is at a risk of being polluted, hence, the risk of being infected by water borne diseases.

Table 7: Sources of water supply

	Isolo Area (%)	Oke Aro Area (%)	Average (%)
Well	78.0	88.0	83.0
Borehole	22.0	12.0	17.0
Public mains	Nil	Nil	Nil
Total	100	100	100

Source: Field Survey, 2011

Table 8: Proximity of wells/boreholes to dump sites

	Isolo Area (%)	Oke Aro Area (%)	Average (%)
Below 50m	56.0	61.0	58.5
51m – 100m	33.0	22.0	27.5
Above 100m	11.0	17.0	14.0
Total	100	100	100

Source: Field Survey, 2011

HEALTH HAZARDS AND THEIR CAUSATIVE FACTORS

The most prevalent disease and the ecological problem identified in the area, as shown in Figure 1 is malaria fever, accounting for 29.6%. Others in their order of magnitudes include typhoid fever, measles, diarrhoea, cholera, dysentery and some communicable diseases prevalent in the tropics. Their identified causative factors include inadequate sanitary services (57.4%), poor water supply (14.8%), unkempt environment (14.8%), overcrowding (12.2%) and poor drainage system (0.9%). Other health issue investigated involved the availability of health institution within the neighbourhood. About 73.9% indicated non-availability of any within their reach. They are either located farther away from their dwellings or completely absent. Only 26.1% are sure of having at least a chemist store or a mini health clinic within their neighbourhood, thus, low level health care and environmental education.

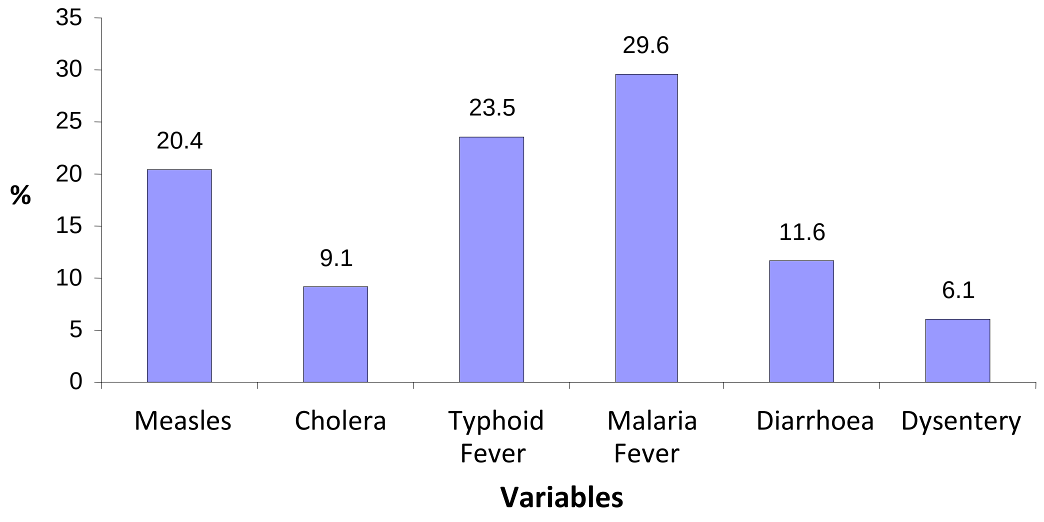


Fig. 1: Environmental Related Problems and Diseases in the study area.

Source: Field Survey, 2011

RECOMMENDATIONS AND POLICY GUIDELINES

Based on the major findings in this research, it has become imperative to put up some recommendations that are necessary to improve the environmental and health conditions of the people. The first thing that needs urgent attention is in the area of public enlightenment and environmental and health education. Residents of these areas should be educated on the effect of improper dumping of refuse. Without grassroots environmental education and enlightenment, enforcement of environmental sanitation and waste disposal laws has a very little prospect of success. There is therefore a need to educate the people about the danger of living in disheveled environment, particularly in the study area. This appears to be a possible solution as a preventive measure against the prevailing environmental hazards in the country, as education promotes health. Also, the existing laws and regulations guiding environmental sanitation and health should be reviewed and enforced with stiffer actions in order to make them more effective. Meanwhile, the reintroduction of the old sanitary inspectors, locally called 'wole-wole' would be of help to sustain this idea. Also, more attention should be given to waste disposal management through adequate funding. Likewise, poverty has been identified as the major underlying cause of poor environmental and good health because the poor are incapable of paying for the required amenities for healthy living. As a result, the ongoing national policy on sustainable minimum wage should be extended to all and sundry. Governments should be alive to their responsibilities of making basic amenities that would enable families and individuals have access and maintain good healthy environment.

Plate 1: A water body polluted with waste in the study area
Source: Field Survey, 2011

Plate2: One of the wells not suitable for drinking as a result of waste pollution
Source: Field Survey, 2011

Plate 3: One of the open dump sites in the study area
Source: Field Survey, 2011

Plate 4: Refuse dumped inside drainage channels which hinders free flow of run-off
Source: Field Survey, 2011

REFERENCES

Adedeji, Y. M.D. (2005). Outdoor Space Planning and Landscape Qualities of Religious Centre in Akure, Nigeria. Inter-World Journal of Science and Technology, R. Durson Associates, Owerri, 2 (1): 40-51

Akaninyere.M. & Atser. J. (2001). Solid Waste Characterization and Management Issues In Uyo Municipalities, Nigeria. Libro-Gem, Lagos, Nigeria.

Akinola. S. & Salami. R. (2001). An Assessment Of The effectiveness of Private Sector Participation Initiatives In Solid Waste Management in Mushin Local Government Area, Lagos State. Nigerian Journal of Social And Educational Research. A Publication of the Nigerian Association of Social and Educational Research, University of Ado-Ekiti.

Domeniq. M. (1995) Non-Hazardous Waste- Part A: Domestic Waste. Compiled for the Austrian Federal Waste Management Plan.

Encarta, 2008. Microsoft Encarta Dictionary. Redmond, WA, United State of America

Famuyigbo. M. F. (1998). Solid Waste Management In Perspective and Policy Overview. Paper presented at the National Seminar, society of Health Nigeria, Kaduna. May 28-31 1998.

Freeman III, A.M. (1979). The Benefits Of Environment Improvement. Baltimore: Resources for the Future. John Hopkins Press.

Gumbo. B. (1996). Aspects of Solid Waste Management. Workshop on Water And Environmental Management organized by the Department of Civil Engineering, University of Zimbabwe.

Hoornweg D. (1999). What a waste: Solid Waste Management in Asia. The International Bank for Reconstruction and Development for The World Bank.
Huang, J. Y. C. (2008). Solid Waste Disposal. Microsoft Encarta, 2009 (DVD). Redmond, WA. Microsoft Corporation.
Lewin, A. (1981) Housing Co-Operatives in Developing Countries. International Technology Publication Ltd.
Lietman. J. (1995). Urban Environmental Issues. The Agricultural and Forestry Systems Division (AGRAF) The World Bank.
Ogedengbe, P. S & Oyedele, J. B. (2006). Effect of waste management on Property values in Ibadan, Nigeria. Journal of land use and development studies, Vol 2, No 1.
Olotuah, A. O. (2006). Housing quality in suburban areas: An empirical study of Oba–Ile, Nigeria. Dimensi Teknik Arsitektur Vol. 34, no. 2. 133-137
Oreyomi. M.K. (1998). Selective Topic On Environmental Health Technology. Term paper presented to the Department of Environmental Health And Epidemiology UNIFE. Unpublished.
Oyinlola. A. K. (1998). Waste reuse and Recycling. A paper presented at the Petroleum (Special) Trust Fund Stakeholders Technical workshop, Abuja.
Thomas. L. (2000). Brief History of Solid Waste Management. Written for The California Department of Health Services.

INDUSTRIAL TRAINING IN GHANA: PERCEPTIONS OF THE UNDERGRADUATE CONSTRUCTION STUDENT

J. Ayarkwa[1], E. Adinyira[2] and K. Agyekum[3]

College of Architecture and Planning, Kwame Nkrumah University of Science and Technology Kumasi, Ghana

The recent oil discovery and processing in Ghana is expected to result in growth of infrastructural development and increased chances of construction graduates to secure jobs. Universities hold the responsibility of producing graduates with sufficient background and excellent qualification to meet the expectations of the construction industry. Although universities' curricula have provisions for industrial training (IT), such programmes have not made the expected impact and need quick redress. This paper assesses the perceptions of undergraduate construction students of the College of Architecture and Planning of the Kwame Nkrumah University of Science and Technology (KNUST), Kumasi, Ghana, on IT, and identifies challenges and possible measures to overcome such challenges. A structured questionnaire survey of 185 final year Building Technology and Architecture students was conducted. Data obtained were analyzed based on mean scores of factors evaluated and also t-test to assess the significance of the differences between students' performance before and after undertaking IT. Students are of the view that IT exposes them to real work environment and increase their job prospects among others. Students' satisfaction level with their performance on personal attitude, communication and work attitude significantly improved after undergoing IT. They are, however, not satisfied with their departments' involvement, particularly, with regards to placement and monitoring. Stressful placement processes and financial strain on students are some of the challenges identified. Educational institutions are to collaborate with industry to secure suitable placement for all students and to monitor IT activities in order to enhance the effectiveness of training programmes.

Keywords: construction undergraduate, Ghana, industrial training.

INTRODUCTION

Rapid growth of infrastructural development in Ghana recently has increased job opportunities for many construction graduates. Until recently construction students have readily been accepted into the Ghanaian construction industry, however, with the increasing number of graduates produced every year, the industry now has to choose graduates with sufficient background and excellent qualification. The universities hold the responsibility of producing graduates who meet the expectation of the construction industry. As an assurance that the performance of construction students is up to the required standards, preparation and exposure of students to industrial training (IT) is necessary in any professional education training programme (Osman et

[1] ayarkwajosh@yahoo.com
[2] rasadii@yahoo.com
[3] agyekum.kofi@yahoo.com

Ayarkwa, J., Adinyira, E. and Agyekum, K. (2011) Industrial training in Ghana: perceptions of the undergraduate construction student *In:* Laryea, S., Leiringer, R. and Hughes, W. (Eds) *Procs West Africa Built Environment Research (WABER) Conference*, 19-21 July 2011, Accra, Ghana, 617-627.

al., 2008). IT is one of the essential curriculum requirements of any technical institution (Bansal et al., 2010; Pillai and Yusoff, 2007). According to Nambudiripad (2003), students graduating from universities are like uncut diamonds and look useless like trifles, but when given proper training they dazzle forth in all their glory.

Bansal et al. (2010) assert that although Universities' curricula have provision for IT and various training schemes are in force, especially for professional courses, some IT programmes have not made the considerable impact expected and need quick redress. It has become a competitive endeavour for students, and placement is akin to job placements, making it stressful to students (Bansal et al., 2010; Pillai and Yusoff, 2007). If students are to meet the skills requirements of an ever-changing labour market, adequate resources need to be invested in appropriate forms of work experience and in building up transferable skills (Mihail, 2006).

To confirm the importance of IT in Ghana, Duodo (2006) noted that, there have been on-going discussions with Ghana Employers Association and Association of Ghana Industries to formalize industrial training programmes. The Students Work Experience program prepares students for the labour market. It has become an innovative phenomenon in human resource development and training in Ghana. IT is, thus, an important strategy to expose students to real work life situation and to equip them with the necessary skills so that they would be job ready when they graduate.

Although IT plays an important role in preparing qualified future professional manpower, little research has been done to address issues which seek to improve the effectiveness of IT programmes, especially, for construction students in Ghana. This study therefore assesses the perceptions of undergraduate students from the Department of Building Technology and the Department of Architecture of the Kwame Nkrumah University of Science and Technology (KNUST) on IT programmes. It also identifies challenges to IT and possible measures to enhance its effectiveness.

THE VALUE AND OBJECTIVES OF INDUSTRIAL TRAINING

The value and objectives of IT are well documented in past research (Rahman et al., 2009; Osman et al., 2008; Connor and Shaw, 2008; Pillai and Yusoff, 2007; Mihail, 2006; Teoh, 2006; Wasonga and Murphy, 2006; Callanan and Benzing, 2004; Fallows and Steven, 2000). Rahman et al. (2009) and Osman et al. (2008) urged graduates to prepare themselves and improve their personal attitude, work attitude, communication, leadership and other soft skills before they graduate. Fallows and Steven (2000) stated that employers need graduates to contribute immediately on starting work, and graduates need to develop their skills in short time towards the competence level set by the employer. IT is reported to improve job opportunities for students since it allows them to refine their job skills and work values, focus on their career choices, directly access job sources, and impress potential employers (Mihail, 2006; Callanan and Benzing, 2004). It is a positive developmental experience for university students to improve their ability to secure career-oriented positions (Callanan and Benzing, 2004), leadership skills (Wasonga and Murphy, 2006), specialist knowledge, information technology, time management, and teamwork (Mihail, 2006). IT also helps to develop the student's communication skills that include daily interaction within the working environment and technical writing (Connor and Shaw, 2008; Mihail, 2006). Work experience is reported by Garavan and Murphy (2001) to provide credible means for softening the reality shock of transitioning from the world of academics to the world of work.

The objectives of IT are to expose the students to construction practice specific to their field of specialization, to the nature of the industry selected, and to expose the students to their responsibilities in the construction profession (Rahman et al., 2009). It provides opportunities for undergraduates to apply what they have learnt at the university, provides on-the-job training and real-life job experience, making them more employment ready (Rahman et al., 2009; Pillai and Yusoff, 2007). IT also makes students more aware of the needs and expectations of the industry and shape graduates who are "energetic and action-oriented" (Rahman et al., 2009; Pillai and Yusoff, 2007).

THE ROLE OF UNIVERSITIES IN INDUSTRIAL TRAINING

IT is an extremely valuable component of university education, especially for professional courses (Bansal et al., 2010; Pillai and Yusoff, 2007). Academic institutions organize and promote the placement of students in private enterprises and other organizations to foster work experience so that students will attain the necessary skills to supplement their theoretical training (Mihail, 2006). While students are still in the university, IT helps them develop a core of global market skills such as communication and time management skills, better self-confidence and better self-motivation, that are now considered requirements (Gill and Lashine, 2003). Students undertaking IT are supervised by their university lecturers as well as industry supervisors, and students have to prepare and submit written reports on their IT experience (Pillai and Yusoff, 2007). Connor and Shaw (2008) emphasized the need for higher educational institutions to continue to strengthen its links with industry and commerce, not only to give graduates the skills which employers value but also to make sure that students are aware of what is happening in the labour market and what employers are seeking.

In analyzing the role of the university in IT, Mihail (2006) stated that modern knowledge economy requires a leap in graduates' skills, and educational institutions are expected to implement innovative reforms to provide their students with skills needed by "high performance" firms. The importance of making the most of communication opportunities between training institutions and employers cannot be underestimated. The flow of supply and demand information between training institutions and employers and the integration of that information into training programs are at the crux of providing strong support to a country's industrial workforce needs (Chileshie and Haupt, 2006). Currently, there are growing concerns about the perceived mismatch between industry needs and demand and skills of the graduates produced by higher education institutions (Haupt, 2003). Haupt (2003) states that there is a gap between what employers appear to want and what higher education provides.

RESEARCH METHOD

The study involved a comprehensive review of published works and electronic presentations on IT and a questionnaire survey of undergraduate construction student. The survey instrument employed was structured questionnaire that avoided interviewer bias, guiding and cues that could impact the validity and reliability of the data collection (Roberts, 2007). The questionnaire was administered to all 185 final year Bachelor of Science Building Technology and Architecture students of the KNUST. The study assumed that final year students had undertaken industrial training at least once and would have a higher level of experience with industrial training and could provide objective and accurate industrial training perspectives.

Closed questions were mainly used in the survey since it is considered likely to reduce bias in the question and answer processes (Roberts, 2007). However, open-ended questions were used where respondents were asked to suggest areas of improvement and possible solutions to challenges to IT. The questionnaire comprised of three main sections as follows.

Section one focused primarily on

- the profile of the respondents;
- their experience with IT;
- reasons for not undertaking IT; and
- issues on placement for IT.

Section two assessed

- factors motivating students to undertake IT;
- students' perceptions on benefits of IT;
- students' perceptions on performance before, during and after IT; and
- IT monitoring system.

Section three focused on

- challenges of IT and measures to overcome such challenges.

For evaluation of factors motivating students to undertake IT, respondents were asked to score the factors on a Likert scale of 1 to 5, where score '1' = strongly disagree, score '2' = disagree, score '3' = neutral, score '4' = agree, and score '5' = strongly agree. For evaluation of respondents' perception before, during and after undergoing IT, they were asked to score their satisfaction levels on the Likert scale of 1 to 5, where score '1' = most unsatisfactory, score '2' = unsatisfactory, score '3' = neutral, score '4' = satisfactory, and score '5' = most satisfactory. From the various scores it was possible to rank the factors according to their mean scores. The one sample t-test was used to determine whether students' satisfaction with their performance on each attribute in three categories (personal attitude, communication and work attitude) increased after IT. To maximize the response rate, face-to-face questioning approach was used to administer the questionnaire. Out of the total of 185 questionnaires administered to all final year students of the Departments of Building Technology and Architecture, 125 were retrieved and used in the analysis, giving a response rate of 68%, considered sufficient for the study (Moser and Kalton, 1993).

RESULTS AND DISCUSSION

Respondent's Profile

Sixty-five percent (65%) of the respondents to the survey are from the Department of Building Technology and 35% are from the Department of Architecture (Fig. 1). About 85% of the respondents have undertaken industrial training at least once and about 15% have not at all undertaken industrial training (Fig. 2). The most common reasons for not undertaking industrial training include, 'industrial training is not compulsory', 'no remuneration' and 'application for placement is stressful'.

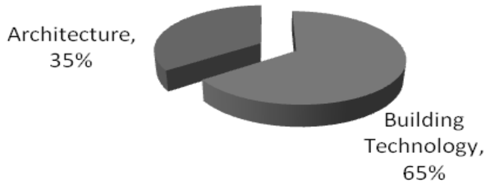


Fig. 1 Percentage of respondents by Department

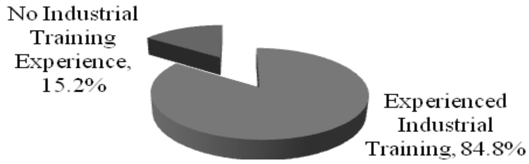


Fig. 2 Percentage by Experience on industrial training

Placement for industrial training

Figure 3 shows that about 91% of the respondents have worked as trainees either in a consultancy or in a construction organization or both. These organizations are directly in the respondents' chosen fields of specialization. However, 4% of the respondents had worked in either the environmental agency or the banking sector, and 3% and 1% of the respondents had worked in the transportation and energy sectors respectively.

Figure 4 shows the method by which respondents received their placement for training in the industry. Forty-two percent (42%) of respondents received placement through their relatives and 38% through their friends. Fourteen percent (14%) of the respondents, however, received placement through their own efforts and only 5% received placement through their respective teaching departments. This result suggests very little involvement of the teaching departments in the placement of prospective trainees.

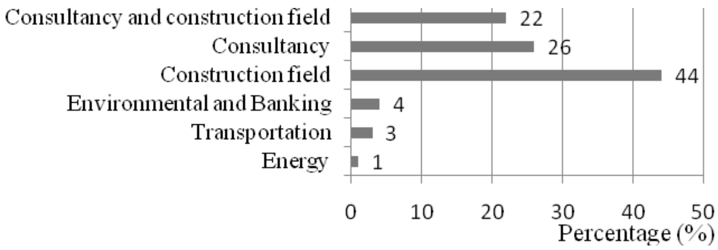


Fig. 3 Percentage by type of industry

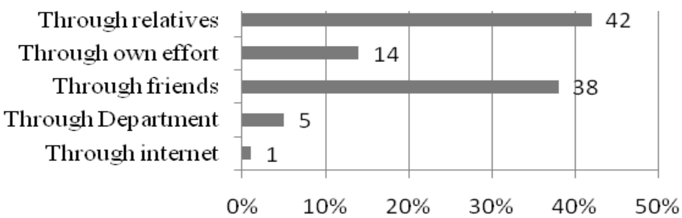


Fig. 4 Percentage by placement methods

Figure 5 shows that the major contribution of the teaching departments has been the area of issuance of introductory letters to prospective trainees (94%). Issuance of introductory letters only does not contribute much to students' chances of obtaining placement for their IT. This is corroborated by the fact that 60% of the respondents indicate their dissatisfaction with the current placement method (Fig. 6).

Mihail (2006) stated that academic institutions should actively organize and promote the placement of students in private enterprises and other organizations to foster work experience so that students will attain the necessary skills to supplement their theoretical training. Gill and Lashine (2003) also emphasized that while students are still in the university, it should be the responsibility of the university to organize IT since it can help students develop a core of global market skills such as communication, time management, better self-confidence, and better self-motivation that are now considered requirements for employment.

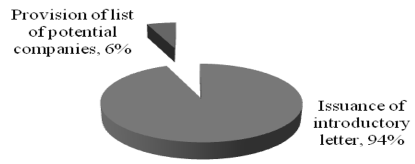


Fig. 5 Percentage contribuiton of Departments to students' placement

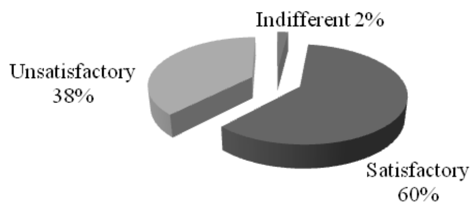


Fig. 6 Students' perceptions on the current method of placement

Motivation factors for industrial training

Factors that motivate respondents to undertake IT include 'exposure to real working environment' and 'increase job prospects' (Table 1). Mean scores of all the motivating factors evaluated except 'meeting requirements of the Department' are significantly greater than the neutral score of 3.00 ($p=0.05$) when the t-test was applied. Thus, the respondents agree that 'exposure to real work environment' and 'increase in job prospects' are the first and second major factors motivating them to undertake IT. Other motivating factors include 'provision of knowledge and guidance in choosing job after graduation', 'confidence in terms of job qualification', and 'improvement of communication skills'. The respondents, however, disagree that 'meeting the requirements of the department' is a motivating factor to undertake IT, suggesting that IT is not enforced by any of the two departments studied. Rahman et al. (2009) emphasize the importance of IT to professional education by stating that it is now a compulsory course for every student in the Civil and Structural Engineering Department in the Universiti Kebangsaan Malaysia (UKM). Bansal et al. (2010) and Pillai and Yusoff (2007) stressing the importance of IT to construction education, assert that universities' curricula have provision for IT, especially for professional programmes. To confirm the importance of IT in Ghana, Duodo (2006) noted that there have been on-going discussions with Ghana Employers Association and Association of Ghana Industries to formalize IT programmes.

Table 1 Factors that motivates students to undergo industrial training

Motivating Factor	Mean	Std. Dev.	Rank
To be exposed to real working environment	4.39	0.610	1
To increase job prospects	4.00	0.663	2
To provide knowledge and guidance in choosing job after graduation	3.92	0.759	3
To increase confidence in terms of job qualification	3.69	0.879	4
To improve communication skills	3.62	0.936	5
To meet requirements of the department	*2.32	1.157	6

**The t-test indicates that the mean score is not significantly greater than 3.00 (p=0.05)*

Perceptions on benefits of industrial training

About 95% of the respondents are of the perception that completion of IT can increase their job prospects, 93% also perceive that IT can provide more confidence in terms of job qualification, and 90% perceive that IT could provide more knowledge and guidance in their job selection after graduation (Fig.7). Eighty-three percent (83%) of the respondents also perceive that it provides a platform for the industry to evaluate their future employees. Thus, majority of students are of the perception that IT is beneficial and allows for the acquisition of job relevant skills. Improved communication skills through daily interaction with the working environment, and improved leadership skills are attributes industrial training can help improve in order to provide more confidence in terms of job qualification (Connor and Shaw, 2008; Mihail, 2006). The results are in line with findings from the literature. Callanan and Benzing (2004) found that IT improves the individual's career decision-making, and Rahman et al. (2009) and Osman et al. (2008) also found that IT serves as a platform for developing the students' communication skills.

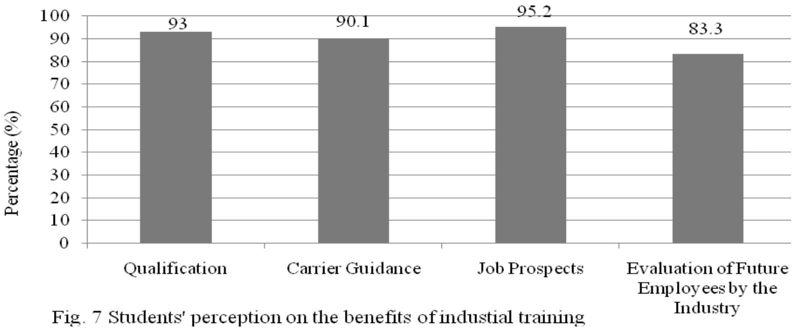


Fig. 7 Students' perception on the benefits of industial training

Perceptions on performance before and after industrial training

Means scores of students' satisfaction with their performance on each of the 17 attributes in the three categories (personal attitude, communication and work attitude) before and after undertaking IT are presented in Table 2. The differences between mean scores (i.e. mean score gaps) of students' satisfaction with their performance on each of the 17 attributes before and after undertaking IT are also presented in Table 2. The one sample t-test at 5% significance level showed that there are significant differences between mean scores of all attribute before and after undertaking IT. Students' satisfaction with their performance on each attribute in the three categories increased after the IT. This indicates that the respondents perceive their personal attitude, work attitude and communication skills to have satisfactorily improved through IT. On personal attitude, the mean score gap shows that students' self-confidence is perceived to have most significantly improved after the IT. With regards to communication, oral communication skills most significantly improved, whilst their subject knowledge also significantly improved after undertaking IT.

The results are consistent with the findings of Rahman et al. (2009) and Osman et al. (2008) which acknowledged the fact that students personal attitude, communication, work attitude, and leadership skills improved after undergoing IT. Rahman et al. (2009) further admonish students to prepare themselves and improve their skills before they graduate. Connor and Shaw (2008) conceding to students' poor communication skills also emphasized that IT helps to develop students' communication skills that include daily interaction within the working environment and technical writing. Other studies also view IT as a positive developmental experience for university students to improve their leadership skills (Wasonga and Murphy, 2006), knowledge in information technology, time management, communication skills and teamwork (Mihail, 2006). Rahman et al. (2009) stated that employers provide the students with hands-on-the-job experience which accelerate the trainee's progress and hands-on knowledge.

Table 2 Mean scores, standard deviations and mean score gaps of students' satisfaction

Aspect	Attribute	Before training		After training		Mean ScoreGap (B-A)
		Mean score (A)	Std. Dev	Mean score (B)	Std. Dev	
Personal attitude	Self confidence	1.70	0.752	4.27	0.502	2.57
	Self esteem	1.92	0.759	4.36	0.566	2.44
	Curiosity	2.33	0.697	4.63	0.484	2.30
	Punctuality	2.27	0.713	4.48	0.494	2.21
	Self and time management	2.26	0.754	4.38	0.488	2.12
Communication	Oral communication	1.76	0.843	4.47	0.502	2.71
	Written communication	1.88	0.837	4.55	0.500	2.67
	Discussion skills	1.99	0.805	4.57	0.498	2.57
	Subject knowledge	2.34	0.684	4.72	0.451	2.38
Work attitude	Adaptable with environment	2.27	0.728	4.54	0.502	2.27
	Problem solving skills	2.32	0.694	4.58	0.513	2.26
	Leadership	2.25	0.721	4.52	0.523	2.25
	Teamwork	2.24	0.732	4.49	0.524	2.25
	Ability to work independently	2.23	0.697	4.46	0.496	2.23
	Ability to work under pressure	2.21	0.749	4.39	0.501	2.18

The one sample t-test (p=0.05) showed that there is a significant difference between mean scores of each attribute before and after undertaking IT

Perceptions on performance during industrial training

Respondents were asked to evaluate their performance during IT on 20 performance criteria. Mean scores of all the performance criteria, except three- 'ability to communicate with the public', 'negotiation skills' and 'independence' were found to be significantly greater than the neutral score of 3.00 ($p=0.05$) when the t-test was applied (Table 3). Thus, the respondents are of the view that they are satisfied with their ability to apply knowledge gained from the classroom to the world of work, interact well within the work environment, and carry out instructions satisfactorily. The respondents also regarded their performance on other 14 performance criteria as satisfactory (Table 3). They were, however, not satisfied with their ability to communicate with the public, their negotiation skills and their independence.

Table 3 Respondent's performance during industrial training

Performance Criteria	Mean	Std. D	Rank
Ability to apply knowledge	3.98	0.838	1
Ability to interact well	3.86	0.944	2
Ability to carry out instructions satisfactorily	3.84	0.929	3
Adequate background knowledge	3.80	0.833	4
Professionalism and work ethics	3.78	0.959	5
Ability to function as a team player	3.70	1.066	6
Listening skill	3.68	1.119	7
Ability to extract information	3.66	0.986	8
Disciplined and motivated	3.65	1.053	9
Ability to function as a leader	3.64	1.001	10
Lifelong learning	3.60	1.053	11
Ability to express ideas (oral)	3.57	1.020	12
Social and multi-racial awareness	3.51	1.114	13
Ability to make decision	3.48	0.908	14
Environmental awareness	3.45	0.965	15
Ability to express ideas (written)	3.39	1.099	16
Non-Verbal skill	3.30	0.946	17
Ability to communicate with public	*3.27	1.070	18
Negotiation skill	*3.25	0.979	19
Independence	*3.10	1.070	20

**The t-test showed that the mean score of the performance criteria is not significantly greater than 3.00 (p=0.05)*

Perceptions on monitoring of industrial training

The results presented in Figure 8 showed that majority (53%) of the respondents do not submit any IT report to their departments. The remaining 47% who submit reports claim that they are not obliged to do so, indicating lack of serious monitoring system to ensure that students undertake IT. Thus, although students are expected to benefit from IT, the absence of an effective monitoring system may affect their seriousness with the training. For IT to achieve the desired impact, training monitoring systems had to be quite effective (Bansal et al., 2010). Effective monitoring provides confidence in the students that the teaching department is at their back to extend helping hand to tackle various bottlenecks that come their way during industrial training (Bansal et al., 2010). Monitoring also helps to check non-serious students by putting them on the right track.

Fig. 8 Submission of reports

Challenges of industrial training

About thirty-four percent (34%) of the respondents consider the current method of placement to be stressful. Some challenges students encountered during IT were identified to include 'improper supervision', 'no remuneration', and 'unprofessional or mundane tasks' (Fig. 9). The stressful nature of placement procedure for IT is in line with findings of Pillai and Yusoff (2007).

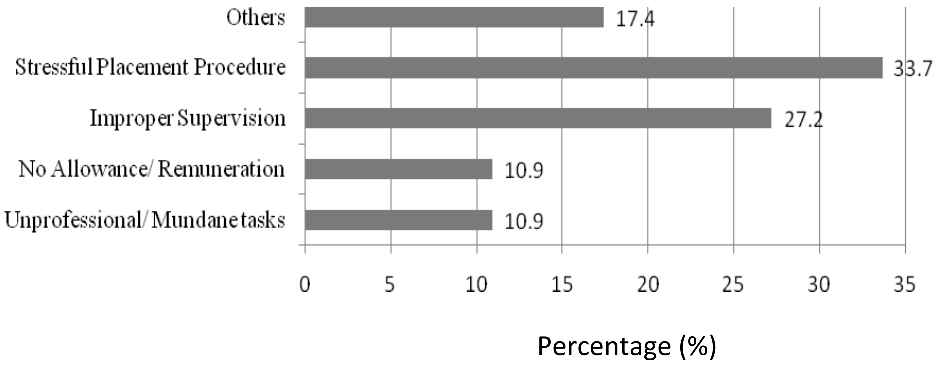


Fig. 9 Challenges encountered by students

On possible measures to overcome the above challenges, the respondents are of the opinion that their teaching departments should contact the appropriate training organization to arrange for placement for all students to undergo industrial training. They also suggested that in addition to providing lists of organizations in good standing for students to choose from, their departments should liaise with training organizations to ensure that IT is well structured and beneficial to them. They further suggested the introduction of strict and effective monitoring systems to enforce IT and provide confidence in the students.

CONCLUSION AND RECOMMENDATIONS

The student-respondents agree that "exposure to real working environment" and "increase in job prospects" are among the major factors motivating them to undertake industrial training. Industrial training provides benefits such as job prospects, more confidence in terms of job qualification, and more knowledge and guidance in job selection after graduation. It also significantly improves the students performance on personal attitude, work attitude and communication skills, and that their self-confidence, oral communication skills and subject knowledge are significantly improved after training. The students are of the view that they are satisfied with their ability to apply knowledge gained from the classroom to the world of work, interact well within the work environment, and carry out instructions satisfactorily during IT. The results, however, have shown that the major contribution of teaching departments to industrial training has been the issuance of introductory letters to prospective trainees, and most of the student-respondents are dissatisfied with the current placement method. There is also no serious monitoring system in place to ensure that students undertake industrial training.

Stressful placement procedure, lack of proper supervision and financial strain on students are some of the perceived challenges to industrial training and on the basis of these, it is recommended that: educational institutions establish industrial training liaison offices to facilitate, manage and monitor the procedures involved in the placement of industrial trainees. Also educational institutions should make industrial training compulsory and training reports should be assessed and graded as part of students' overall marks. Educational institutions should institute effective monitoring systems for industrial training such as site visits, in order to enhance the effectiveness of industrial training. There is the need to have educational institutions foster linkages with industry and bridge the gap between the academia and the employer, in this case the Ghana Employers Association, in order to ensure that industrial training is well structured and beneficial to students and also the training organization.

REFERENCES

Bansal,V.K., Grover, S., and Ashok, K. (2010) “Feedback on students industrial training for enhancing engineering education quality: a survey based analysis”, International Journal of Engineering Science and Technology, 2:9, 4807- 4816.

Callanan, G. and Benzing, C. (2004) “Assessing the role of internships in the career-oriented employment of graduating college student”, Education & Training, 46: 2, 82-89.

Chileshie N. and Haupt. T. C. (2006) “Industry and Academia; Perceptions of Construction Management Education. The Case of South Africa”. Available online, http://www.cebe.heacademy.ac.uk/news/events/beecon2006/pdf/p14-Nicholas Chileshe.pdf. [Accessed 18th April 2009]

Connor, H. and Shaw, S. (2008) “Graduate Training and Development: Current trends and Issues”, Education & Training, 50:5, 357-365.

Duodu A. (2006) “TVET in Ghana, A core study-Technical and vocational education division, Ghana education service ministry of education and sports”, Accra, Ghana.

Fallows, S. and Steven, C. (2000) “Integrating Key Skills in Higher Education”, London, United Kingdom.

Garavan, T.N. and Murphy, C. (2001) “The co-operative education process and organizational socialization: a qualitative study of students perceptions of its effectiveness”. Education & Training, 43: 281-302.

Gill, A. and Lashine, S. (2003) “Business education: a strategic market-oriented focus”, The International Journal of Education Management, 17:5, 188-94.

Haupt, T.C. (2003) “Student Attitudes towards Cooperative Construction Education

Degree Level Skills for Construction and Surveying Students Experiences”. The Australian Journal of Construction Economics and Building, 3:1, 31-42.

Mihail, D.M., (2006) “Internships at Greece Universities: An exploratory study”, Journal of Workplace Learning, 18:1, 28-41.

Moser, C. A and Kalton, G. (1993), Survey Methods in Social Investigation, 2nd ed., Dortworth, Aldershot, England.

Nambudiripad, K. B. M. (2003) “On Designing a Curriculum for Undergraduate

Engineering Degree”. The Indian Journal of Technical Education, 26:3, 18-28.

Osman, S.A., Omar, M.Z., Kofli, N.T., Mat, K., Darus, Z.M. and Rahman, M. N.A. (2008) “The importance of Industrial Training: Students’ Perception in Civil Engineering Sector”. Proceedings of the 7th WSEAS International Conference on Education and Educational Technology (EDU’08), pp. 121-125

Pillai, S. and Yussof, M. (2007) “The Student Industrial Training Programme: Issues and Challenges”. World Association of Corporate Education, WACE2007.

Rahman, M.N.A., Omar, M.Z., Kofli, N.T., Mat, K., Osman, S.A. and Darus, Z.M. (2009) “Assessment of Engineering Students Perception After Industrial Training Placement”, European Journal of Social Sciences, 8:3, 420-431.

Roberts, C. (2007) “Mixing modes of data collection in surveys: A methodological review”, ESRC National Centre for Research Methods, Briefing Paper.

Teoh, S. (2006) “Industry Explores Internship Issues”. In The Star Online, http:/star-techcnetral/tehc/story.

Wasonga, T.A. and Murphy, J.F., (2006). “Learning from tacit knowledge: the impact of the internship”, International Journal of Educational Management, 20:2, 153-163.

INFLUENCE OF CHANNELS OF RECRUITMENT ON PERFORMANCE OF CONSTRUCTION WORKERS IN NIGERIA

Godwin Iroroakpo Idoro[1] and Ebenezer Olutide Bamidele[2]

[1] *Department of Building, University of Lagos, Akoka, Lagos, Nigeria*

[2] *Federal Polytechnic, Ilaro, Ogun State, Nigeria*

The productivity of construction workers which has been discovered to be a major problem and the possible contribution of the channel adopted for recruiting workers to it necessitates the adoption of appropriate channel of recruitment. This study investigates the use and influence of existing channels of recruitment on workers performance in the Nigerian construction industry. The objectives are to evaluate the extents of use of selected channels of recruitment and their influence on construction workers' length of service and performance. A field survey of 532 construction workers selected from construction companies in Nigeria by purposive sampling was conducted. For the field survey, 10 channels of recruitment were selected and data were collected on respondents' characteristics, the channels adopted for recruiting the respondents and the immediate supervisors' assessment of their performance. The data were collected using structured questionnaires and analysed using percentage, mean item score and chi-square test. The study discovers that some channels adopted in recruiting construction workers are more used than others however; their use does not contribute to the length of service and performance of construction workers. The study suggests that construction firms should neglect the possible length of time that prospective workers will serve them and their performance but rather consider the convenience, cost, possibility of reaching prospective applicants and other related factors in choosing the channel to adopt in recruiting their prospective workers.

Keywords: employee recruitment, Nigeria, workers' characteristics, workers' length of service, workers' performance

INTRODUCTION

Construction labour occupies a very significant position and it is often regarded as the most important of all the resources employed in the process of construction project development. Gberevbie (2010) asserted that human resource is seen as one of the most crucial factors in every firm without which the goals of an organisation are as good as dead. This assertion stems from the fact that it is the active resource that employs, activates and mobilises other resources to work therefore the productivity of other resources depends upon that of construction labour. Apart from this, Guhathakurta and Yates (1993) maintained that the execution of construction projects is mainly labour intensive. This assertion tends to imply that labour is the most significant input in the construction of projects. In support of this assertion, several studies have discovered that labour cost constitute the highest proportion of project const. Ersoz (1999) discovered that labour cost makes up a large proportion of the

[1] iroroidoro@yahoo.com

[2] bolutide11@yahoo.com

Idoro, G.I. and Bamidele, E.O. (2011) Influence of channels of recruitment on performance of construction workers in Nigeria *In:* Laryea, S., Leiringer, R. and Hughes, W. (Eds) *Procs West Africa Built Environment Research (WABER) Conference,* 19-21 July 2011, Accra, Ghana, 629-639.

total cost of a construction project. Guhathakurta and Yates (1993) put labour cost at between 30 to 50% of project cost while Ng et al., (2004) and Kazaz et al., (2008) maintained that the percentage of labour cost in the total cost of a project could be up to 40%. This finding tends to indicate that any saving in labour cost will translate to considerable saving in project cost.

Labour cost is a product of productivity therefore any attempt to achieve savings in labour cost will involve improvement in labour productivity. Hanna et al., (2008) maintained that when productivity is increased, labour cost is reduced in the same proportion. Yates (1993), Assaf et al., (1995), Kaming et al., (1998) and Chan and Kumaraswamy (2002) in separate studies discovered that the productivity of construction labour especially in developing countries is poor. The findings of these studies tend to emphasise the need for measures that will bring about improvement in the productivity of construction labour.

One of the factors that can contribute to poor performance of construction labour is the channel used to recruit them. Cascio (2003), Heneman and Judge (2003) and Gberevbie (2008) in separate studies discovered that one of the fundamental challenges facing organisations in the area of performance is their inability to put in place strategies capable of recruiting competent employees and retaining them to achieve organisational goals. Gberevbie (2010) opined that for an organisation to realise its goals, appropriate strategies for employee recruitment and retention are sine-qua-non for enhanced performance. This assertion is particularly true with construction labour whose productivity is known to be very poor. The industry is characterised by migrant workers and for this reason, several channels ranging from informal to formal approaches are often adopted to recruit workers. Whereas, studies have examined several factors that contribute to the poor productivity of construction workers, the contribution of the several approaches adopted to recruit workers has been neglected.

Ofoegbu (1985) and McOliver (2005) in separate studies established a relationship between the strategy of employee recruitment and performance. The relationship is an indication that the qualification and indeed the productivity of workers recruited will vary from one channel to another. It is therefore incumbent on contracting organisations to adopt the most appropriate channels to recruit their workers in order to recruit the most qualified, skilful and productive ones. In the light of this understanding, this study attempts to fill the gap in literature on the contribution of the channels adopted in recruiting construction workers to their productivity. The study examines the influence of channels of recruitment adopted in the Nigerian construction industry on the performance of construction workers. The objectives are to evaluate the extent of use of selected channels of recruitment and determine its relationship with the length of service and performance of workers in the industry. The achievement of these objectives will assist stakeholders especially construction firms in several ways. The evaluation of the extent of use of existing channels of recruitment will make practitioners as well as academics to know the common channels of recruitment adopted in the industry. The evaluation of the relationship between recruitment channels and the length of service and the performance of workers recruited by them will assist the stakeholders to know the contribution of the various channels of recruitment they adopt to the productivity of their workers.

RECRUITMENT CHANNELS AND PROJECT PERFORMANCE

Studies have it that workers' performance has a relationship with the channel by which they were recruited. Banjoko (2003) described employee recruitment as the process of reaching out, searching for and attracting, a large supply of people or a large pool of interested applicants from which an organisation can choose those it considers competent or most qualified for a job. Adebayo (2001), Ejiofor and Mbachu (2001) and Olowu and Adamolekun (2005) maintained that the human resource is the most valuable asset in any organisation and it is fundamental to the achievement of the organisational goals. Ofoegbu (1985) and McOliver (2005) in separate studies established a relationship between the strategy of employee recruitment and performance in an organisation and identified the problems in employee recruitment as basis for poor performance of public sector workers in Nigeria.

Project performance remains a prominent issue in project delivery all over the world. Ling (2004) stated that the performance of a project is multifaceted and may include unit cost, construction and delivery speeds and the level of clients' satisfaction. Pinto and Slevin (1998) classified project performance parameters into (1) internal factors which are project variables namely: schedule, cost and quality and (2) external factors which are concerned with stakeholders' satisfaction with the performance of a project and the perceived impact on organisation's effectiveness. Schedule, time, cost and quality are quantifiable, measurable and controllable as such they do not vary in assessment therefore; internal factors are regarded as objective performance parameters. However, project stakeholders are many and their satisfaction often varies from one stakeholder to another, therefore external factors are regarded as subjective performance parameters. Ling et al. (2004) also identified two categories of indicators of project success namely: product success which consists of measures of achievement of quality standards and process success which is made up of variables that measure the achievement of time and cost. Idoro (2008) however considered three parameters namely: time, cost and quality as the most prominent in research studies. Josephson and Lindstrom (2007) maintained that project goal which considers clients' goals, is measured from several perspectives but the main aim is to stimulate clients to identify and clearly present their goals and to stimulate all managers involved to inform and remind all individuals of the goals. Hatush and Skitmore (1997) maintained that success in a project is generally operationalized into time, cost and quality. Michell et al. (2007) remarked that the primary concern of construction clients is that their projects are completed within budget, on time and at the required level of quality. On the basis of the above assertions, time and cost overruns are selected in this study as parameters for measuring project performance. The third parameter (quality) which is commonly used when defining project objectives and setting targets and deadlines is not a common objective parameter in research studies because as Vincent and Joel (1995) put it: stakeholders see the goal of quality management as customer satisfaction.

HYPOTHESES OF THE STUDY

Two research hypotheses were postulated in the attempt to achieve the objectives of the study. The first hypothesis states that the channel of recruitment is not significantly related with the length of service of construction workers. The hypothesis is intended to establish the contribution of the channels of recruiting construction workers to the length of their service with their employers. The construction industry is known for several forms of employment contracts such as casual, contract, part-time and permanent because construction work is a temporary endeavour and migrant in nature. The test of the hypothesis is intended to determine whether or not some channels of recruitment are appropriate for prospective workers offered particular contracts of employment and whether or not the channels by which workers are recruited contribute to staff turnover in the construction firms.

The second hypothesis states that the channel of recruitment is not significantly related with the performance of construction workers. The test of this hypothesis is intended to establish whether or not the channel adopted in recruiting construction workers contribute to their performance on the job. The issue of performance is synonymous with productivity which has been established in previous studies as a major problem in the construction industry especially those of developing countries like Nigeria. The result of the hypothesis will therefore indirectly establish whether or not the channels by which construction workers are recruited contribute to their poor productivity.

RESEARCH METHOD

The study adopted a questionnaire survey design approach because the data required for the study could easily be obtained from the respondents of the study by questionnaires. In the approach, a field survey involving a sample of 532 construction workers was conducted in 2009. The sample was drawn from the population of workers employed in construction firms in Nigeria. To obtain the study population, the difficulty encountered in obtaining reliable data of construction workers in Nigeria prompted a preliminary survey. The preliminary survey which was conducted in early 2009 was meant for two purposes namely: to obtain respondents views on the channels of recruitment used by them and to obtain the number of workers employed on their sites to serve as the study population frame. From the preliminary survey, 75 on-going projects were identified in which a total of 1125 workers were employed. The workers employed (1125) in the projects identified were adopted as the population of the study. Contractors' site supervisors who were either engineers or builders were adopted as respondents.

The variables selected to achieve the objectives of the study were classified into two categories namely: channel of recruitment and construction workers' characteristics. Selected respondents were interviewed during the pilot study and from the interview conducted, ten channels of recruitment namely: walk-in/casual job seekers, referral, advertisement, state employment agency, training programmes, private employment agency, professional search firm, professional body, educational institutions and military operations were identified and used as the variables of channel of recruitment. construction workers' length of service and performance were selected as construction workers' characteristics. Based on the assertion by Ofoegbu (1985) and McOliver (2005), the length of service and performance of construction workers can be said to be related to the channels adopted in recruiting them.

The respondents were requested to indicate the channel adopted in recruiting the workers employed on the sites, their age, sex, marital status, educational qualification, position and the number of years served in the firm and the respondents' assessment of his performance. Ten channels of recruitment stated in the variables of the study were listed for respondents to indicate the one adopted to recruit each worker. The length of service of construction workers was measured using six ranks namely: 1-5 years, 6-10 years, 11-15 years, 16-20 years, 21-25 years and above 25 years.

However, no respondent indicated 1-5 years therefore, the rank was omitted and only the remaining five ranks were used for the study.

For the measurement of the performance of construction workers, the inclusion of all cadres of workers and the large size of the study sample did not permit the use of work study to collect data on the productivity of the study sample therefore a subjective assessment of their performance by their immediate supervisors was adopted. Their performance was measured using five ranks namely: poor, fair, moderate, high and very high. The ranks were assigned scores of 1, 2, 3, 4 and 5 respectively. The age of construction workers was classified into four categories namely: 20-30 years, 31-40 years, 41-50 years and 51-60 years. The sex of construction workers is either male or female while their marital status was categorised as single, married or divorced. Their educational qualifications were classified into four categories namely: West African School Certificate (WASC) or National Examination Certificate (NECO) for secondary school certificates, City and Guilds (C&G) and National Diploma (ND) for technical school certificates, Higher National Diploma (HND) and University Degree (B.Sc.) for degree and equivalent and Masters of Science (M.Sc.) and above for Post-graduate degree. The position occupied by construction workers on site was classified into six categories namely: manager, supervisor, foreman, artisan, clerical staff and general labour.

The data were collected with the aid of structured questionnaires. The instrument was administered on the respondents in late 2009. From the population frame of 1125, 532 questionnaires were selected for the study by purposive sampling. In the sampling, at least five most fully completed questionnaires were selected from each project. Data collected were analysed using percentage and the hypothesis was tested with Chi-square test.

RESULTS

The results of the analysis of data collected are presented as follows:

Characteristics of the Respondents of the Study

The characteristics of the respondents of the study were investigated. The descriptive results are presented in Table 1

Table 1 Descriptive result of the characteristics of the respondents of the study

Characteristic	N	%	Characteristic	N	%
Age			Marital status		
20-30 years	140	26.3	Single	228	42.9
31-40 years	184	34.6	Married	303	57.0
41-50 years	134	25.2	Divorced	1	0.2
51-60 years	74	13.9	Total	532	100.0
Total	532	100.0	Length of service		
Sex			5-10 years	337	63.3
Male	483	90.3	11-15 years	94	17.7
Female	49	9.2	16-20 years	53	10.0
Total	532	100.0	21-25 years	33	6.2
Educational qualification			Above 25 years	15	2.8
WAEC/NECO	102	19.2	Total	535	100.0
C&G/ND	99	18.6	Employment position Manager		
HND/B.Sc.	226	4.5	Supervisor	64	12.1
M.Sc. and above	105	19.7	Clerical officer	123	23.2
Total	532	100.0	Foreman	58	10.9
			Artisan	42	7.9
			General labour/security	197	37.2
			Total	46	8.7
				530	100.0

N=Number of respondents

The results in Table 1 indicate that the respondents are adults within working age group (20 – 60 years). The results of the sex of the respondents reveal that both male and female construction workers are covered by the study although male workers constitute the majority. The results of the respondents' educational qualifications reveal that the respondents possess different qualifications ranging from secondary school certificates to degree. The analysis of the marital status of the respondents shows that the majority of the respondents are either single or married. The analysis of the length of service of the respondents shows that the length of service of the majority of the respondents is 5-10 years. The analysis of the employment position of the respondents shows that several cadres of construction workers are covered by the study however, artisan constituted the highest percentage among the different cadres of construction workers covered by the study.

Levels of Use of Selected Channels of Recruitment

One of the objectives of the study is to evaluate the levels of use of channels of recruitment in the construction industry. To achieve this objective, ten channels of recruitment stated in the variables of the study were selected. Respondents were requested to indicate the channel of recruitment adopted during their employment. The percentages of respondents employed by each of the channels were analysed. The results of their ranks are presented in Table 2.

Table 2 Ranks of the levels of use of selected channels of recruitment

Channel of recruitment	N	%	Rank
Advertisement	181	34.0	1
Referral	116	21.8	2
State employment agency	81	15.2	3
Walk-in/casual job seekers	57	10.7	4
Training programmes	26	4.9	5
Private employment agency	20	3.8	6
Professional search firm	17	3.2	7
Professional body	16	3.0	8
Military operations	11	2.1	9
Educational institutions	7	1.3	10

N=Number of respondents

The results in Table 2 show that advertisement is the most used channel of recruitment followed by referral. State employment agency, walk-in/casual job seekers, training programmes, private employment agency and professional search firms. Professional bodies, military operations and educational institutions are the least used channels of recruiting the respondents.

Difference in the Levels of Use of Selected Channels of Recruitment

From the ranks of the extent of use of the selected channels of recruitment among the study sample in Table 2, the study has shown that the use of the channels for recruiting construction workers differs from one channel to another. The study attempted to investigate further the result by determining whether or not the difference is significant. The first hypothesis of the study was postulated for this purpose. The hypothesis states that the difference in the use of selected channels adopted to recruit construction workers is not significant. The hypothesis was tested using the Chi-square test with $p \leq 0.05$. The rule for the acceptance or rejection of the hypothesis is that when the p-value>0.05, the test fails to reject the hypothesis but when the p-value≤0.05, the hypothesis is rejected. The results are presented in Table 3.

.Table 3 Results of Chi-square test of difference in the use of selected channels for recruiting construction workers

Variables differentiated	N	x^2 -value	Df	p-value	Decision
Extents of use of 10 selected channels of recruitment	532	554.805	9	0.001	Reject

N=Number of respondents, Df=Degree of freedom

The result of the test of the hypothesis in Table 3 reveals that the hypothesis is rejected. The result indicates that the difference in the extent of use of the ten selected channels of recruitment is significant. This result confirms that the levels of use of the channels of recruitment are significantly different.

Length of Service of Construction Workers Recruited by selected Channels of Recruitment

One of the objectives of the study is to investigate the contribution of the channels of recruiting construction workers to workers' turnover in construction firms. This investigation involves the analysis of the length of service of respondents recruited by the ten selected channels of recruitment. Data were collected on the number of years that respondents have served in their respective organisations and the channel adopted in recruiting them. The number of years of service which otherwise implies length of service was classified into five groups namely: 6-10 years, 11-15 years, 16-20 years, 21-25 years and above 25 years. The first hypothesis of the study was postulated for the purpose of the investigation. The percentage of respondents in each of the five groups of length of service that were recruited by each of the ten channels of recruitment was analysed. The results of their ranks are presented in Table 3.

Table 5 Percentages of construction workers with selected length of service recruited by selected channels of recruitment

Recruitment channel	5-10 yrs		11-15 yrs		16-20 yrs		21-25 yrs		26-30 yrs		Total	
	N	%	N	%	N	%	N	%	N	%	N	%
Casual job seekers	28	8.3	12	12.8	9	17.0	5	15.2	3	20.0	57	10.7
Referral	72	21.4	27	28.7	8	15.1	7	21.2	2	13.3	116	21.8
Advertisement	123	36.5	24	25.5	19	35.8	9	27.3	6	40.0	181	34.0
State employment agency	54	16.0	15	16.0	7	13.2	3	9.1	2	13.2	81	15.2
Private employment agency	16	4.7	2	2.1	1	1.9	0	0.0	1	6.7	20	3.8
Professional search firms	9	2.7	4	4.3	3	5.7	1	3.0	0	0.0	17	3.2
Educational institutions	7	2.1	0	0.0	0	0.0	0	0.0	0	0.0	7	1.3
Professional bodies	7	2.1	4	4.3	1	1.9	4	12.1	0	0.0	16	3.0
Military operations	8	2.4	0	0.0	1	1.9	2	6.1	0	0.0	11	2.1
Training programmes	13	3.9	6	6.4	4	7.5	2	6.1	1	6.7	26	4.9
Total	337	100	94	100	53	100	33	100	15	100	532	100

N=Number of respondents, Yrs=years

Table 5 shows that workers recruited by casual, referral, advertisement, state employment agency and training programmes have length of service ranging from 5-30 years. Workers recruited through private employment agencies and professional bodies have length of service ranging from 5-20 years and 26-30 years whereas workers recruited through professional search firms have length of service that ranges from 5-25 years. Workers recruited from military operations have length of service that ranges from 5-10years and 21-25 years while only workers with 5-10 years length of service were recruited from educational institutions. The results indicate that both short-serving and long-serving construction workers were recruited by casual, referral, advertisement, state employment agency, training programmes, private employment agencies, professional bodies professional search and military operations whereas only short-serving or new workers are employment from educational institutions.

Relationship between Channel of recruitment and Length of Service of Construction Workers

The results in Table 5 have revealed that the percentages of the respondents of the study recruited by each channel differ according to their length of service. The question posed by these results is ‘Does the channel of recruitment influence their length of service? The study attempted to answer the question by postulating the second hypothesis of the study. The hypothesis states that the channel of recruitment is not significantly related with the length of service of construction workers. The respondents recruited by each of the ten channels of recruitment and their length of service in their respective organisations analysed above were used for the test. The hypothesis was tested using the chi-square test with $p \leq 0.05$. The rule for the acceptance or rejection of the hypothesis is that when the p-value>0.05, the test fails to reject the hypothesis but when the p-value≤0.05, the hypothesis is rejected. The results are presented in Table 6.

Table 3 Results of Chi-square test of relationship between channels of recruitment and the length of service and performance of construction workers

Parameters compared	N	x^2 -value	Df	p-value	Decision
Channel of recruitment					
Length of service of workers	532	42.146	36	0.222	Accept
Assessment of performance of workers	503	43.486	36	0.183	Accept

N=Number of respondents, Df=Degree of freedom

The result of the test of the hypothesis in Table 3 shows that the test fails to reject the hypothesis. The result indicates that the channel by which the respondents were recruited has no significant relationship with their length of service.

Performance of Construction Workers Recruited by selected Channels of Recruitment

The study also investigated the contribution of the channels of recruiting construction workers to their performance. This investigation involves the analysis of the performance of the study sample recruited by each channel of recruitment. As described in the research methods, the Mean Item Score (MIS) of the immediate supervisors’ assessment of the performance of the workers recruited by each channel was analysed. The results of their ranks are presented in Table 6.

Table 6 Ranks of supervisors’ assessment of the performance of workers recruited by selected channels of recruitment

Recruitment channel	1	2	3	4	5	N	Score	MIS	Rank
Educational institutions	0	0	1	4	2	7	29	0.83	1
Advertisement	0	12	63	76	25	176	632	0.81	2
Professional body	0	0	2	10	2	14	56	0.80	3
Military operations	0	0	3	6	1	10	38	0.76	4
Private employment agency	0	2	3	10	3	18	68	0.76	4
Training programmes	0	0	7	15	1	23	86	0.75	6
State employment agency	1	5	21	41	11	79	293	0.74	7
Walk-in/casual job seekers	3	2	12	26	5	48	172	0.72	8
Professional search firms	0	3	3	8	2	16	57	0.71	9
Referral	1	9	43	50	9	112	393	0.70	10

N=Number of respondents, 1=poor, 2=fair, 3=moderate, 4=high, 5=very high,
MIS=Mean Item Score

Table 6 shows that the immediate supervisors' assessment of the performance of workers recruited by educational institutions is the highest while those of workers recruited by advertisement and professional bodies are second and third highest respectively. The performance of workers recruited from military operations and private employment agency are fourth highest while those of respondents recruited through training programmes and state employment agencies are sixth and seventh highest respectively. The performance of workers recruited by casual method is eighth highest while those of workers recruited by professional search firms and referral are the lowest.

Relationship between Channels of recruitment and Construction Workers' Performance

Table 6 reveals that the immediate supervisors' assessments of the performances of respondents recruited by the ten selected channels of recruitment differ. The question posed by this result is 'Does the channel of recruiting construction workers influence their performance? The study attempted to answer the question by testing the third research hypothesis. The hypothesis states that the channel of recruitment is not significantly related with the performance of construction workers. Workers recruited by each of the ten channels of recruitment and their immediate supervisors' assessment of their performance analysed above were used for the test. The hypothesis was tested using the Chi-square test with $p \leq 0.05$. The rule for the acceptance or rejection of the hypothesis is that when the p-value>0.05, the test fails to reject the hypothesis but when the p-value≤0.05, the hypothesis is rejected. The results are presented in Table 3. The result of the test of the hypothesis in Table 3 shows that the test fails to reject the hypothesis. The result indicates that the channel by which the respondents were recruited has no significant relationship with their performance or productivity.

DISCUSSION OF FINDINGS

The analysis of the characteristics of the respondents has shown that the respondents consist of construction workers who possessed both secondary and technical schools certificates, Polytechnic diplomas and University degrees. Similarly, the respondents consist of managerial and supervisory staff and labour. This result indicates that the study sample consists of all categories of construction workers both junior and senior staff and both management, supervisory and technical staff. This result implies that the channels of recruitment and the performance of workers investigated in the study cover all categories of construction workers.

The test of the first research hypothesis has established that some channels of recruitment are more adopted in recruiting construction workers than others. The analysis of the extent of use of the channels of recruitment above shows that advertisement is the most used channel while referral is the second most used. State employment agency is discovered to be the third while casual job-seeker is the fourth most used. Military operations and educational institutions are discovered to be the least used channels of recruitment.

The test of the second research hypothesis has shown that the use of the selected channels of recruitment has no significant relationship with the length of service and performance of the workers sampled. The result of no significant relationship between channels of recruitment and the length of service of the respondents is an indication that the number of years that workers serve their organisations is not influenced by the channel through which they were recruited. In other words, the channel through which construction workers are recruited does not have influence on the number of years that the workers will serve their organisations. This result tends to imply that the channels of recruitment have no influence on workers' turnover. The result of no significant relationship between the use of the channels of recruitment and the performance of the respondents is an indication that the channels by which construction workers are employed have no influence on their performance. This result tends to imply that the channel of recruiting both management and supervisory staff and labour in the construction industry does not contribute to the performance of the workers. This result contradicts the assertion made in previous studies (Ejiofor and Mbachu, 1983; Ofoegbu, 1985; Adebayo, 2001; McOliver, 2005; Olowu and Adamolekun, 2005) that the strategy of employee recruitment and their performance are related. The contradiction may be due to the fact that not all the workers can be recruited through the same channel. In other words, the channels are appropriate for recruiting specific workers.

CONCLUSION

The study has established that the extent of use of the existing channels for recruiting construction workers differs. This result implies that some are more favoured than others. Further investigation has revealed that the use of any of the channels of recruitment does not contribute to the length of service of construction workers and their performance on the job. This result does not reveal any justification for construction firms to favour one channel of recruitment more than another. The conclusion from the results is that construction firms could adopt any channel to recruit any category of worker and that such would not have any negative effect on the productivity and length of service of the worker. Based on this conclusion, it is suggested that construction firms should neglect the possible length of time that prospective workers will serve them and their productivity but rather consider the convenience, cost, possibility of reaching prospective applicants and other related factors in choosing the channel to adopt in recruiting their prospective workers.

REFERENCES

Adebayo, A (2001). Principles and Practice of Public Administration in Nigeria. 2nd edition. Ibadan. Spectrum Books Limited.

Assaf, S A, Al-KHALIL, M and Al-Hazmi, M (1995). Causes of Delay in Large Building Construction Projects. Journal of Management in Engineering, 1, 45-50

Banjoko, S A (2003). Human Resource Management: An Expository Approach. 1st edition. Ibadan. Pumack Nigeria Limited.

Cascio, W F (2003). Managing Human Resources: Productivity, Quality of Work life and Profits. 6th edition. Boston. McGraw-Hill, Irwin.

Chan, D W M and Kumaraswamy, M M (2002). Compressing Construction Durations: Lessons leaned from Hong Kong Building Projects. International Journal of Project Management, 20, 23-35

Ejiofor, P N O and Mbachu, A U (2001). Imperatives of Human Resource Practices in the New Millennium. Journal of Management Science, 5, 1-10

Ersoz, Y Y (1999).Neural Network Model for Estimating Construction Productivity. Journal of Construction Engineering and Management, May/June,

Gberevbie, D E (2008). Staff Recruitment, Retention Strategies and Performance of Selected Public and Private Organisations in Nigeria. PhD Thesis, Covenant University, Ota, Nigeria.

Gberevbie, D E (2010). Strategies for Employee Recruitment, Retention and Performance: Dimension of the Federal CIVIL Service of Nigeria. African Journal of Business Management, 4(8), 1447-1456

Guhathakurta, S and Yates, J (1993). International Labour Productivity. Cost Engineering, 35(1), 15-25

Hanna, A S, Chang, C, Sullivan, K T and Lackney, J A (2008). Impact of Shift Work on Labour Productivity for Labour Productivity for Labour Intensive Contractor. Journal of Construction Engineering and Management, 138(3), 197-204

Hatush, Z and Skitmore, M (1997). Evaluating Contractor Prequalification Data Selection Criteria and Project Success Factors. Construction Management and Economics, 15: 129-147

Heneman, H G and Judge, T A (2003). Staffing Organisation. 4th edition. Boston. McGraw-Hill, Irwin.

Idoro, G I (2008). Effect of Mechanisation on Project Performance in the Nigerian Construction Industry. Proceedings of RICS Construction and Building Research Conference (COBRA 2008), Dublin Institute of Technology, Dublin, UK, 4-5 September, 2008

Josephson, P E and Lindstrom, J (2007). Measuring Performance in Construction Projects. Proceeding of the CIB World Building Conference on Construction for Development Cape Town, South Africa, 14 – 18 May 2007: pp 383-394

Kaming, P F,Holt, G D, Kometa, S T and Olomolaiye, P O (1998). Severity Diagnosis of Productivity Problems-A Reliability Analysis. International Journal of Project Management, 16(2), 107-113.

Kazaz, A, Manisali, E and Serdar, U(2008). Effect of Motivational Factors on Construction Workforce Productivity in Turkey. Journal of Civil Engineering and Management, 14(2), 95-106

Ling, F Y Y (2004). Key Determinants of Performance of DBB Projects in Singapore. Building Research and Information, 32(2): 128-139

Ling, F. Y. Y.; Chan, S. L.; Chong, E. and El, P. 2004. Predicting Performance of Design-Build and Design-Bid-Build Projects. Journal of Construction Engineering and Management ASCE. 130(1): 10-20

McOliver, F O (2005). Management in Nigeria: Philosophy and Practice. International Journal of Communication Human Studies, 2, 1-8

Michell, K; Bowen, P; Cattell, K; Edward, P and Pearl, R (2007). Stakeholder Perceptions of Contractor Time, Cost and Quality Management on Building Project.Proceeding of the CIB World Building Conference on Construction for Development, Cape Town, South Africa, 14 – 18 May 2007: pp 231-240

Ng, S T, Skitmore, R M, Lam, K C and Poon, A W C (2004). De-motivating Factors influencing the Productivity of Civil Engineering Projects. International Journal of Project Management, 22, 139-146

Olowu, D and Adamolekun, L (2005). Human Resources Management, in L. Adamolekun (eds) Public Administration in Africa: Main Issues and Selected Country Studies. Ibadan. Spectrum Books.

Ofoegbu, R (1985). Personnel Recruitment and Management, in H. N. Nwosu (eds) Problems of Nigerian Administration. Enugu. Fourth Dimension Publishing Co.Limited.

Pinto J K and Slevin, D P (1998). Project Success: Definitions and Management Techniques. Project Management Journal, 19(1): 67-71

Vincent, K O and Joel, E R (1995). Principles of Total Quality. Kogan Page, London

Yates, J (1993). Construction Decision Support System for Delay Analysis. Journal of Construction Engineering and Management, 119, 226-244.

INFLUENCE OF CONSTRUCTION SITE OHS FACILITIES ON OHS PERFORMANCE IN NIGERIA

Godwin Irororakpo Idoro[1]
Department of Building, University of Lagos, Akoka, Yaba, Lagos, Nigeria

As part of the effort to improve the poor Occupational Health and Safety (OHS) condition of the Nigerian construction industry, this study investigates the OHS condition of construction sites in Nigeria. In the study, construction site OHS condition is defined by OHS facilities provided. The objectives are to evaluate contractors' perception of the adequacy of selected OHS facilities and its influence on OHS performance on construction sites. To achieve the objectives, a questionnaire survey approach involving a field survey of 86 construction projects selected by stratified random sampling was adopted. Data were collected from the heads of the project sites on the adequacy of 12 selected facilities required on construction sites, the characteristics and number of construction workers employed, accidents and injuries recorded on sites in 2008 using structured questionnaires and analysed using Relative Provision Index (RPI) and chi-square test. The results indicate that contractors perceive the adequacy of OHS facilities provided on sites to be moderate and their adequacy has significant influence on OHS performance. It is concluded that the OHS facilities provided on project sites contribute to improvement in OHS performance. It is suggested that construction firms should commit adequate resources and effort to the provision if OHS facilities on their project sites and put in place appropriate provisions in their OHS policy and structures that will ensure adequate provision of the facilities.

Keywords: construction site, contractor, Nigeria, OHS performance, OHS facility.

INTRODUCTION

Studies have discovered that construction is one of the most hazardous industries in every economy (HSE, 1993; Short, 1998; Eurostat, 2001; Whitelaw, 2001; Hare and Cameron, 2010). In UK, HSE (1993) discovered that the construction industry recorded the highest accident, injury and non-injury to injury/accident rates on site. CBPP (2002) reported that the UK construction industry is responsible for more than 70 deaths, thousands of disabling accidents and thousands of people that suffered ill-health. The European Agency for Safety and Safety at Work reported that about 13 workers per 100,000 lose their lives in UK construction as against 5 per 100,000 all sector average (Eurostat, 2001). HSC (2001 & 2003) reported a fatal injury rate of 0.8 per 100,000 workers which put the number of injured workers in UK at 225 in 2002/03. It also reported a non-fatal injury rate of 614.1 per 100,000 workers in 2002/03. HSE (2009) report shows that over 2,800 people died from injuries received from construction work in the last 25 years. Figures published by the body showed that the industry in UK exceeded the all-industry average rates on musculosketal disorders, occupational dermatitis, mesothelioma, asbestos and diffuse pleural

[1] iroroidoro@yahoo.com

Idoro, G.I. (2011) Influence of construction site OHS facilities on OHS performance in Nigeria *In:* Laryea, S., Leiringer, R. and Hughes, W. (Eds) *Procs West Africa Built Environment Research (WABER) Conference*, 19-21 July 2011, Accra, Ghana, 641-650.

thickening and work related hear loss. Hare and Cameron (2010) reported that 72 fatal accidents occurred in Britain's construction industry in 2007/08 while 53 fatal accidents were recorded in 2008/09.

The OHS performances of the construction industries of other European countries are not in any way different from what prevails in UK. Eurostat (2001 & 2002) reported that in 1998/99, the construction industries across European Union recorded the highest number (1,330) of fatal accidents and discovered that they constituted one of the high-risk industries in terms of workers absence from work due to injury. It also discovered that the rate of injury in the construction industries of European Union was 8,008 per 100,000 workers.

In Nigeria, there is a dearth of records on OHS performance of the construction industry. In a sample of the number of accidents recorded by 20 selected reputable contractors across Nigeria in 2006, Idoro (2007) discovered that the Accident per Contractor Rate (ACR) of indigenous contractors was 1-16 with a mean of 11 while that of expatriate contractors was 2-14 with a mean of 8. The study also discovered the Injury per Contractor Rate (ICR) of indigenous contractors to be 2-8 with a mean of 5 while that of expatriate contractors was 1-10 with a mean of 4. The study equally discovered the Injury per Accident Rate (IAR) of indigenous contractors to be 0.19-3.0 with a mean of 0.77 while that of multinational contractors was 0.13-4.0 with a mean of 0.94. The high ACR, ICR and IAR of the two categories of Nigerian contractors indicate that the Nigerian construction industry is certainly one of the most hazardous.

Studies have investigated the problem of high accident and injury rates in the construction industry and measures that can reduce them. The parameters mentioned above and similar others such as lost time injury frequency rate which are traditional measures of safety performance do actually report performance. However, researchers have argued that they do not proffer solution to the problem and therefore described them as Negative Performance Indicators (NPIs) or lag factors (Dingsdag *et al.,* 2008). In the effort to develop measures that can bring about improvement in the OHS performance of the construction industry, the use of NPIs or lag factors was criticised because of their inability to improve performance. In their place, Positive Performance Indicators (PPIs) or lead factors which centre on safety culture were advocated (Dingsdag *et al.*, 2006a & b; 2008). Several indicators have been developed for PPIs as discussed in the literatures reviewed below however, it is observed that all the indicators of safety culture so far developed for PPIs (psychological, conditional and behavioural) neglected the project environment. This omission by implication is an indication that the project environment is not part of the safety culture of construction projects and it does not contribute to safety performance. The multi-causal nature of construction accidents as opined by Reason (1997) and HSE (2006) has made researchers to examine numerous factors associated with construction in the search for the solution to poor OHS. Jaselskris *et al.*, (1996) measured organisational factors affecting safety performance at company and project levels and discovered that safety manuals, programmes, meetings or inspections, training for foremen and safety personnel, coordinator's time spent on safety, alcohol and drug testing programmes contributed to variation in safety performance. Sawacha *et al.*, (1999) examined seven groups of factors namely: historical, economical, psychological, technical, procedural, organisational and environmental factors and discovered that the age and experience of operatives, payment of hazard and productivity bonus, care for personal safety, knowledge of OHS act, management attitudes and involvement, training on safety, work environment and site layout are more likely to provide a high level of safety performance. Abudayyeh *et al.*, (2006) studied organisational profile and resources. IQSH (2009) and QCA (2009) mentioned that the UK National Qualifications Framework specified generic qualifications for ranking safety qualifications. Idoro (2008) examined management efforts while several studies (Blewett, 1994; Shaw, 1994; Dingsdag *et al.*, 2006a&b; 2008; Choudhry *et al.*, 2007) examined various parameters of safety culture. Although, some of these studies covered safety training and personal protective equipment however; the factors relating to construction sites have been neglected.

This study therefore attempts to fill a gap in literature by examining the contribution of the OHS facilities provided on construction sites to safety performance. The objectives are to evaluate the adequacy of the provision of selected OHS facilities and their relationship with OHS performance in construction sites. The results of the study will establish whether or not the provision of OHS facilities contribute to OHS performance in construction sites and as such be included in the indicators of safety culture or not.

VARIABLES OF THE STUDY

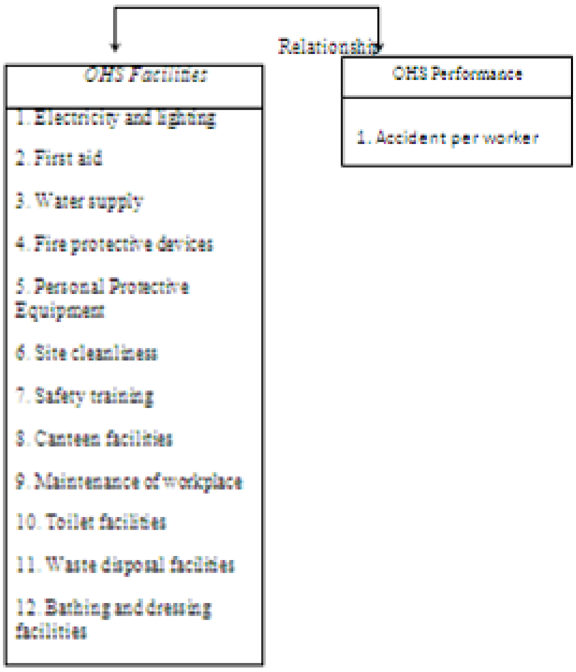


Fig. 1 Conceptual framework for evaluating the relationship between the provision of OHS facilities on construction sites and OHS performance

The variables used for the study were grouped into two categories namely: OHS facilities and OHS performance. OHS facilities consist of twelve parameters namely: electricity and lighting, first aid facilities, water supply, fire protective devices, personal protective equipment (PPE), site cleanliness, safety training, canteen facilities, maintenance of workplace facilities, toilet facilities, waste disposal and bathing and dressing facilities. OHS performance consists of three parameters namely: accident per worker, injury per worker and injury per accident rates. The relationship between the variables is based on the assumption that OHS facilities could be an important component of safety culture and the findings in previous studies that safety culture impacts on OHS performance. On these bases, the parameters of OHS facilities are considered to have influence on the parameters of OHS performance. This theory on which the study is based forms the conceptual framework for the study which is presented in Fig. 1.

HYPOTHESIS OF THE STUDY

To achieve the objective of determining the relationship between the provision of OHS facilities on sites and OHS performance, a research hypothesis was postulated. The hypothesis states that the adequacy of provision of selected OHS facilities on construction sites has no significant relationship with OHS performance. The result of the hypothesis will establish whether or not the provision of OHS facilities contributes to OHS performance on site.

OCCUPATIONAL HEALTH AND SAFETY PERFORMANCE

The inability of NPIs to improve OHS performance has generally been accepted as a strong weakness in previous studies and in their place, PPIs have been strongly advocated. Since the mid 90's when PPIs were advocated, several studies have been conducted and conferences were held to develop appropriate and acceptable parameters for measuring OHS performance using lead factors. National Occupational Health and Safety Commission (NOHSC) of Australia organised workshops to determine the viability of PPIs as alternative to NPIs but could not produce any acceptable standards for their measurement (Blewett, 1994; Shaw, 1994; Dingsdag *et al.,* 2008). Another attempt made in 1999 by NOHSC through a tri-partite working group of industry, government and unions to develop a set of broad PPIs for measuring OHS performance across industry led to the development of 24 performance indicators. In two separate studies, Dingsdag *et al.,* (2006a & b) developed a matrix of safety cultural competencies based on safe behaviours and Safety Management Tasks (SMTs) for the Australian construction industry. Three main dimensions of safety culture namely: psychological, conditional and behavioural formed the thrust of the effort to develop performance indicators for PPIs (Choudhry *et al.,* 2007).

Dingsdag *et al.,* (2008) presented a summary of researches on safety culture in which several indicators so far proposed as measures of safety culture were listed. It is discovered that all the proposed indicators of PPIs have several shortcomings such as difficulty of measurability of safety performance, lack of validated evidence that the positive safety actions they generate actually impact on safety performance, lack of uniformity and standardisation in the application of PPIs, lack of acceptable measures of PPIs in the construction industry and lack of reference and use of PPIs in the provisions of existing safety regulations (Dingsdag *et al.*, 2008).

RESEARCH METHODS

A questionnaire survey research design approach was adopted in the study. The approach involves the use of structured questionnaires which was considered as the most appropriate tool to reach the population of the study especially when data required for the study can be obtained by the instrument. In the approach, a field survey of a sample of 86 projects was conducted. To obtain the sample, a preliminary survey of projects completed in 2008/09 in Nigeria was conducted in 2009 because of lack of reliable data on them. From the survey, a list of 120 projects was prepared and adopted as the study population frame. The heads of the project sites among contractors' site staff who were either engineers or builders constituted the respondents of the study.

Data collected consist of the characteristics of the construction firms sampled using four parameters namely: contractor type, business type, scope of operation and site OHS manager. Contractor type consists of indigenous and expatriate. Contractor business type consists of building, civil engineering and building/civil engineering. Contractor scope of operation consists of local (within one State in Nigeria), regional (within a geo-political zone consisting of six states), national (within two or more geo-political zones) and multinational (within two or more countries). Site OHS manager consists of safety coordinator/officer and site manager. Respondents were requested to indicate the type of firm or OHS manager applicable in their projects. Data were also collected on the adequacy of the provision of twelve CSF listed in the variables of the study. This was measured using five ranks namely: poor, low, moderate, high and very high. The ranks were scored as 1, 2, 3, 4 and 5 respectively. Data were also collected on the average number of workers engaged on the project sites in 2008 and the number of accidents and injuries recorded.

The data were collected with the aid of structured questionnaires administered on the respondents of the study. From the population frame, 86 projects executed by indigenous and expatriate construction firms were selected by stratified random sampling to form the study sample. The sampling option was adopted to ensure good representation of the two categories of contractors. The data collected were used to derive the parameters of OHS performance namely: accident per worker, injury per worker and injury per accident rates. The data were analysed using percentage, Relative Provision Index (RPI) and Chi-square test. RPI which is the same as Relative Importance Index (RII) was selected in order to obtain the mean index or score of the level of provision of the selected facilities and rank them. Chi-square test was selected for the test of the relationship between site facilities and OHS performance because the extent of provision of site facilities was measured in ordinal scale.

RESULTS

The results of the analysis of data collected are presented as follows:

Characteristics of Contracting Organisations used in the Study

The characteristics of the construction firms sampled were analysed and presented in Table 1.

Table 1. Characteristics of contracting organisations sampled

Characteristic	N	%	Characteristic	N	%
Contractor type			Contractor scope of operation		
Indigenous	70	81.4	Local	9	9.5
Expatriate	16	18.6	Regional	10	11.9
Total	86	100	National	40	47.6
Contractor business type			Multinational	26	31.0
Building	44	51.2	Total	84	100
Civil engineering	6	7.0	Site OHS manager		
Building/civil engineering	36	41.9	Safety manager	44	64.7
Total	86	100	Site manager	24	35.3
			Total	68	100

N=Number of respondents

Table 1 shows that the percentage of indigenous firms sampled is 81.4 while that of expatriate firms is 18.6. The result shows that the percentage of indigenous firms used for the study is higher than that of expatriate firms. This result is borne out of the results in previous studies that indigenous construction firms considerably outnumbered their expatriate counterparts (Edmond, 1979; Ogunpola, 1984; Olateju, 1991). Table 1 also shows that the percentage of the firms sampled that are engaged in building construction is 51.2, the percentage of firms engaged in the construction of civil engineering projects is 7 while that of firms engaged in the construction of both building and civil engineering projects is 41.9. This result shows that both building and civil engineering construction firms were covered in the study. The scope of operation of the contractors sampled shows that the percentage of local contractors is 9.5, that of regional and national contractors are 11.9 and 47.6 respectively while that of multinational contractors is 31. This result shows that the four categories of contractors that represent small, medium and large contractors are covered in the study. The analysis of the person responsible for OHS on site shows that the percentage of project sites with safety manager/coordinator is 64.7 while that of sites where the site manager is responsible for OHS is 35.3 This result shows that in the majority of the projects sampled, a safety manager/coordinator was engaged while in the minority of the projects, a safety manager/coordinator was not engaged rather the site manager was responsible for OHS management.

Adequacy of the Provision of Selected OHS Facilities on Construction Sites

Table 2 Ranks of Relative Provision Index (RPI) of selected OHS facilities on construction sites

Facilities	N	1	2	3	4	5	TS	RPI	Rank
Electricity and lighting	86	2	4	14	24	42	358	4.16	1
First aid facilities	86	2	4	14	30	36	352	4.09	2
Water supply	86	0	8	12	32	34	350	4.07	3
Fire protective devices	86	0	6	16	30	34	350	4.07	3
Personal protective equipment	86	2	2	14	40	28	348	4.05	5
Site cleanliness	86	0	4	26	30	26	336	3.91	6
Safety training	86	6	4	22	24	30	326	3.79	7
Canteen facilities	86	0	6	28	36	16	320	3.72	8
Maintenance of workplace facilities	86	2	8	20	40	16	318	3.70	9
Toilet facilities	86	2	12	22	34	16	308	3.58	10
Waste disposal	86	0	8	34	32	10	296	3.52	11
Bathing and dressing facilities	86	6	22	18	32	8	272	3.16	12

N=Number of respondents; 1=Poor; 2=Fair; 3=Moderate; 4=Good; 5=Very good;
TS=Total Score; RPI=Relative Provision Index

The OHS facilities provided on the project sites sampled were investigated to determine their adequacy. Respondents were requested to indicate the adequacy of provision of twelve selected facilities using five ranks as described in the research methods. The Relative Provision Index (RPI) which is similar to Relative Importance Index (RII) was used for the analysis of the data as explained in the research methods. The RPI of each facility was calculated and ranked. The results are presented in Table 2. The results in Table 2 indicate that the provision of electricity and lighting which is regarded by the respondents as good is the most adequate facility provided on site. This is followed by the provision of first aid facilities, water supply, fire protective devices and PPE which are also considered as good by the respondents. The provision of safety training, canteen, toilet, waste disposal and bathing and dressing facilities and cleanliness of site are regarded as average.

Relationship between Provision of Selected OHS Facilities and OHS Performance

In the attempt to establish whether or not the selected OHS facilities contribute to OHS performance, a research hypothesis was postulated. The hypothesis states that the adequacy of provision of selected OHS facilities on construction sites has no significant relationship with OHS performance. The respondents' assessment of the adequacy of provision of the selected facilities and three parameters of OHS performance namely: accident per worker rate, injury per worker rate and injury per accident rate which were derived as explained in the research methods were used for the test of the hypothesis. The hypothesis was tested using Chi-square test at p≤0.05. The rule for accepting or rejecting the hypothesis is that when the p-value>0.5, the hypothesis is accepted but when the p-value≤0.05, the hypothesis is rejected. The results are presented in Table 3.

Table 3 Results of Chi-square test of relationship between the adequacy of provision of OHS facilities and OHS performance on construction sites

Variables compared	N	χ^2 value	Df	p-value	Decision
Provision of toilet facilities on site					
Accident per worker rate	32	80.762	36	0.001	Reject
Injury per worker rate	42	119.875	57	0.001	Reject
Injury per accident rate	28	84.000	39	0.001	Reject
Provision of canteen facilities on site					
Accident per worker rate	32	74.133	36	0.001	Reject
Injury per worker rate	42	126.000	57	0.001	Reject
Injury per accident rate	28	84.000	39	0.001	Reject
Supply of portable water on site					
Accident per worker rate	32	66.222	36	0.002	Reject
Injury per worker rate	42	126.000	57	0.001	Reject
Injury per accident rate	28	84.000	39	0.001	Reject
Provision of first aid facilities on site					
Accident per worker rate	32	86.095	36	0.001	Reject
Injury per worker rate	42	121.275	57	0.001	Reject
Injury per accident rate	28	56.000	26	0.001	Reject
Site cleanliness					
Accident per worker rate	32	70.133	36	0.001	Reject
Injury per worker rate	42	120.750	57	0.001	Reject
Injury per accident rate	28	84.000	39	0.001	Reject
Waste disposal from site					
Accident per worker rate	30	45.357	22	0.002	Reject
Injury per worker rate	40	120.000	54	0.001	Reject
Injury per accident rate	26	52.000	24	0.001	Reject
Supply of PPE to workers on site					
Accident per worker rate	32	27.733	12	0.006	Reject
Injury per worker rate	42	37.760	19	0.006	Reject
Injury per accident rate	2	28.000	13	0.009	Reject
Safety training for workers on site					
Accident per worker rate		93.943	48	0.001	Reject
Injury per worker rate		162.667	76	0.001	Reject
Injury per accident rate		112.000	52	0.001	Reject
Provision of fire protective devices on site					
Accident per worker rate		62.667	36	0.004	Reject
Injury per worker rate		121.091	57	0.001	Reject
Injury per accident rate		84.000	39	0.001	Reject
Maintenance of workplace facilities					
Accident per worker rate		86.667	48	0.001	Reject
Injury per worker rate		168.000	76	0.001	Reject
Injury per accident rate		112.000	52	0.001	Reject
Provision of bathing & dressing facilities on site					
Accident per worker rate		122.514	48	0.001	Reject
Injury per worker rate		168.000	76	0.001	Reject
Injury per accident rate		112.000	52	0.001	Reject
Provision of electricity and lighting on site					
Accident per worker rate		65.067	36	0.002	Reject
Injury per worker rate		119.250	57	0.001	Reject
Injury per accident rate		84.000	39	0.001	Reject

N=Number of respondents; Df=Degree of freedom

Table 3 shows that the adequacy of provision of toilet facilities on site is significantly related to accident per worker rate, injury per worker rate and injury per accident rate. Similarly, the adequacy of provision of canteen facilities on site is significantly related to accident per worker rate, injury per worker rate and injury per accident rate. The adequacy of supply of portable water on site is significantly related to accident per worker rate, injury per worker rate and injury per accident rate. Also, the adequacy of provision of first aid facilities on site is significantly related to accident per worker rate, injury per worker rate and injury per accident rate.

Table 3 shows that the adequacy of cleanliness of site is significantly related to accident per worker rate, injury per worker rate and injury per accident rate while the adequacy of disposal of waste from site is significantly related to accident per worker rate, injury per worker rate and injury per accident rate. The test of the hypothesis also shows that the adequacy of provision of PPE is related to accident per worker rate, injury per worker rate and injury per accident rate while the adequacy of provision of safety training is related to accident per worker rate, injury per worker rate and injury per accident rate. The adequacy of provision of fire detective devices on site is discovered to be significantly related to accident per worker rate, injury per worker rate and injury per accident rate. The result of the test also shows that the adequacy of maintenance of workplace facilities is significantly related to accident per worker rate, injury per worker rate and injury per accident rate while the adequacy of provision of bathing and dressing facilities on site is significantly related to accident per worker rate, injury per worker rate and injury per accident rate. In the same vein, the adequacy of provision of electricity and lighting on site is significantly related to accident per worker rate, injury per worker rate and injury per accident rate. The results of the test of the hypothesis above indicate that the adequacy of provision of the twelve selected facilities has significant influence on the three parameters of OHS performance.

DISCUSSION OF FINDINGS

The results of the analysis of the characteristics of the respondents have indicated that the majority of the contractors sampled are indigenous firms. These results indicate that the results of the study are mostly applicable to projects executed by indigenous contractors. The results of the ranking of the adequacy of provision of the selected OHS facilities show that the RPIs vary from one facility to another with the provision of electricity and lighting being the most adequate while the provision of bathing and dressing facilities on site is the least adequate. These results tend to indicate that the contracting firms who are majorly indigenous contractors provide some facilities more than others on site. This result implies that the priority accorded the facilities and the resources committed to their provision by the contracting firms vary from one facility to another.

The attempt to establish the contribution of the provision of the facilities and perhaps the reason why some are more provided than others led to the test of the relationship between their provision and OHS performance. The results of the test above show that the adequacy of the provision of all the facilities has significant influence on OHS performance. The implication of this result is that the adequacy of the provision of any of the facilities will contribute to improved OHS performance on site. In other words, inadequate provision of the facilities will contribute to increase in the number of accidents and injuries to workers on site while adequate provision of the facilities can contribute to reduction in the number of accidents and injuries to workers on site.

CONCLUSION

The results of the study have shown that the adequacy of the provision of some facilities is good while that of others is average. From these results, it can be concluded that some facilities are provided more than others and that there is room for improvement in the provision of all the facilities. The results of the relationship between the provision of the facilities and OHS performance have further indicated that the provision of each of the facilities on site can contribute to improvement in OHS performance on construction sites. This result is an indication that the provision of any of the facilities is as important as the provision of others. In other words, Nigerian contractors need to give equal consideration and commit equal resources and effort to the provision of all the facilities. The result equally indicates the need for construction firms to ensure improvement in the provision of the facilities. Such an improvement as established by study can reduce accident and injury rates on site.

Based on the results of the study, it is suggested that contracting firms should commit adequate resources to the provision of OHS facilities in every project site. They should put in place appropriate provisions in their OHS policy and structures to ensure that the facilities are adequately provided whenever they mobilise workers to a site.

REFERENCES

Abudayyeh, O, Fredericks, T K, Butt, S and Shaar, A (2006) An investigation of Management's Commitment to Construction Safety. *International Journal of Project Management*, 24(2), 167-174

Blewett, V (1994). Beyond Lost Time Injuries, Positive Performance Indicators for OHS. Summary Paper *Positive Performance Indicators Beyond Lost Time Injuries, Part 1 – Issues.* Worksafe Australia, National Occupational Health and Safety Commission, Canbarra, pp 1-55

CBPP (2002) Construction Best Practice Programme. http://www.cbpp.org.uk. Cited February, 2002

Choudhry, R, Fang, D P and Mohamed, S (2007). The Nature of Safety Culture: A Study of the state-of-the-art. *Safety Science,* 45, 993-1012

Dingsdan, D P, Biggs, H C and Sheahan, V L (2006a). The Carrot and the Stick: Driving Safety Culture in the Construction Industry, in K. Brown, K. Hampson and P. Brandon (eds.), *Clients' Driving Innovation: Moving Ideas into Practice.* Cooperative Research Centre for Construction Innovation, Icon Net Pty Limited, Brisbane, pp214-223

Dingsdan, D P, Biggs, H C, Sheahan, V L and Cipolla, D J (2006b). *A Construction SafetyCompetency Framework: Improving OH&S Performance by Creating and Maintaining a Safety Culture.* Cooperative Research Centre for Construction Innovation, Icon Net Pty Limited, Brisbane

Dingsdan, D P, Biggs, H C and Cipolla, D (2008). Safety Effectiveness Indicators (SEIs): Measuring Construction Industry Safety Performance. *Proceedings of the 3rd International Conference of the Cooperative Research Centre (CRC) for Construction Innovation – Clients' Driving Innovation, Benefitting from Innovation.* Gold Coast, Australia.

Edmonds, G A (1979): Macro firms; Construction Firms for the Computer Age. *Journal of Construction Engineering and Management* 109 (1). 13-24.

Eurostat (2001) European Social Statistics: Accidents at Work and Work related health problems (1994-2000). Eurostat, European Communities

Eurostat (2002) European Social Statistics: Accidents at Work and Work related health problems (1994-2000). Eurostat, European Communities

Hare, B and Cameron, (2010) Site Manager Training and Safety Performance. *Proceedings of CIB 2010 World Congress on Building a Better World,* 10th-13th May 2010, Salford. UK

HSC (2001) *Health and Safety Statistics 2000/01*, National Statistics. Health & Safety Commission

HSC (2003) *Health and Safety Statistics 2002/03*, National Statistics. Health & Safety Commission

HSE (1993) Health and Safety Executive. http://www.hse.gov.uk Cited February 2002

HSE (2002) Health and Safety Executive. http://www.hse.gov.uk Cited February 2002

HSE (2006) An Analysis of the Significant Causes of Fatal and major Injuries in Scotland.

Research Report 443. Health and Safety Executive, London

HSE (2009) HSE Statistics. http://www.hse.gov.uk/statistics. Cited September 2009

Idoro, G I (2007) A comparative Evaluation of Health and Safety Performance of

Indigenous and Multinational Construction Firms in Nigeria. *Construction Research Journal,* 1(1), 65-75

Idoro, G I (2008) Health and Safety Management Efforts as Correlates of Health and Safety Performance in the Nigerian Construction Industry. *Journal of Civil Engineering Management,* 14(4), 277-288

IQSH (2009) *IQSH Membership Structure. Institution for Occupational Safety and Health*. http://www.iqsh.co.uk/index.ofm?go=membership structure. Cited September 2009

Jaselskris, E, Anderson, S and Russell, J (1996) Strategies for achieving Excellence in Construction Safety Performance. *Journal of Construction Engineering and Management*, 122(1), 61-70

Ogunpola, A (1984): The Structure of Building Costs and Implication for Economic Development. *Proceedings of the Annual Conference of Nigerian Economic Society***.** Nigerian Economic Society, University of Ibadan, Ibadan, Nigeria. pp 28.

Olateju, B (1991): Enhancing the Contract Management Capabilities of the Indigenous Contractor: *Effective Contract Management in the Construction Industry.* The Nigerian Institute of Building, Lagos, Nigeria. pp.132-142

QCA (2009) *Qualifications can cross Boundaries.* http://www.qca.org.uk. September 2009

Reason, J (1997) Managing the Risks of Organisational Accidents. Ashgate Publisher, Aldershot

Shaw, A (1994). OHS Performance Indicators for Benchmarking: *Positive Performance Indicators beyond Lost Time Injuries, Part 1 – Issues.* Worksafe Australia, National Occupational Health and Safety Commission, Australia, pp 15-27

Short, B (1998) *Health and Safety in the Construction Industry, positive prognosis or bitter pill*. http//www.hse.gov.uk/indg 341. Accessed March 16 2006.

Whitelaw, J (2001) Safety: What do you think? *New Civil Engineer*, January, 11, 22-24.

INFLUENCE OF IT USE AT PRE-CONTRACT STAGE OF CONSTRUCTION PROJECTS IN AKWA IBOM STATE NIGERIA

Jimmy Wilson[1] and Godwin Idoro[2]
1Department of Building, University of Uyo, Uyo, Nigeria
2Department of Building, University of Lagos, Akoka, Nigeria

The growth of the construction industry is increasingly predicated on technology driven investments in Information Technology (IT). This study evaluates the extent of use of IT at pre-contract stage of construction projects in Akwa Ibom State. The objectives are to determine the factors that affect the use of IT at pre-contract stage, the extent of use of IT at pre-contract stage of construction projects and its influence on project performance. A questionnaire survey design approach involving a field survey of a sample of forty projects was conducted. Data were collected from project leaders of the projects sampled using structured questionnaires and analysed with Mean Item Score and Chi Square. The results indicate that high cost of IT hardware and software, lack of management commitment, low level of computer literacy of project leaders and size of firm rank high in effect on the use of IT. It also reveals that the extent of use of IT at pre-contract stage does not contribute to project performance. Greater use of IT at pre-contract stage is suggested as a tool for improving project performance while local production of IT hardware and software, greater management commitment and computer training programmes are suggested as measures of increasing the extent of use of IT at pre-contract stage.

Keywords: information technology, Nigeria, pre-contract stage, project performance.

INTRODUCTION

Every construction process requires heavy exchange of data and information between project participants on a daily basis. Construction industries usually use Information Technology (IT) in order to overcome problems and achieve improvements in construction process. The average annual growth rate of IT investment in the construction industry is increasing every year and this now constitutes a significant part of the total project cost. (Issa *et al*., 2007). Information Technology (IT) is seen as a mechanism that enables fundamental change to be effected in the construction industry. However, firms in the construction industry are slowly responding and adapting to developments in information and communication technologies (Alshawi *et al*., 2003). O'Connor and Yang (2003) opined that the success of a project is related to the level of IT use. The duo approached the issue of IT by means of statistical methods and discovered that there is a statistically significant correlation between the use of IT and projects being successful. In Nigeria, Oladapo (2007) argued that the level of use of IT in the construction industry is low and one of the reasons is attributed to the project leaders' attitudes toward the use of IT in their organisations.

[1] Jimmy2wilson@yahoo.com
[2] iroroidoro@yahoo.com

Wilson, J. and Idoro, G. (2011) Influence of IT use at pre-contract stage of construction projects in Akwa Ibom State Nigeria *In:* Laryea, S., Leiringer, R. and Hughes, W. (Eds) *Procs West Africa Built Environment Research (WABER) Conference,* 19-21 July 2011, Accra, Ghana, 651-661.

The focus area of this study are on the level of use of IT at pre-contract stage, the factors that affect IT adoption, the use of IT in construction projects in Akwa Ibom State and its influence on project performance. IT has been an effective tool adopted in other industries to enhance work processes and achieve digital-based documentation and communication, resulting in a real-time connection among work stakeholders and suppliers (Fischer and Kunz, 2004). The use of IT reduces task fragmentation and improves coordination and collaboration, resulting in better communication practices among team members of the construction project (Stewart *et al.,* 2002). The implementation and use of IT is not a straightforward process because many issues need to be considered at the earlier stages when IT is to be adopted. Previous study conducted by O'Connor *et al.,* (2003) focused on the use of IT throughout the different phases of a project. The focus of the study is restricted to the pre-contract stage because it is the stage when major documentation on a project is done. The significance of this study comes from the fact that IT has an important role to play in the speed, cost and quality of project documentation which should translate to improved project performance. In order for this to be achieved, there is the need for greater awareness of the benefits that IT brings to construction. This understanding prompts this study. The objectives are to evaluate the impact of selected factors on IT usage, the extent of IT usage at the pre-contract stage of oil and gas projects and its influence on project performance in Akwa Ibom State of Nigeria. The results will assist oil and gas companies, construction organisations and project leaders to promote the use of IT in the delivery of construction projects in Akwa Ibom State Nigeria.

USE OF IT AND ORGANISATIONAL PERFORMANCE

Information technology strategy can positively influence competitive and organisational performance (Hampson and Tatum 1997). Johnson and Clayton (1998) contended that information technology can improve productivity of teams and management procedures. Back and Moreau (2000) suggested that improving internal information exchange and integrating project-based information across organizational boundaries may result in project cost and schedule reductions. Thomas *et al*., (2001) evaluated the impacts of design/information technologies by connecting their use to project performance in terms of cost growth, schedule growth, and safety success. Whyte *et al*., (2002) explored processes by which emerging technologies can be introduced into construction organizations. Goodrum and Haas (2002) investigated the impact of different types of equipment technologies on construction productivity. De Lapp et al. (2004) examined the impacts of computer-aided design (CAD) on design realization. Tse and Choy (2005) carried out an in-depth interview for studying the scope of use of information technology (IT) in Hong Kong's construction industry. Lee *et al.,* (2005) examined the relative impacts of selected practices on project cost and schedule. Peansupap and Walker (2005) addressed the critical issue of how best to adopt and diffuse information technology (IT) into organizations. A review of the literature suggests that the use of technology as a means to enhance project performance has been widely supported. Generally, many researchers have suggested that technology provides significant benefits to construction projects. The literature review provides a background for developing an understanding of the issues related to the adoption and use of technology, factors influencing the adoption of technology, and the benefits to be derived from information technology. This research adds to the literature by providing important results on the comparisons of information technology utilisation at project phases.

BENEFITS OF THE USE OF IT IN CONSTRUCTION PROJECTS

IT has been an effective tool adopted in other industries to enhance work processes and achieve digital-based documentation and communication, resulting in a real-time connection among work stakeholders and suppliers (Fischer and Kunz, 2004). The potential benefits to be derived from using IT in construction processes can be examined from construction strategy and operational views (Love *et al* 2004, Stewart 2008); therefore the benefits of IT could be tangible and direct or intangible and indirect, depending on their nature and scope (Suwardy *et al.*, 2003, Love *et al.*, 2004). Moreover, the benefits of using IT in the construction industry should be apparent in such business success criteria as increased work efficiency, effectiveness and performance of the construction projects (Alshawi *et al.*, 2003). However, implementing IT in construction companies does not always have economic justification and does not usually provide all the benefits initially envisaged at the expected time (Andresen *et al.*, 2000, Alshawi *et al.*, 2003). The use of IT reduces task fragmentation and improves coordination and collaboration, resulting in better communication practices among team members of the construction project (Stewart *et al.*, 2002). The strategic IT benefits for construction companies do not occur unless dramatic changes take place, because the technology only enables, and benefits don't come about automatically (Alshawi *et al.*, 2003, Norton, 1995). A specific style of management may realize IT benefits in a short time frame. Other benefits require more time for maturity, therefore, there is a time gap between the initial investment and revenues (Peppard *et al.*, 2007). Some benefits have direct and tangible effects on productivity, while others have intangible results in terms of effectiveness and performance (Andresen et al, 2000).

BARRIERS TO THE USE OF IT IN CONSTRUCTION PROJECTS

Many of the barriers to the use of IT are attributable to the high cost of investment and the nature of the construction industry (Marsh & Finch 1998, Marsh & Flanagan 2000). A common barrier is the limited investment in IT by firms in the construction industry. (Marosszeky *et al.* 2000) identified causes of low levels of adopting IT. In their study, they found out that limited skills and vision in strategic IT use at organisational level; Perceptions of financial risk and lack of precedent clear benefits of IT investment were the reasons of low level of IT adoption. Another barrier to IT adoption is technical constraints. Problems in this area can be grouped into immaturity of technology, limited quality of technology, and non-standardisation. Stewart and Mohamed (2002) identified barriers to IT implementation in developing countries. The result his study concluded that high cost of IT; Quality and quantity of IT infrastructure; System incompatibility; Lack of IT skill and supports IT were the barriers to IT implementation in developing countries. IT adoption involves both technical and social issues and requires an understanding of IT management in order to ensure that full benefit is gained from IT investment. Construction organisations that derive benefits from IT investment will only get partial benefits if only a few people actually adopt and use it and even within organisations where many users adopt IT, they will find it difficult to communicate or transfer electronic information with colleagues who avoid using IT (Stewart *et al.*, 2004)

VARIABLES AND CONCEPTUAL FRAMEWORK FOR THE STUDY

Three variable groups namely: IT factors, IT usage and project performance were used in the study. IT factors consist of sixteen factors that affect the extent of use of IT in project delivery process. IT usage variable group consists of eleven project delivery processes. Two parameters of project performance namely: time-overrun and cost-overrun were selected.

Relevant literature was reviewed in order to select the variables and develop a research framework. The role of the organisational characteristics such as size, firm business type, was considered as vital factor in the use of IT in construction project. Several researchers have discussed this variable from different perspectives; from the adoption of microcomputers, use of PCs, to studying end-user satisfaction. The demographic variables are the most widely studied factors. The variables include computer literacy, commitment of management to IT investment, experience on IT, educational qualification and IT awareness of management staff. Montazemi (1988) discovered that the level of management's computer literacy correlates with their participation in the systems development process. Fear of virus attack, non compatible software, need to continually upgrade, constituted technological factors according to Oladapo (2007). According to O'Connor (2001), there are a total of 68 work functions that make a project. For the purpose of this work, 11 work functions which make up the pre-contract process as modified from Kim (1996) are studied. Pre-contract work function include: design, tender/bid analysis, budgeting /financing, project communication, engineering analysis, estimating and accounting, project data storage , documentation and reporting, risk assessment, scheduling and tracking and project scope definition. The benefits of IT usage in these work functions from the studies reviewed above (Suwandy et al., 2003; Alshawi et al., 2003; Love et al., 2004) are manifested in project performance. The framework for the study was developed from the understanding that IT usage is related to project performance. The framework is presented in Fig. 1.

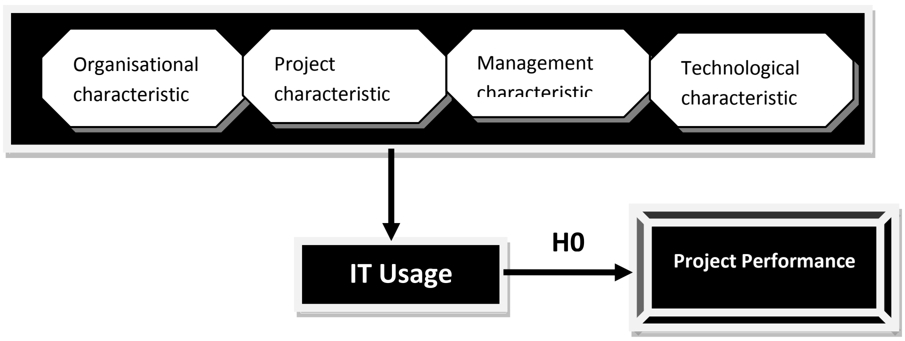


Fig. 1 Conceptual Framework for evaluating the relationship between IT usage and project performance

RESEARCH METHOD

A questionnaire survey design approach was adopted for the study. In the approach, a field study of forty oil and gas construction projects was conducted. The projects were a sample of oil and gas projects located in Akwa Ibom State of Nigeria. To obtain the sample, a pilot study was conducted in late 2010 to identify recently completed oil and gas projects within the study area. From the survey, 76 projects were identified and adopted as the study population frame. Data were collected on the respondents' assessment of the effect of the sixteen selected factors on the use of IT and the extent of use of IT in eleven pre-contract phase work processes, the initial and final contract periods and sums of the projects sampled. Respondents' assessment of the effect of IT factors and the extent of use of IT in project delivery processes were measured using five ranks namely: nil, low, moderate, high and very high. The ranks were assigned scores of 1, 2, 3, 4 and 5 respectively. This measurement scale agrees with the scale of measurement on the level of computerisation of project (Kim, 1996).

A research hypothesis was postulated to achieve the objectives of the study. The hypothesis tests significant relationship between the parameters of IT usage and project performance. The results of the hypothesis will establish whether or not the use of IT contributes to project performance.

Data were collected using structured questionnaire. The instrument was administered in early 2011 on the project leaders such as: project managers, architects, project engineers, project co-ordinators, design engineers, discipline engineers, cost and schedule engineers and construction managers, responsible for managing the projects sampled. Project leaders in this study are professionals employed in clients' organisations and they represent the project clients. From the questionnaires returned, forty projects were selected by stratified sampling technique as the study sample. In the sampling, the data were classified into onshore and offshore and Greenfield and brownfield and samples were selected from each project category randomly.

The initial contract periods of the projects sampled were subtracted from their actual contract periods to derive time-overrun while the initial contract sums were subtracted from final contract sums to derive cost-overruns. The percentages of time-overrun to initial contract periods and cost-overrun to initial contract sums of the projects were thereafter derived as parameters of project performance. The data were analysed to determine the characteristics of projects sampled using percentage, compare the respondents' assessment of the effect of IT usage factors and the extent of use of IT in selected project delivery processes using Mean Item Score (MIS) and the relationship between IT usage and project performance using Chi-square test.

RESULT OF DATA ANALYSIS AND DISCUSSION

The results of the analysis of data collected are presented as follows:

Table 1 Descriptive result of the characteristics of respondents used in the study

Respondents' characteristic	N	%	Respondents' characteristic	N	%
Job Description			**Experience**		
Project manager	10	25.0	1-5 years	6	15.0
Discipline engineer	2	5.0	5-10 years	13	32.0
Design engineer	6	15.0	11-15 years	8	20.0
Architect	3	7.5	16-20 years	11	27.5
Construction manager	5	12.5	21-25 years	2	5.0
Project co-ordinator	4	10.0	Total	40	100.0
Project engineer	6	15.0	**Organisation business type**		
Cost/Schedule engineer	4	10.0	Offshore construction	19	47.5
Total	40	100.0	Onshore construction	11	27.5
Qualification			Oil & Gas services	5	12.5
HND	9	22.5	Civil engineering construction	1	2.5
B.Sc.	18	45.0	Engineering Design service	1	2.5
M.Sc.	13	32.5	Consultancy services	3	7.5
Total	40	100.0	Total	40	100.0

N=Number of respondents

Characteristics of Respondents of the Study

Four characteristics namely: Respondents' job description, qualification, experience and organisation business type were investigated. The percentages of the respondents' sampled in each of the sub-variables of respondents' characteristics are analysed and presented in Table 1. Table 1shows that the eight disciplines that serve as project leaders in oil and gas construction projects were covered in the study. Result on respondents' qualification shows that the respondents of the study possessed qualifications required for management position. On experience, this result shows that project leaders with both short and long experience were covered in the study.

Characteristics of Projects Sampled

Five project characteristics namely: project type, category, location, duration and cost were investigated. The percentages of the projects sampled in each of the sub-variables of project characteristics are presented in Table 2.

Table 2 Descriptive result of the characteristics of projects used in the study

Project characteristic	N	%	Project characteristic	N	%
Project location			**Project type**		
Onshore	16	40.0	Civil construction	7	17.5
Offshore	24	60.0	Fabrication	16	40.0
Total	40	100.0	Installation	9	22.5
Project category			Building construction	2	5.0
Greenfield	17	42.5	Well work/servicing	2	5.0
Brownfield	23	57.5	Pipeline	4	10.0
Total	40	100.0	Total	40	100.0
Project duration			**Project budget**		
1-6 months	11	27.5	$1-25 million	19	47.5
7-12 months	18	45.0	$26-50 million	8	20.0
Above 12 months	11	27.5	$51-100 million	8	20.0
Total	40	100.0	Above $100 million	5	12.5
			Total	40	100

N=Number of projects

Table 2 shows that both onshore and offshore projects were used in the study although offshore projects constituted the majority. Results of project category also indicate that both greenfield and brownfield projects were sampled but the latter constituted the majority.

Factors affecting the Use of Information Technology in Construction Project Delivery

Sixteen factors stated in the variables of the study were investigated to evaluate their effects on IT usage in project delivery. Respondents were requested to indicate their assessment of the effect of the factors on the use of IT in the delivery process of their projects. The respondents' assessment was measured as described in the research methods. The Mean Item Score (MIS) of their assessment was analysed and ranked. The results are presented in Table.3.

Table 3 reveals that the cost of IT, size of firm, project leaders' computer literacy level and firms' business type are the top four constraints to the use of IT in project delivery. Computer components are known to be import-oriented in Nigeria and this has made their cost to be very high. This result tends to imply that the import-oriented nature of IT in Nigeria has the highest impact on the use of IT in project delivery. On the size of firm, a firm can be large or small depending on its workforce and workload. The result tends to indicate that the use of large or small firm in project delivery and its type of business have high impact on the use of IT in project delivery process. This finding supports Valida *et al.* (1994) who discovered that different business sectors have different levels of IT integration. The computer literacy level of project leaders is another factor that is discovered to have a high impact on the use of IT in project delivery. Project location, type and category are discovered to have the least impact on the use of IT in project delivery. These results indicate that project characteristics are not major factors that hinder or promote the use of IT in project delivery. This shows that brown field or green field projects, onshore or offshore projects within the area of study have no effect on the use of IT at pre-contract stage.

Table 3 Ranks of the effect of selected factors on the use of IT in project delivery process

Pre-contract stage process	1	2	3	4	5	N	Score	MIS	Rank
Cost of hardware & software	0	2	4	6	28	40	180	0.90	1
Size of firm	0	0	6	16	18	40	178	0.89	2
PLs computer literacy	0	0	9	10	21	40	172	0.86	3
Firm business type	1	1	2	9	27	40	171	0.86	3
Commitment of management	0	1	7	14	18	40	169	0.85	5
PL experience on construction	0	1	11	12	16	40	163	0.82	6
PL educational qualification	1	1	7	17	14	40	162	0.81	7
Technological demand	1	3	7	14	15	40	159	0.80	8
Cost of IT staff	0	3	11	12	14	40	157	0.79	9
Fear of virus attack	0	3	10	14	13	40	157	0.79	9
Non-compatible software	0	4	9	15	12	40	155	0.78	11
Supply of power	0	3	11	13	11	40	154	0.77	12
IT awareness	2	1	10	16	11	40	153	0.77	12
Project location	1	3	9	17	10	40	153	0.77	12
Project type	0	3	14	16	7	40	147	0.74	15
Project category	1	14	13	6	6	40	122	0.61	16

1=Nil, 2=Low, 3=Moderate, 4=High, 5=Very high, N=Number of respondents, PL= Project leader

Extent of Use of Information Technology at Project Pre-contract Stage

Table 4 Ranks of the levels of use of IT in selected pre-contract stage processes

Pre-contract stage process	1	2	3	4	5	N	Score	MIS	Rank
Design	0	0	7	13	20	40	173	0.87	1
Tender/bid analysis	0	0	9	9	22	40	173	0.87	1
Budgeting/financing	0	1	8	11	20	40	170	0.85	3
Communication	0	0	7	18	15	40	168	0.84	4
Engineering analysis	0	2	9	9	20	40	167	0.84	4
Estimating and accounting	0	1	12	11	16	40	162	0.81	6
Data storage	0	1	4	10	21	40	159	0.80	7
Documentation and reporting	0	0	16	14	10	40	154	0.77	8
Risk assessment	0	0	12	22	6	40	154	0.77	8
Scheduling and tracking	0	2	14	15	9	40	151	0.76	10
Scope definition	0	5	18	11	6	40	138	0.69	11

1=Poor, 2=Low, 3=Moderate, 4=High, 5=Very high, N=Number of respondents

One of the objectives of the study is to evaluate the extent of use of IT at the pre-contract stage of a project. The pre-contract stage is mainly an engineering and project documentation stage in which several documents that define the requirements of clients and objectives of projects are defined and translated into plans, reports or bills for the execution of projects. For this reason, the process of preparing the pre-contract documents was used as the basis of evaluating the extent of use of IT at the pre-contract stage. Eleven processes stated in the variables of the study were selected and the extent of use of IT in each stage was measured as described in the research methods. Respondents were requested to indicate the rank representing their assessment of the extent of IT use in carrying out each process. The MIS of the respondents' assessment was analysed and ranked. The results are presented in Table 4.

Table 4 shows that the extent of use of IT in carrying out the selected pre-contract processes differs from process to process. The results shows that the use of IT at pre-contract stage is high ranging from MIS of 0.69 to 0.87. Design and tender analysis processes are discovered to have the highest IT usage. This shows that IT is used extensively for design and tender analysis. Communication and engineering analysis are also discovered to rank high in the use of IT. The use of IT for project budgeting/financing is also discovered to rank high. In line with the earlier result which shows that the cost and availability of hardware and software has the highest impact on IT usage, these results tend to indicate that software for project design, tender analysis, communication and engineering analysis are readily available and applied. The reverse is the case of risk analysis, project scheduling and tracking and scope definition which are discovered to rank lower than other processes in the use of IT at pre-contact.

Relationship between the Use of Information Technology and Project Outcome

To achieve the objective of evaluating the influence of the use of IT on project performance, eleven project delivery processes and two parameters of project performance namely: time-overrun and cost-overrun stated above were used.

Table 5 Results of Chi-square test of relationship between the use of IT and project outcome

Variables correlated	N	x^2 value	Df	p-value	Decision
Project time-overrun					
Design	40	45.416	50	0.658	Accept
Tender/bid analysis	40	55.640	50	0.271	Accept
Budgeting/financing	40	93.962	75	0.068	Accept
Communication	40	59.212	50	0.175	Accept
Engineering analysis	40	81.111	75	0.295	Accept
Estimating and accounting	40	85.221	75	0.197	Accept
Data storage	40	64.413	75	0.803	Accept
Documentation and reporting	40	57.137	50	0.227	Accept
Risk assessment	40	55.025	50	0.290	Accept
Scheduling and tracking	40	79.762	75	0.332	Accept
Scope objective definition	40	82.744	75	0.253	Accept
Project cost-overrun					
Design	40	80.000	78	0.416	Accept
Tender/bid analysis	40	80.000	78	0.416	Accept
Budgeting/financing	40	120.000	117	0.406	Accept
Communication	40	80.000	78	0.416	Accept
Engineering analysis	40	120.000	117	0.406	Accept
Estimating and accounting	40	120.000	117	0.406	Accept
Data storage	40	120.000	117	0.406	Accept
Documentation and reporting	40	80.000	78	0.416	Accept
Risk assessment	40	80.000	78	0.416	Accept
Scheduling and tracking	40	120.000	117	0.406	Accept
Scope objective definition	40	120.000	117	0.406	Accept

N=Number of respondents, Df=Degree of freedom

A research hypothesis was postulated for this objective. The hypothesis states that the use of IT at pre-contract stage has no significant relationship with project performance. The hypothesis was tested using the Chi-Square test at $p \leq 0.05$. The rule for the rejection or non-rejection of the hypothesis is that when the p-value > 0.05, the test fails to reject the hypothesis but when the p-value ≤ 0.05, the hypothesis is rejected. The results of the test of the hypothesis are presented in Table 5.

Table 5 shows that the p-values for the test of relationship between project time-overrun, project cost overrun and the use of IT are greater than the critical p-value (0.05). The results of the test fail to reject the hypothesis. These results indicate that the use of IT at pre-contract stage have no significant relationship with project performance. The results indicate that the use of IT for carrying out project delivery processes at the pre-contract stage does not contribute to project performance. This result tend to imply that increased utilisation of IT at pre-contract stage does not contribute to the long delay and high cost-overrun of projects which have been the bane of the construction industry in Nigeria and it does not serve as a solution. This finding does not support the result of the study conducted by O'Connor *et al*., (2003) which discovered that information technology usage throughout all project phases contributes to cost and schedule success of a project. Also, it does not agree with the findings in O'Connor and Yang (2003) study that, for US projects, the levels of information technology usage in project work functions are positively associated with the projects' levels of cost success. The reason for this may not be unconnected with the fact that the parameters of project performance used in the study do not include the time and cost expended at the pre-contract stage. This may also be due to the limitation in the scope of the study to IT use at pre-contract stage. Other reasons could be variation in perception of project success and ways to execute work functions between the project phases. This result tends to imply that increased utilisation of IT at pre-contract stage does not contribute to the long delay and high cost-overrun of projects which have been the bane of the construction industry in Nigeria and it does not serve as a solution. It also tends to indicate that the benefits of IT usage will manifest better in the delivery speed and cost of pre-contract processes than post-contract processes.

CONCLUSION

The purpose of this study is to investigate the extent to which information technologies are used in pre-contract processes in Akwa Ibom State Nigeria and its contribution to project performance. This was accomplished by carrying out a survey of 40 completed oil and gas projects located in Akwa Ibom State in 2011. The conclusion from the findings of the study is that first, high cost of IT has the highest impact on its use in project delivery. The problem can be traced to the high cost of importing IT components. The problem calls for support from all stakeholders including the Nigerian government to ensure high level of IT literacy among project participants, subsidised IT components and development of local and affordable software.

Second, information technology usage at pre-contract stage is high but it does not contribute to project performance. Generally, the findings indicate that oil and gas construction projects in Akwa Ibom State employ relatively high level of technology usage but this does not statistically produce significant correlation with the levels of cost and schedule successes. The availability of specialized software coupled with limited work scope may help explain the high information technology levels associated with this phase. The findings of the study provide direction for decision making on information technology investment and are helpful to managers in deciding whether to apply technologies to certain work functions.

The findings of the study do not in any way imply that IT usage does not contribute to project performance. IT innovation has an important role to play at both strategic and operational levels in project delivery. At a business strategy level, IT could be used to establish a corporate differentiation strategy as well as a cost reduction strategy. At an operational level, IT can be used to help improve project information exchange, communication and document sharing during the construction project life cycle. In addition, it can also enhance the process of construction procurement. These benefits should provide one of the primary drivers for IT use and adoption in the construction industry. However, the results do indicate that the benefits of IT usage will manifest mainly on the performance of the process or function for which it is used. This understanding suggests the need for an investigation of the use of IT on the performance of pre-contract stage process.

REFERENCES

Alshawi, M. and Ingirige, B. (2002) Web-based project management: A report on web-enabled project management, School of Construction and Property Management, University of Salford, UK.

Alshawi, M. and Ingirige, B. (2003), 'Web-enabled project management: An emerging paradigm in construction', Automation in Construction, vol. 12, no. 4, pp. 349- 64.

Andersen, T., and Segars, A. (2002). The impact of IT on decision structure and firm performance: evidence from the textile and apparel industry. Information and Management, 39, 85-100.

Andresen J., Baldwin A., Betts M., Carter C., Hamilton A., Stokes E. and Thorpe T. (2000). A Framework for Measuring IT Innovation Benefits, Journal of Information Technology in Construction (ITcon), 5, 57-72.

Back, W. E., and Moreau, K. A. (2000). Cost and schedule impacts of information management on EPC process. Journal of Management. Engineering, 16(2),59–70.

De Lapp, J. A., Ford, D. N., Bryant, J. A., and Horlen, J. (2004). Impacts of CAD on design realization. Engineering, Construction and Architectural Management, 11(4), 284–291.

Fischer M. and Kunz J. (2004). The scope and role of information technology in construction. CIFE Technical Report 156, Civil and Environmental Engineering Dept., Stanford University, Palo Alto, pp 17-28.

Hampson, K., and Tatum, C. (1997). Technology strategy and competitive performance in bridge construction. Journal of Construction Engineering and Management, 123(2), 153-161.

Issa, RR.A.; Flood, L.; Caglasin, G. (2007). A survey of e-business implementation in the US construction industry. Electron Journal Information Technology Construction. 8, 115-120.

Johnson, R. E., and Clayton, M. J. (1998). The impact of information technology in design and construction: The owner’s perspective.”Autom. Constr., 8(1), 3–14.

Kim, C. (1996). An evaluation of the impact of integration and computerization on construction projects. PhD Thesis., Worcester Polytechnic Institute, Worcester, MA.

Lee, S., Thomas, S. R., and Tucker, R. L. (2005). “The relative impacts of selected practices on project cost and schedule.” Constr. Manage. Econom., 23(5), 545–553.

Love P. E. D., Irani, Z. and Edwards D. J. (2004). Industry-centric benchmarking of information technology benefits, costs and risks for small-to-medium sized enterprises in construction, Journal Automation in Construction, 13(4), 507–524.

Norton D. P. (1995). Managing benefits from information technology, Information Management & Computer Security, 3(5), 29-35. ITcon 16 (2011),Karrem, pg. 492

Marosszeky, M., Sauer, C., Johnson, K., Karim, K. and Yetton, P. (2000). Information Technology in the building and construction industry: The Australian Experience, Proceedings of INCITE 2000 conference, implementing IT to obtain a competitive advantage in the 21st century, Hong Kong Polytechnic University, Hong Kong, 78-92.

Marsh, L. and Finch, E. (1998), 'Attitudes towards auto-id technologies within the UK construction industry.' Construction Management & Economics, 16(4), 383-8.319

Marsh, L. and Flanagan, R. (2000), 'Measuring the costs and benefits of information technology in construction', Engineering, Construction and Architectural Management, 7(4), 423-35.

Montazemi, A. R., (1988) "Factors Affecting Information Satisfaction in the Context of the Small Business Environment", MIS Quarterly 12(2), 239-256.

O´Connor, J. T. and Yang, L. R.(2003). Impact of integration and automation technology success measures. 4th Joint Symposium on IT in Civil Engineering, ASCE, Reston, Va.

Oladapo A. (2007). An investigation into the use of ICT in the Nigerian construction industry. Journal of Information Technology in Construction (ITcon), 12(18), 261-277.

Olugbode, Mojisola.; Richards, Rhodri, Biss, Tom.(2007).The role of information technology in achieving the organisation's strategic development goals: a case study Information Systems, 32, 641-648.

Peansupap, V, and Walker, D. (2005). Factors affecting ICT diffusion: A case study of three large Australian construction contractors. Engineering, Construction and, Architectural Management., 12(1), 21-37.

Peppard J., Ward J. and Daniel E. (2007). Managing the Realization of Business Benefits from IT Investments, MIS Quarterly Executive, 6(1), 1-11.

Thomas, S. R., Macken, C. L., and Lee, S. H. (2001). "Impacts of design/ information technology on building and industrial projects." BMM2001-10, Construction Industry Institute (CII), Austin, Tex.

Tse, R. Y., and Choy, L. (2005). "Is IT training in construction industry useful?" Journal of Construction Research., 6(1), 1–13.

Stewart R. A. (2003). Lifecycle Management of Information Technology (IT) Projects in Construction, PhD Thesis, Griffith University, Gold Coast.

Stewart R. A., Mohamed S. and Daet R. (2002). Strategic Implementation of IT/IS Projects in construction: a case study, Journal of Construction Automation, 11(6), 681- 694.

Stewart R. A. (2008). A framework for the life cycle management of information technology projects: ProjectIT, International Journal of Project Management, 26, 203-212.

Suwardy T., Ratnatunga J., Sohal A. S. and Speight G. (2003). IT projects: evaluation, outcomes and impediments, Benchmarking: An International Journal, 10(4), 325-342.

Svidt K. and Christiansson P. (2006). Experiences from implementation of ICT for resource management in small construction companies, World Conference on IT in Design and Construction, INCITE/ITCSED, New Delhi, Vol. 1, 285-295

Valida, A. C., Leng, A. C., Kasiran, M. K., Hashim, S and Suradi, Z., (1994) " A Survey of Information Technology Utilization Among Business Organizations in Malaysia", Proceedings of International Conference on IT, KL: Malaysia.

Webb, R. M., Smallwood, J., and Haupt, T. C. (2004). "The potential of 4D CAD as a tool for construction management. Journal of Construction Research, 5(1), 43–60.

Whyte, J., Bouchlaghem, D., and Thorpe, T. (2002). IT implementation in the construction organization. Engineering, Construction and, Architectural. Management., 9(5–6),371–377.

INNOVATIVE APPROACHES TO SUSTAINABLE BUILT ENVIRONMENTS IN NIGERIA

Chinwe Sam-Amobi[1]
Department of Architecture, University of Nigeria, Enugu Campus, Enugu, Nigeria

Sustainability as far as the environment is concerned, is not new. It is seen as a means of reducing environmental degradation, enhancing environmental protection, and environmental costs (such as energy consumption). Sustainability concepts also encompass the basic principles of having a healthy lifestyle. This work reviews the concept of sustainability as it relates to buildings and the built environment by examining the basic principles and indicators of sustainable buildings, with a view to determining innovative approaches to attaining sustainability in buildings in Nigeria.

Keywords: innovative approach, Nigeria, sustainable buildings, sustainability.

INTRODUCTION

With rising human population and the desire of all humanity for a comfortable, healthy lifestyle, the Earth is experiencing increasing stress to the physical, chemical, and biological systems that sustain life on our planet. Consequently, the greatest challenge facing humanity is to attain harmony with the global environment and to provide a sustainable future for the diversity of life on Earth. According to Levin (1997) the contribution of buildings to the total environmental burden ranges between 12–42% for the eight major environmental stressor categories: use of raw materials (30%), energy (42%), water (25%) and land (12%), and pollution emission such as atmospheric emissions (40%), water effluents (20%), solid waste (25%) and other releases (13%).

The role of environmental sustainability therefore has increased strongly during the past decade. There is a worldwide awareness of the large role of built environment, for example in U.S., the built environment accounts for 40 % of total energy consumption and over 38 % of total carbon dioxide emissions, (Schleich, et al 2009). Consequently, the built environment has an important role in climate change and in delivering a sustainable energy economy. Energy consumption in the housing sector, work and leisure places, lighting, heating, cooling and water heating is higher than in transport or even industrial sectors. As this consumption grows,it leds to a proportionate increase in CO^2 emission into the environment, (Mickaityte,et al 2008).

The World Commission on Environment and Development was one of the first who adopted the simple definition for sustainability to the mainstream international political agenda. The WCED (1987) defines sustainable development as: *"…development that meets the needs of the present without compromising the ability of future generations to meet their own needs"*. The definition contains within it, two key concepts: 1) the concept of 'needs', in particular the essential needs of the world's

[1] chinwe.sam_amobi@unn.edu.ng

Sam-Amobi, C. (2011) Innovative approaches to sustainable built environments in Nigeria *In:* Laryea, S., Leiringer, R. and Hughes, W. (Eds) *Procs West Africa Built Environment Research (WABER) Conference*, 19-21 July 2011, Accra, Ghana, 663-673.

poor, to which overriding priority should be given; and 2) the idea of limitations imposed by the state of technology and social organization on the environment's ability to meet present and future needs.

Building sustainably is a balancing act between planning and research. By taking the time to research and plan ahead of time, the building can be built with the Earth in mind. While upfront costs can be higher, sustainable buildings save money in lower energy, water, and clean-up costs. The core concepts of the sustainable development of buildings are straightforward and allow for variety in visual design and application.

Sustainable buildings have existed since the historic past. They are built using such traditions and know-how of generations that take into consideration such opportunities as the characteristic properties of the wind, sun, currents of air, vegetation, water surfaces, and natural sources of light. They are made of natural materials known for a long time in ways based on tradition and experience, (Lányi 2007). Most countries in the tropics have a long history of sustainable buildings, vernacular architecture, with the hot and dry regions with hot days and cold nights developed over centuries, a perfect balance of shading and daylighting, natural ventilation and heat storage. In the hot and humid regions natural ventilation and shading systems were perfectly adapted to the local climate, (Laar et al 2002). For buildings therefore to be sustainable they should be able to minimize the consumption of natural resources and the release of harmful emissions through the building system. In addition, sustainable buildings should be able to create the desired building performance that corresponds to the user needs and requirements stated by the owner.(Häkkinen, 2007). This paper reviews the concept of sustainability as it relates to buildings and the built environment, by examining the basic principles and indicators of sustainable buildings, with a view to determining approaches to attaining sustainability in the built environment in Nigeria.

INDICATORS OF SUSTAINABLE BUILDINGS

The United Nations Conference on Environment and Development in 1992 recognized the important role that indicators could play in helping countries make informed decisions concerning sustainable development. Sustainability is a laudable goal, but difficult to define and to implement because of the complexity of interlinked human and natural systems, and the uncertainty inherent in such complex systems. Resilience shows promise as a relevant and measurable attribute of sustainability, which itself defies measurement. Identification and assessment of conditions that are desirable, as well as those that are undesirable, are necessary in order to determine both the degree of progress toward sustainability and the removal of impediments to such progress. Indicators therefore are ideal means by which progress towards sustainable development can be measured. However, most indicator initiatives throughout the world have been aimed at state-of-the-environmental reporting, with relatively few aimed at developing sectoral indicators.

Indicators perform many functions. They can lead to better decisions and more effective actions by simplifying, clarifying, and making aggregated information available to policy makers. They can help incorporate physical and social science knowledge into decision-making, and they can help measure and calibrate progress toward sustainable development goals. Indicators can provide an early warning to prevent economic, social and environmental setbacks. They are also useful tools to communicate ideas, thoughts and values. Indicators are supposed to be simple figures or other signs, with help of which the information on a complicated phenomenon like environmental pressure is simplified in a more easily understandable format. This is how the information is easier to explain also for those who are not experts or who need the information quickly. It may be defined as a quantitative model and a form of information that makes a certain phenomenon perceptible that is not immediately detectable. Indicators therefore provide a simpler and more readily understandable form of information than complex statistics or complex phenomena. The three main functions of indicators are: quantification, simplification, and communication. .(Häkkinen, 2007)

Agenda 21, chapter 40 states that "Indicators of sustainable development need to be developed to provide solid bases for decision making at all levels, and to contribute to a self-regulating sustainability of integrated environmental and development systems." Sustainability indicators are primarily needed, because complicated ecological, social, cultural and economical phenomena need to be considered in decision making at all levels. "Sustainable development is a continuous, guided process of societal change at the global, regional and local levels, aimed at providing every opportunity to present future generations to live a good life", (Rorarius 2007). In general, sustainable development comprises three operational dimensions: an eco-economic, a societal and a cultural dimension. The four dimensions of sustainability that must be aspired are shown below:

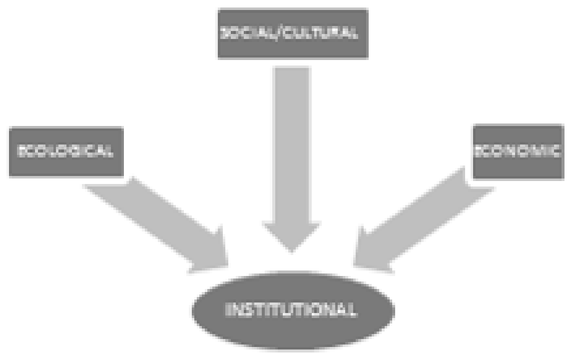


Figure 1: The four dimensions of sustainability (Source: Rorarius 2007)

The mutual dependence of the economic, ecological, social and cultural dimension of sustainable development, extends beyond the current generation and the long-term nature of policies. However it rests on a global, national and local consistency between various policy sectors; strong scientific foundation and an approach based on the assessment of risks and probabilities; and strengthening of human resources by offering better prerequisites for sustainable choices and equal opportunities for individuals to attain self-fulfillment and influence society.

The question of how bad or good a building is in relation to 'sustainability' is an important one and predicates on decisions of how much we need to improve the nature or performance of a building in order to make it really sustainable. In the years between 1980 and now Nigeria joined the rest of the world in the design and construction of mansions such as the one below in fig 1 otherwise called "mcmansions", generally characterized by shoddy construction, steep roofs of complex design, theatrical entrances, lack of stylistic integrity and backsides which are notably less fussy than their fronts. They appealed to people who value perceived social status over actual, physical, economic or historic value. These buildings dot the entire Nigerian urban areas and are high energy users, needing constant air-conditioning, artificial lighting, and high maintenance costs.

Fig 1: A mcmansion under construction.

APPROACHES TO SUSTAINABILTY IN THE NIGERIA BUILT ENVIRONMENT

Urban areas are centres of arts, culture, education, entertainment and technological innovations, which come with far reaching economic, socio-spatial and health implications Sustainable development as applied to urban areas is the ability of the urban areas and their regions to continue to function at levels of desired quality of life by communities without limiting the options available to the present and future generations and resulting to adverse impacts within and outside their boundaries (Daramola, et al 2010).

The design, construction, and maintenance of buildings have a tremendous impact on the environment and natural resources. All around the world, a huge amount of buildings are being constructed and the challenge is to build them smart with a minimal usage of non-renewable energy, minimal production of pollution, and minimal cost of energy. Other important issues include increasing the comfort, health, and safety of the people who live and work in them. According to the chaotic theory of sustainable building there are three principles which are an example of natural levels of order that can exist in architectural projects. The principles indicate that we need strategies, not symbols, to create sustainable design and design innovation. An important factor is that they can be applied in many ways, with a variety of architectural expressions. They can be relevant at a master-planning level or the design of a single building (Wheatley 2009). Either way this should lead to sustainability in the built environment. Sustainable buildings should be seen as a comprehensive process which is able to understand user needs and requirements, to create design options that fulfill these requirements while minimizing environmental impacts and life cycle costs, (Häkkinen, 2007).

The three major benefits associated with sustainable building and construction are environmental, economic, health and community benefits. Environmental benefits include improved air and water quality, reduced energy and water consumption and reduced waste disposal. Economic benefits include reduced operational costs, reduced maintenance costs and increased revenue (sale price or rent). Health and community benefits include enhanced occupant comfort and health, (Häkkinen, 2007). In a country like Nigeria the community benefits will also include designs that take into consideration the various traditions and culture of the people such as polygamy, extended family system, street trading, and communal land ownership.

Creating a sustainable built environment in the developing world requires a different approach to that taken by the developed world, the following sustainability indicators if properly applied can lead to sustainable built environments in Nigeria.

Land use planning

In Nigeria, there is still strong adherent to the conventional land use planning approach. Most major cities including Lagos, Kaduna, Port Harcourt, Onitsha, Enugu, Aba, Yenogoa, Asaba have been developing with the conventional land use approach. This has generated diverse urban problems manifesting in the form of deterioration of cities into slums, pollution, congestion, unsanitary condition and epidemics. Nigeria cities are reputed to be the dirtiest, most unsanitary, least aesthetically pleasing and dangerously unsafe for living . They are characterized by non-functioning infrastructure facilities, most poorly governed, intensively dotted with illegal structures while physical growth and development of the cities had not been properly managed or controlled (Aribigbola, 2008). Thus people in urban areas wallow not only in abject poverty, but they also do not live in planned urban areas, which are "orderly safe, convenient and healthy living environment' that is promised as the gains of land use planning.

Fig 2: A chaotic transit route with trading going on alongside vehicular and pedestrian movement.

In Nigerian millions of naira is spent producing masterplans for both institutional and urban development. However there is very little awareness of the existence of these plans by the people and great apathy on the part of government in adhering to or implementing them. In Nigeria land use planning and control tools are either not available or weakly implemented. Land use activities are disjointed and uncoordinated with several organizations and agencies (example in Enugu where there exists the Capital Development Authority, the Local Government Planning Authorities, the Enugu State Waste Management Agency and the Ministry of Environment). Figure 2 below shows the confusion found in most of our cities, where there is no distinction between vehicular movement, pedestrian movement and street trading. This leads to the chaos seen in the picture below.

With a little more efficiency in planning it could be easy to separate pedestrian and vehicular circulation as this will lead to a more efficient and orderly city as shown below in Fig 3. Innovative approaches to achieve sustainability in the built environment in Nigeria will require new planning strategies such as;

1. Community participation to encourage a feeling of ownership; promote public awareness; and encourage community involvement;
2. Involvement of all stakeholders from the initial stages of planning process to implementation and maintenance;
3. By providing sustainable approaches that address long-term concerns and energy efficient urban development,
4. Encouraging greater diversity within the built environment, avoiding urban sprawl and redeveloping urban wasteland

Energy

More than 90 per cent of our time is spent in buildings i.e. either in the office or at home. Energy used in buildings (residential and commercial) accounts for a significant percentage of a country's total energy consumption. This percentage depends greatly on the degree of electrification, the level of urbanization, the amount of building area per capita, the prevailing climate, as well as national and local policies to promote efficiency. The energy efficiency of a building therefore is the extent to which the energy consumption per square meter of floor area of the building measures up to established energy consumption benchmarks for that particular type of building under defined climatic conditions.

Fig 3: A well designed tree lined pedestrian walkway.

In Nigeria where electricity supply is poor, intermittent and power rationing is frequent, there is a large demand for alternative energy sources such as diesel or renewable energy-based backup/stand-by power generation from end-users. Reducing power and energy requirements in buildings reduces the capital outlay required and the running costs of these stand-by systems.

The main benefit from measures to improve energy efficiency in buildings in Nigeria will be to lower energy costs. Energy efficiency measures are meant to reduce the amount of energy consumed while maintaining or improving the quality of services provided in the building. Adopting energy efficiency strategies in Nigeria will involve a retraining of Architects. Among the benefits likely to arise from energy efficiency investments in buildings in Nigeria are: reducing energy use for cooling, reduced electricity use for lighting, lower maintenance requirements and improved comfort.

Building Energy efficiency strategies for Nigeria must include integration of

(a) natural lighting (day lighting) strategies in building designs there by reducing the incidence of daytime artificial lighting use.

(b) natural ventilation by efficient use of window openings (size and type), location of openings on the facade. Currently the use of sliding windows cuts air flow into interior spaces by half while the use of louvres achieves almost 100% air flow into interior spaces. These louvres could be made to be more aesthetic and less boring by producing them in various sizes and shades. Casement windows though quite aesthetic are clumsy and not very durable while in use. They also allow for almost 100% air flow into the buildings but unlike louvres require constant maintenance of the controls.

(c) proper ventilation will reduce the use of air conditioning and thereby reduce costs.

(d) introduction of renewable energy sources such as solar energy, and bio mass will reduce reliance on electricity supply from the national grid, while improving the environmental quality of Nigerian built environment.

Water

Water is essential for life and every day domestic activities. Agriculture and industry depend on reliable clean water supplies. Household water use is influenced by the weather, type of dwelling, the number of water saving devices and house hold size. Minimizing the water usage during production, maintenance, and other phases of the building operation is a major goal of sustainability. Reducing water consumption and protecting water quality are key objectives in sustainable building. To the maximum extent feasible, facilities should increase their dependence on water that is collected, used, purified, and reused on-site. The protection and conservation of water throughout the life of a building may be accomplished by designing from inception water conservation systems.

A good example of a sustainable building system for Nigeria will be one that has a well designed rainwater harvesting system. This will require efficient strategies for harnessing abundant rain water, on the average a normal heavy rainfall that lasts for about two hours fills up a 500l (five hundred liter) tank, with the make-shift water harvesters installed in buildings, as can be seen in fig 4 below. The rainwater is collected and stored either in underground concrete tanks or in over head tanks. When needed, it is then pumped out for use. A water treatment plant could be installed. Many urban centers in Nigeria lack portable water and residents are sometimes forced to resort to unsafe water sources, such as run-offs, seasonal contaminated streams and shallow wells. In towns like Enugu were the coal deposits make it impossible for boreholes, residents resort to hand dug shallow wells to supplement the sporadic and irregular supply from the state mains.

It rests therefore on designers and Architects to integrate water harvesting systems at the conceptual stage of their designs. It also follows that roofing sheets should be designed and produced with water collectors as a major feature of them in order that they may be aesthetic and properly integrated into the designs and facades.

Fig 4: Showing local efforts at water harvestation from the roof.

Other water saving strategies to ensure sustainability is water recycling and reuse. Nigeria has a huge domestic water consumption level from bath water, laundry water etc. If waste water collection strategies are integrated into building design and construction it is possible, with rain water harvestation for a building to generate over fifty percent of its water needs.

Materials

The use of materials directly affects the environment. Sustainable architecture also considers the use of material that will not waste energy in its production, transport and use in construction. Building materials typically considered to be 'green' include locally sourced and rapidly renewable plant materials like bamboo (because bamboo matures quickly) and straw, lumber from forests certified to be sustainably managed, recycled stone, recycled metal, and other products that are non-toxic, reusable, renewable, and/or recyclable. Building materials should be extracted and manufactured locally at the building site to minimize the energy embedded in their transportation. Nigerians are making breakthroughs in the production of building materials from local raw materials such as bamboo, mud, stone, rice husk etc. These materials need to be mass produced for commercial purposes. These efforts requires Government intervention not only in research but also in encouraging their use for construction, especially in government buildings and mass housing projects.

Biodiversity

Green materials also involve the use of non-toxic and renewable materials so that natural resources are not excessively and rapidly depleted, and vital rainforests denuded. Building sustainably must also take into consideration care of wildlife habitats through preventing building on ecologically valuable sites and to protect and enhance local ecology. Government, cooperation and individuals must take tree planting ceremonies more seriously. The Enugu Capital Development Commission advocates at least one tree per compound within the Enugu Urban area. This is yet to be implemented. This strategy if properly articulated and implemented would change the urban space and image of the city and could also be applied to other major cities in Nigeria which are bare and lack luster.

Social

Most cities in Nigeria have a diverse population; gender, age, ethnicity, religion, income, wealth and ability. In some cases, this reflects ethnic or religious differences. The way most Nigerian cities are planned or developed, both historically and currently, have failed to take into account the needs of many of these diverse groups, because the groups lack the influence to bring their interests to prominence and therefore to affect policy and planning decisions. A cursory look at most Nigerian cities reveals that ethnic ties and identities are reinforced because most city-dwellers are to some extent within their own ethnic network, which serves as a partial barrier between them and the wider social system. The sharp cultural differences among many groups further hamper the development of an inter-ethnic sense of community. This may be responsible for the killing and unrest in some parts of the country. This could also be attributed to incompatible modes of community life. For the built environment to be sustainable residents of the city must feel safe and secure. this shows that attainment of sustainability in Nigeria can only be possible with intervention of government in provision of appropriate and effective security to city dwellers.

Economic

Good design, in the context of sustainability is economical, and calls for designing buildings which are easy to use, easy to convert for other uses, safe to use for both children and the elderly. It can also have an influence on energy usage, repair and maintenance, and inevitably, on the property’s value. Energy efficiency in the Nigerian built environment will be most economical to residents because of cost savings from alternative power generation, better health due less exposure to pollution (fume and gases, water, etc).

The physical well-being of the occupants is the primary concern of this principle. Its area of concern is the general atmosphere within a building. For example, stale air is not healthy to breathe for long periods of time and good design can prevent this problem. The use of hazardous building materials are also avoided by this principle.

DISCUSSION

With respect to matters of the environment, the Nigerian people are becoming more aware of the fact that the land, water, coastlines, air and other natural resources in the towns and cities are being rapidly polluted and degraded, creating in the process loss of valuable resources. However, low level of involvement of the people, absence of effective advocacy and inappropriate programmes of development compound the problems. To make progress in the area of sustainable development in Nigeria, there must be conscious changes. What is required is a new approach that will respect the climate and culture of each region and therefore create an ecological and cultural sustainability in the built environment. There are a lot of solutions that may be implemented in order to achieve a much better sustainability. In some areas, research and development work has to be done; improvement in the formation of future architects and engineers, beginning with interdisciplinary projects at the faculties; prototypes and pilot projects for research and development as well as for proving to investors and planners that these new ideas really work. This is definitely a government duty as appropriate policy is very crucial. The government must set up appropriate drivers (political, environmental and economical) leading to sustainable management systems by;

(a) building industry capacities through training
(b) developing work in sustainable building technologies
(c) government taking the lead by giving incentives to private sector to improve existing building stock by retrofitting to improve energy efficiency
(d) energy profiling of building types and raising awareness on the benefits of sustainable buildings
(e) developing and imposing minimum standards especially for new construction by introducing energy codes, energy rating and certification.
(f) the implementation of sustainable building practices in a multi-cultural society with different cultural practices and aspirations, and different ways of using the built environment
(g) An integrated approach to sustainable development by encouraging and enabling collaboration between the different built environment professions, the professions and other professions such as environmentalists, sociologists, anthropologists, and the professions and the different layers of government (federal, state and local), as well as community involvement and public/private partnerships.

CONCLUSION

The country is currently undergoing fundamental political, social and economic reforms aimed at stabilizing the economy and placing the nation on the path of sustainable development.

Sustainable development policies in Nigeria must incline toward longer-term, broad-spectrum interventions, touching upon the driving forces operating in human society. This would mean tackling inequities, poverty, and population growth and thereby contributing, for example, to the control of land degradation and deforestation, biodiversity loss, soil erosion, food insecurity, and decline in water quality. (Corvalán, et al 1999).

The concept of Sustainable architecture is not new. It has been resorted to before as a means of reducing building operating costs (such as energy consumption and maintenance), and its precepts also encompass the basic principles of having a healthy lifestyle. The former reduces the building’s negative impact on the environment, while the latter ensures that the occupants’ well-being (which may not only be limited to physical well-being) is also taken care of.

Sustainable architecture can therefore become a significant part of the path to a sustainable future in Nigeria because a sustainable building serves the needs of the people who inhabit it. It supports and nurtures their health, satisfaction, productivity, and spirit. It requires the careful application of the acknowledged strategies of sustainable architecture - non-toxic construction; the use of durable, natural resource efficient materials; reliance on the sun for day lighting; renewable energy sources; and recycling of wastes into nutrients.

Employment of integrated design principles: optimization of energy efficiency and use of renewable energy; protection and conservation of water; enhancement of indoor environmental quality, and reduction of environmental impacts of materials, will lead Nigeria to achieving sustainability.

REFERENCES

Aribigbola, A. (2008) Imroving Urban Land Use Planning And Management In Nigeria: The Case Of AkureTheoretical and Empirical Researches in Urban Management, Year 3, Number 9, 2008 Cercetari practice si teoretice în Managementul Urban, Anul 3, Nr. 9, 2008 ISSN: 1842-5712

Corvalán, C.F., Kjellström,T., Smith, K.R., (2009). Health, Environment and Sustainable Development. Identifying Links and Indicators to Promote Action Epidemiology September 1999, Vol. 10 No. 5 656-660

Daramola, A., & Ibem, E.O., (2010) Urban Environmental Problems in Nigeria: Implications for Sustainable Development. Journal of Sustainable Development in Africa (Volume 12, No.1, 2010) ISSN: 1520-5509

Dizdaroglu, D., Yigitcanlar, T., & Dawes, L. (2010). "Assessing The Sustainability Of Urban Ecosystems: An Innovative Approach". 1 4 T H International Planning History Society Conference .http://web.itu.edu.tr/~csuygar/iphs2010/abs/ID228.pdf

Ghosh S., (2007) Sustainable Approach to Healthy Buildings Indoor Proceedings of Clima 2007 WellBeing Indoors

Häkkinen, T., (2007) Draft of New Work Item Proposal - Sustainability in building construction Sustainability indicators - Part 1 Buildings. http://www.rpd-hesr.com/uploads/custompages/ISO 059SC17_N0236_Draft_of_New_Work_Item_Proposal_-_Susta.pdf (assessed July, 2010)

Laar, M., Grimme, F.W. (2002) Sustainable Buildings in the TropicsRIO 02 - World Climate & Energy Event, January 6-11, 2002 163. http://www.rio02.com/proceedings/pdf/159_Grimme.pdf (assessed September, 12, 2010)

Lányi, E., (2007) The basic principles of sustainable architecture. http://www.pp.bme.hu/ar/2007_2/pdf/ar2007_2_06.pdf (assessed July, 2009)

Leitner, T., Schiffleitner, A., Lipp, B., (2010) Assessment and Simulation Methods for Green Building Planning http://www.corp.at/archive/CORP2010_261.pdf

Levin, H. (1997). Systematic evaluation and assessment of building environmental performance (ASEABEP). Proc. Second International Conference on Buildings and the Environment, CSTB and CIB, 2, Paris, June, 3–10.

Mickaityte, A., Zavadskas, E.K., Kaklauskas A., Tupenaite L.I. (2008). The concept model of sustainable buildings refurbishment/koncepcinis darnaus visuomeniniu pastatu atnaujinimo modelis.(Report) International Journal of Strategic Property Management - March, 2008

Rorarius, J., (2007). Existing Assessment Tools and Indicators: Building up Sustainability Assessment (Some Perspectives and Future Applications for Finland)

Schleich, H., Lindholm, A., Heidi Falkenbach, H. (2009)Environmental sustainability–drivers for the real estate investor http://www.eres2009.com/papers/1A_Schleich.pdf

Wheatley, D., (2009) A Chaotic Theory Of Sustainable Building Principles http://www.woodsbagot.com/en/Documents/Public_Research/090318_Donna_wheatley_chaos_paper.pdf (assessed September, 12, 2010).

INVESTIGATING THE PERCEPTIONS OF ARCHITECTS IN THE GHANAIAN BUILDING INDUSTRY WITH REGARD TO PHOTOVOLTAIC ENERGY TECHNOLOGY

Naa Adjeley Ashiboe-Mensah[1], Fred Akuffo[2] and Frank Fugar[3]

1,3Department of Building Technology, Kwame Nkrumah University of Science and Technology, Kumasi, Ghana

2 Department of Mechanical Engineering, Kwame Nkrumah University of Science and Technology, Kumasi, Ghana

Photovoltaic energy conversion is widely considered one of the promising renewable energy technologies with the potential to contribute significantly to a sustainable energy supply and which may help to mitigate green house emissions. However the availability of physical and technical potential of the technology does not guarantee adoption. Rather a number of factors including how the technology and its attributes are perceived by potential adopters influence the adoption decision. This study therefore investigates the perceptions of photovoltaics by architects in the Ghanaian building industry. It involved a survey of architects within the Ghana Institution of Architects. Results of the study showed a generally positive perception regarding photovoltaics except with a number of items such as initial cost of the technology. The few negative perceptions may however account for the low levels of actual photovoltaic adoption in the Ghanaian building industry.

Keywords: energy, Ghana, innovation diffusion, photovoltaic.

INTRODUCTION

According to (Alsema and Nieulaar, 2000) “photovoltaic (PV) energy conversion is widely considered one of the promising renewable energy technologies which has the potential to contribute significantly to a sustainable energy supply and which may help to mitigate green house emissions” (Jackson and Oliver, 2000) (Johansson *et al*., 2004). In Ghana where there is a need to decrease demand on the national grid and also increase the renewable component of the nation’s energy mix, photovoltaics (a type of solar technology that generates electricity using sunlight) seem like a plausible means of achieving both goals simultaneously especially by incorporating them in new buildings in urban areas.

PHOTOVOLTAIC ADOPTION AND DIFFUSION

Literature, relating to Ghana and the world, shows that there is a significant difference in the actual levels of investment in photovoltaic energy technology and the possible levels of investment given the physical and technical potentials (Bawakyillennuo,

[1] naaadjeleyashiboe@yahoo.co.uk
[2] foakuffo@gmail.com
[3] frankfugar@yahoo.com

Ashiboe-Mensah, N.A., Akuffo, F. and Fugar, F. (2011) Investigating the perceptions of architects in the Ghanaian building industry with regard to photovoltaic energy technology *In:* Laryea, S., Leiringer, R. and Hughes, W. (Eds) *Procs West Africa Built Environment Research (WABER) Conference,* 19-21 July 2011, Accra, Ghana, 675-682.

2007). This problem of adoption and use of photovoltaics have been attributed to a number of barriers including misplaced incentives, distortionary fiscal and regulatory policies, unpriced cost such as air pollution, unpriced goods such as education, training and technological advances, and insufficient and imperfect information (Brown, 2001) (Golove and Eto, 1996) (Painuly and Fenhann, 2002). Consequently the aim has been to identify these barriers and eliminate them in order to promote adoption.

Whereas this traditional approach has been to identify related barriers and eliminate them, an alternate approach to compliment the traditional approach forms the basis of this paper. This perspective seeks to understand the factors that may potentially influence individuals' adoption of photovoltaics by focusing on how the theoretical understanding of the diffusion of innovations as presented by Rogers (2003) can be used to evaluate the factors that influence PV adoption and diffusion in the Ghanaian building industry.

Formal inquiries into energy efficient and renewable energy technologies such as photovoltaics tend to isolate diffusion and adoption factors without integrating them into a broader theoretical framework except in a few cases (Bawakyillennuo, 2007). Investigations hence become difficult to compare owing to differences in concepts used to describe similar phenomenon. Although photovoltaic adoption and diffusion has widespread interest owing to their environmental, national security and macroeconomic repercussions; they are essentially like other products and services which also face obstacles that hinder their adoption. As such they can be investigated using the vast array of concepts and theories; grouped under the umbrella of innovation diffusion; specially established to study how and why new products, practices and ideas spread.

PURPOSE

This paper is part of a larger research to investigate the factors that may influence photovoltaic adoption in the Ghanaian building industry and involves clients, architects and electrical engineers. The paper however only reports on the initial results of a cross-sectional survey that investigates the perceptions of architects about photovoltaics.

The diffusion of innovation theory (Rogers, 2003) and a framework by Hartmann *et al.* (2006) together provide a majority of the relevant variables that influence the adoption of innovations. However this study evaluates the factors that relate to perceived innovation attributes as these have been noted to account for 49-87 percent of variance in the rate of adoption of innovations. (Rogers, 2003) (Ostlund, 1974) (Dearing, 2007). Five standard attributes have been defined by Rogers (2003) and include:

1. The relative advantage of the innovation
2. Its compatibility with the potential adopters' current way of doing things and with social norms
3. The complexity of the innovation
4. Trialability, the ease with which the innovation can be tested by potential adopter
5. Observability, the ease with which the innovation can be evaluated after trial

These attributes formed the basis of the items that are rated in the questionnaire.

RESEARCH DESIGN AND METHOD

In diffusion research[4] two major research approaches are applicable- Variance research and Process research depending on the aim of the research (Gopalakrishnan and Damanpour 1994, Subramanian and Nilakanta, 1996). Whereas variance research involves data gathering and analysis that consists of determining the covariance (correlations) among a set of variables, process research seeks to determine the sequence of a set of events over time (Rogers, 2003). For example variance research may be employed to investigate the key variables that influence innovation adoption/diffusion and process research maybe used to investigate the process an individual goes through in coming to a decision to adopt an innovation. Consequently variance research involves quantitative methods which measure variables by assigning numerical values to behaviour and process research involves qualitative methods.

The study employed a survey method of research to the research aim outlined above. The choice of the survey method hence the variance approach in this research was informed by the aim of the study. The survey was a cross-sectional one with data collected at one point in time rather than over time and involved the use of a structured self administered questionnaire.

The population of the study comprised of architects within the Ghanaian building industry with the sample frame of the architects selected based on the list of members as provided by Ghana Institute of Architects. The list was made up of 586 architects out of whom 314 had valid email addresses.

Questionnaire design

The design of the research questionnaire was carried out in four steps: informal interviews, literature review, informal and formal questionnaire pre-tests. The initial step conducted in the research and which informed the questionnaire design was the informal interview of building professionals and researchers, employees at the Ghana Energy Foundation and Energy Commission. These interviews brought to light the issues surrounding energy generation and use in Ghana and hence helped identify the research problem to be investigated and the major issue the questionnaire was to tackle. Clearly identifying the research problem guided and focused the literature review. The interviews also made sure that the problem identified was directly relevant to the Ghanaian context.

A review of literature for other related surveys and interviews was then conducted so as to determine the format of the survey instrument and how questions were paraphrased and generated. The literature review also provided the theoretical framework of the research and most of the relevant variables include in the instrument. Supporting the empirical inquiry with a theoretical framework as was done provided a majority of the factors to be evaluated. Also it made it easier to identify new information that may extend the boundaries of the selected framework. Furthermore the framework also presented the methodological options available for the study and provided a reference point around which the discussion of the results and findings are centred.

A draft of the questionnaire was then developed and an informal pre-test conducted to determine whether the questions were easily and consistently understood by asking

[4] Diffusion research deals with the study of how and why innovations(an idea, practice or object that is perceived as new by an individual or other adoption unit) are adopted and spread

the individuals to say in their own words what they thought the questions meant. Finally a final formal pre-test involving ten individuals working as professionals and researchers in the building industry and clients was done. Although respondents included only architects, the pre-test had respondents drawn from a range of individuals within the Ghanaian building industry in addition to architects in order to obtain comprehensive comments and input. This culminated in the final questionnaire used in data collection.

Sample size

Sample size was calculated using the following formulae:

$$\frac{\quad}{\quad} = \frac{\quad}{\quad} = 96$$

n = sample size

Z = the z-score from a normal distribution table at 95% confidence interval (1.96)

p = the proportion of the population that expresses the same opinion. 0.05 is selected since this value of '*p*' gives the highest sample size

E = standard error which is assumed to be 0.1 for the study

This sample size of 96 was however the total for the larger study of architects (70), clients (16) and electrical engineers (10). Although only 70 architects were required to respond, 314 architects (all those with valid email addresses on the GIA list) were contacted with the questionnaires to cater for low response rates.

Data collection

Actual data collection was carried out using dual methods. The initial distribution of the questionnaires was done via email and then a second phase involved the distribution of hard copies of the questionnaire. Respondents were first sent an introductory email informing them of the impending survey and explaining the purpose of the survey. Subsequently, a second email containing a hyperlink to access the survey was sent followed by two reminder emails a week apart. Respondents who failed to respond to the questionnaire were then contacted by telephone with a final reminder. Some respondents expressed a preference for printed copies of the questionnaire and were therefore furnished with them.

FINDINGS

The findings reported in this paper are based on thirty-nine[5] responses obtained from the survey out of the total of 314 questionnaires sent out.

Knowledge of PV

The first question sort to find out how many architects knew about photovoltaics. Out of the 38 responses obtained 32(84%) knew about PV and 6(16%) did not. One person did not respond to this question. Only respondents that knew about photovoltaics (32) went on to answer the follow up questions.

[5] As at the time the paper was written only 39 responses had been received, but it is expected that more will respond subsequently.

Communication channels

In this question respondents were asked to indicate where they first heard about photovoltaics.

Table 2 Source information on Photovoltaics

COMMUNICATION CHANNEL	FREQUENCY
University/research institute	6
Worldwide web/internet	5
Peers/friends	5
Don't remember	4
Trade show/building exhibition	4
Manufacturer's brochure	1
Consultants and fellow building participants	1
Journal/technical publication	1
Secondary school	1
Client	0
Sales and supplier representatives	2
Seminar/conference	1
Advertisement (television, newspapers, radio etc.)	1
Non-response	1
Total	39

Level of adoption

This question investigated the number of architects who had actually adopted the technology. [Table 2]

Table 3 Photovoltaic adoption by architects

TYPE OF ADOPTION DECISION	RESPONSES
been part of a project in which photovoltaics were adopted (adoption)	6
currently on a project in which photovoltaics are to be installed (adoption)	3
been part of a project in which photovoltaics were proposed but not installed (rejection)	8
never been part of a project in which photovoltaics have been adopted (non-adoption)	14
been part of a project in which photovoltaics were adopted but later discontinued (discontinuance)	1
Non-response	1
Total	33

Decision-making

This aspect of the questionnaire had two questions that found out about building participants involved in the decision to adopt photovoltaics and the one that made the final decision. Out of the 33 responses 19 who had been involved in some decision-making process regarding photovoltaics went on to answer this question.

Perceived innovation attributes

This question sought to investigate the perceptions of architects on the attributes of photovoltaics by rating a number of items. A summary of statistics of the results is presented in tables 5 and 6.

DISCUSSION

Prior to making a decision to adopt or reject an innovation such as photovoltaics, there must be the knowledge of the existence of the innovations (Rogers, 2003). Data collected reveals a majority of the architects have been exposed to the existence of photovoltaics however the question does not explore the type of knowledge they have.

Table 3 Innovation-decision making unit

BUILDING PARTICIPANT	HAD AN INFLUENCE		HAD NO INFLUENCE		NON APPLICABLE		TOTAL	NON-RESPONSE	MADE THE FINAL DECISION	
Client	16	88.9%	2	11.1%	0	0%	18	1	11	64.7%
Project manager	3	20.0%	5	33.3%	7	46.7%	15	4	0	0.0%
Architect	13	86.7%	2	13.3%	0	0%	15	4	5	29.4%
Quantity surveyor	3	20.0%	8	53.3%	4	26.7%	15	4	0	0.0%
Structural engineer	0	0.0%	10	71.4%	4	28.6%	14	5	0	0.0%
Contractor	3	20.0%	11	73.3%	1	6.7%	15	4	0	0.0%
Lenders, insurers and bankers	1	6.7%	8	53.3%	6	40%	15	4	1	5.9%
Electrical engineer	11	68.8%	4	25.0%	1	6.2%	16	3	0	0.0%
Mechanical engineer	6	40.0%	7	46.7%	2	13.3%	15	4	0	0.0%
							Total responses		17	100%
							Non-response		2	

Table 4 Item codes for attributes and definition[6]

ITEM ID	ATTRIBUTES
1	Impact of photovoltaics on profitability
2	Certainty of its future performance
3	Labour savings derived from the use of photovoltaics
4	Waste reduction potential of photovoltaics
5	Ability to recover the cost of photovoltaics
6	Reduction in build time
7	Compatibility with preferred construction practices
8	Ease of continuing use of photovoltaics
9	Impact of photovoltaics on image/status
10	Initial cost of the photovoltaics
11	Ease in first use of photovoltaics
12	The risk of failure associated with using photovoltaics
13	Continuing cost of photovoltaics (Cost-in-use/running cost)
14	Quality compared with alternatives (diesel generators, electricity from the grid i.e. ECG etc)
15	Compatibility with construction codes and standards
16	Greenhouse gases/CO2 reduction potential of photovoltaics
17	Ability to see the photovoltaics in use in other projects
18	Noise reduction potential of photovoltaics
19	Cost savings derived from the use of photovoltaics
20	Visual/aesthetic impact of photovoltaics
21	Ability to try the photovoltaics prior to actual adoption
22	Material savings derived from the use of photovoltaics
23	Impact of photovoltaics on safety

Knowledge does not however guarantee adoption; rather the attitude towards an innovation frequently intervenes between knowledge and the decision functions in the innovation decision process. From the study, the architects generally have a favourable attitude or perception of photovoltaics i.e. 50% and above of respondents rate majority of the items as good, very good or excellent (% Rating ≥ good). [Table 5 and table 6]. However some attributes have negative perceptions: Labour savings

[6] This table to be used with Table 5 and 6 to define the meaning of the Row headings 1-23 and the attributes they represent

derived from the use of photovoltaics, reduction in build-time, initial cost of photovoltaics, ease in first use of photovoltaics, the risk of failure associated with using photovoltaics, ability to see the photovoltaics in use in other projects, ability to try the photovoltaics prior to actual adoption and material savings derived from the use of photovoltaics. Of the above the initial cost of photovoltaics had an extremely negative rating i.e. 73% of the respondents rated it as fair or poor [Table 5].

The study also investigated the building participants involved in decision to adopt photovoltaics. Clients and architect were detected to wield a greater influence in the innovation decision than other building participants. [Table 3]

Table 5 Architects' Perceptions of Photovoltaic Energy Technology

ANALYSTIC STATISTICS	ATTRIBUTES											
	1	2	3	4	5	6	7	8	9	10	11	12
Mode[7]	0/4	3	0	0	4	0/2	3	3	0	1	0	0
Mode frequency	4	5	7	6	5	5	4	5	4	6	7	7
Rating < good (frequency)	2	1	3	1	3	5	4	3	3	11	5	4
Rating > good (frequency)	5	6	2	5	7	2	4	4	5	0	1	1
Rating ≥ good (frequency)	8	11	5	8	9	5	8	9	8	1	3	4
Total response	14	14	15	15	15	15	15	15	15	15	15	15
Total response with opinions	10	12	8	9	12	10	12	12	11	12	8	8
Non-response	7	7	6	6	6	6	6	6	6	6	6	6
% Mode	29	36	47	40	33	33	27	33	27	40	47	47
% Rating < good (frequency)	14	7	20	7	20	33	27	20	20	73	33	27
% Rating > good (frequency)	36	43	13	33	47	13	27	27	33	0	7	7
% Rating ≥ good (frequency)	57	79	33	53	60	33	53	60	53	7	20	27
Mean	2.43	3.14	1.53	2.2	2.8	1.8	2.4	2.47	2.47	1.27	1.33	1.4
Mean(excludes respondent without opinions)	3.4	3.67	2.88	3.67	3.5	2.7	3	3.08	3.36	1.58	2.5	2.63
Average deviation	0.8	0.83	0.66	0.81	0.92	0.7	0.83	0.78	0.94	0.58	0.88	0.63
Interpretation of mode	Don't know or have no opinion/ very good	Good	Don't know or have no opinion	Don't know or have no opinion	Very good	Don't know or have no opinion/ Fair	Good	Good	Don't know or have no opinion	Poor	Don't know or have no opinion	Don't know or have no opinion

[7] 5 = Excellent 4= Very good 3= Good 2= Fair 1= Poor 0= Don't know or have no opinion

Table 6 Architects' Perceptions of Photovoltaic Energy Technology

ANALYTIC STATISTICS	ATTRIBUTES										
	13	14	15	16	17	18	19	20	21	22	23
Mode[8]	3/4	3	3	4	2	5	3/4	3	3	0/2/3	3
Mode frequency	5	5	4	4	7	8	4	7	5	4	5
Rating < good (frequency)	2	4	2	0	7	1	2	6	5	6	2
Rating > good (frequency)	7	4	4	10	3	11	7	0	0	0	3
Rating ≥ good (frequency)	12	9	8	11	5	12	11	7	5	4	8
Total response	15	15	14	13	14	14	14	14	14	14	14
Total response with opinions	14	13	12	11	12	13	13	13	10	10	10
Non-response	6	6	7	8	7	7	7	7	7	7	7
% Mode	33	33	29	31	50	57	29	50	36	29	36
% Rating < good (frequency)	13	27	14	0	50	7	14	43	36	43	14
% Rating > good (frequency)	47	27	29	77	21	79	50	0	0	0	21
% Rating ≥ good (frequency)	80	60	57	85	36	86	79	50	36	29	57
Mean	3.2	2.53	2.71	3.77	2.36	4	3.29	2.36	1.64	1.57	2.14
Mean(excludes respondent without opinions)	3.43	2.92	3.17	4.45	2.75	4.31	3.54	2.54	2.3	2.2	3
Average deviation	0.86	0.88	0.89	0.6	0.88	0.71	0.96	0.5	0.7	0.64	0.8
Interpretation of mode	Good/ very good	Good	Good	Very good	Fair	Excellent	Good/ very good	Good	Good	Don't know or have no opinion/ fair/good	Good

[8] 5 = Excellent 4= Very good 3= Good 2= Fair 1= Poor 0= Don't know or have no opinion

CONCLUSIONS

The use of the theory of diffusion of innovation in investigating the adoption of photovoltaics is limited and those that pertain to the Ghanaian building industry are absent. This paper therefore is part of a larger study which extends the use of the theory applying it to a new context.

The theory of diffusion of innovation is extensive in its propositions and concepts hence fitting it within a single research study presents a challenge. This study focuses on just a portion and so there remains need for further research in this area within the context of the Ghanaian building industry. The current study only investigates the perceptions of architects but the perceptions of other building project participants, for example the building client, are relevant hence more studies are needed in this regard.

Although the study shows a high level of knowledge and generally positive perceptions regarding photovoltaics, a number of attributes reveal negative perceptions and actual adoption of the technology is low (6 respondents have been part of projects in which they have been adopted [Table 2]). Consequently if the preferred end of policy makers to increase adoption is to be realised perceptions must be positively influenced. Where perceptions represent an objective assessment of performance of the photovoltaics, efforts should be aimed at improving the technology and introducing policies that minimise negative effects of adoption. Alternatively in cases where perceptions are contrary to the objective assessments, further education is required to alter such false perceptions.

REFERENCES

Alsema, E. A. and Nieuwlaar, E., 2000, Energy viability of photovoltaic systems. *Energy Policy*, Vol.28, Issue 14, 999-1010.

Bawakyillennuo, S. 2007. *Rural electrification in Ghana: Issues of photovoltaic energy technology utilisation*. Ph.D. diss., The University of Hull, Hull.

Brown, M.A., 2001, Market failures and barriers as a basis for clean energy policies, *Energy policy* Vol.29, Issue 14, 1197-1207

Dearing, J.W. 2007. Measurement of Innovation attributes. [Online]. Available on: http://www.research-practice.org/tools/measures/Innovation%20attributes%20measurement.pdf [Accessed: 19/10/2010]

Golove, W. and Eto, J. 1996 *Market barriers to energy efficiency: a critical appraisal of the rational for public policies to promote energy efficiency*. Berkeley

Gopalakrishnan, S. and Damanpour, F. 1994. Patterns of generation and adoption of innovation in organisations: contingency models of innovation attributes, *Journal of Engineering and Technology Management* Vol. 11 No. 2 95-116

Hartmann, A., Dewulf, G. and Reymen, I. 2006 *Understanding the innovation adoption process of construction clients*. Clients driving innovation: Moving ideas into practice 12-14 March 2006

Jackson, T. and Oliver, M. 2000. The viability of photovoltaics. *Energy Policy*, Vol. 28, Issue 14, pp. 983-988.

Johansson, T.B., McCormick, K., Neij, L. and Turkenburg, W. 2004. *The Potential of renewable energy*. Paper presented at the International conference for renewable energies. Bonn.

Ostlund L.E. 1974, Perceived innovation attributes as predictors of innovativeness. *The journal of consumer research* Vol. 1 No. 2 23-29

Painuly, J.P. and Fenhann, J.V. 2002. *Implementation of renewable energy technologies – Opportunities and barriers*. Denmark: UNEP Collaborating Centre on Energy and Environment.

Rogers, E.M. 2003. *Diffusion of innovations* (Fifth edition).New York: The Free Press.

Subramanian, A. and Nilakanta, S. 1996. Organisational innovativeness: exploring the relationship between organisational determinants of innovativeness, types of innovations and measures of organisational performance. *Omega* Vol. 24, No.6, 631-647.

INVESTIGATION INTO THE USE OF TOTAL QUALITY MANAGEMENT IN NIGERIAN CONSTRUCTION INDUSTRY: A CASE STUDY OF LARGE AND MEDIUM SIZE FIRMS

Peter Gangas Chindo[1] **and Kulomri Jipato Adogbo**[2]
Department of Quantity Surveying, Ahmadu Bello University, Zaria, Nigeria

Previous researches indicate that Total Quality Management (TQM) has been in use since the 1980s. In Nigeria, studies have shown little usage of TQM despite its potential benefits to the industry. This study therefore aims at investigating the use of TQM in Nigerian construction industry. The study was carried out using structured questionnaire to collect data from stake holders in the construction industry. The data were analysed and the mean and standard deviations were determined and formed the basis for discussion. The results indicate that most contracting organisations in Nigeria are yet to fully adopt TQM in their operations. The findings suggests that principal factors which prevent contracting organisations from adopting TQM is the perception that it takes a long time to yield the desired benefits, and that TQM involves unnecessary extra cost. It was recommended that government being the major client of the construction industry should come up with an award for excellence for quality construction to deserving organisations and a penalty for organisations which refuse to adopt TQM. This will serve as an incentive for conformity to standards in various areas of the industry and deterrent to defaulters.

Keywords: Total Quality Management, Nigeria.

INTRODUCTION

Total Quality Management (TQM) is a concept which developed over time from the basic principles of management having as its main objective the improvement of every part of an organisation. It's basically about doing the right things at the right time in the first instance (Ramachandran, 2010). TQM features focus on the customers' satisfaction, continuous improvement in terms of service delivery and measurement of quality (Emison, 2004). TQM requires a thorough understanding by all members in an organisation, of the needs and desires of the clients in order to meet these needs in the most efficient and cost effective way possible. The elements of TQM as identified by Ramachandran (2010) include customer (the ultimate user who wants a quality product at a reasonable price); leadership (vision, commitment and leadership exhibited by top management); recognition and rewards (recognising employees' outstanding performance); education and training (to upgrade the knowledge of the employees); feedback mechanism (customers' feedback is analysed and corrective steps taken); and team work (employees work as a united team to achieve common goal). Koh and Low (2010) identified the following eight elements: top management

[1] pcgangas@yahoo.com
[2] kjadogbo@yahoo.com

Chindo, P.G. and Adogbo, K.J. (2011) Investigation into the use of total quality management in Nigerian construction industry: A case study of large and medium size firms *In:* Laryea, S., Leiringer, R. and Hughes, W. (Eds) *Procs West Africa Built Environment Research (WABER) Conference,* 19-21 July 2011, Accra, Ghana, 683-690.

leadership, customer management, people management, supplier management, quality information management, process management, organisational learning and continual improvement. The factors identified in Ramachandran (2010) and Koh and Low (2010) were listed by Metri (2005) in what he calls critical success factors (CSFs) for the implementation TQM by construction organisations.

The study into quality management may be viewed from the point of view of the several theories underlying the subject area, the quality management processes involved and the role of various professionals in quality management (Anon, 1999). This paper considers the professionals involved in the construction industry and seeks to establish their perception on the use of TQM by their organisations. There is an increasing interest in the human resource issues surrounding quality thus requiring organisations to reassess or redesign their quality management programmes. Sanni and Windapo (2008) observe that today quality has moved beyond manufacturing into...construction. Kiwus and Williams (2001) and Al-Momani (2007) have observed that TQM techniques can be applied to improve construction processes.

Haupt and Whiteman (2003) opined that the construction industry has been slow to embrace the concept stating that contractors will only use those aspects that would improve their competitive advantage and improve their financial performance. This notwithstanding, it is helpful to look into the adoption of the concept of TQM by contractors in order to determine extent of use and to ascertain benefits derived by them. There is need for a proposed radical change in the industry practice that will improve the quality of the construction processes and level of clients' satisfaction. The image of most contractors has been dented over the last eight (8) years (FOS, 2004), as a result of their inability to meet up with their clients' requirements which led to a decrease in the level of clients' satisfaction. Information on news and print media have been reporting cases of abandoned projects, total collapse of buildings at the construction stages, decrease in profit margins, low quality of construction works, poor performance by contractors, increase in overhead charges and formal litigation. Above all, there is greater difficulty in selecting a high quality oriented contractor for a project. Therefore, it has become pertinent for contracting organizations to establish a quality management system that will help to bring projects to a satisfactory completion within time, cost limitations and maintaining quality standards, with greater improvement in quality of construction, construction processes, and the level of clients' satisfaction.

Against this backdrop, the study aims to investigate the use of Total quality management among construction firms in Nigeria. This research covers the use of total quality management among large and medium size construction firms located within the Kaduna and Abuja metropolis. According to Uduak (2006), the construction firms in Nigeria can be classified as follows:

1. Large firms: firms whose annual turnover range from 500 million naira and above and have over fifty workers on its pay roll. They undertake erecting of a wide range of building from housing estate to offices, hospitals and factories, these firms occupy less than three percent of the contracting firms in Nigeria, they undertake both national and regional works.

2. Medium sized firms; those who have annual turnover between 100-500 million naira and have between 20 to 50 people in its pay roll. The regional firms undertake regional work such as real estate schemes and others and they constitute about twenty three percent of total contracting firms in Nigeria.

3. Small sized firms: those whose annual less than 10 million naira to 100 million naira and have less than 20 people on its pay roll. They undertake small works, industry minor repairs and maintenance works and they are almost seventy four percent of contracting firms in Nigeria.

TOTAL QUALITY MANAGEMENT IN CONSTRUCTION

Several studies have looked into the adoption of TQM in construction and the general observation is that the construction industry is slow in adopting TQM concept despite its identified potential benefits. According to Haupt and Whiteman (2003), this is one reason why construction remains behind where it should be on the implementation of TQM. Agha (2011) opines that the reason for the late arrival of the construction industry to TQM approach is that construction professionals are not familiar with its principles and techniques. However, Boaden and Dale (1992) note that the relative immaturity of the construction industry in adopting TQM may be an advantage if companies learn from the mistakes and the best practices of other organisations. Ramachandran (2010) observed that the construction industry is more complex compared to other industry and that the use of TQM approach can be useful in analysing and remedying defects as soon as they occur. Miller (1993) notes that the emphasis of TQM is placed on prevention of the causes of defects rather than on correction, thus providing a means for achieving quality in the construction process. Pheng and Teo (2004) investigated how TQM can be applied more actively in the construction industry in Japan. They noted that TQM can be embraced in the construction industry to help raise quality and productivity and concluded that for successful implementation of TQM, organisations needed to develop a culture change and a change in status quo. It is easier to teach new employees about TQM strategy than to try to teach old employees who are set in their ways.

McIntyre and Kirschenman (2000) surveyed the acceptance of TQM in upper Midwestern United States and they found that majority of their respondents (72.5%) employed TQM practices and benefits articulated include higher customer satisfaction and improved schedule performance. They recommended an increased effort to be put in the education and training requirements regarding the implementation and application areas of TQM and a more systematic approach to the collection and analysis of data concerning the overall TQM process. According to a survey by Koh and Low (2010), they found that of eight identified elements of TQM, customer management, process management and top management leadership were implemented at a higher level by construction companies.

Agha (2011) studied the suitable applications of TQM in different phases of construction projects and concludes that though the industry is late in adopting TQM it is a suitable tool for improving business quality, increasing customer satisfaction and saving time. Sannni and Windapo (2008) evaluated contractor's quality control practices on construction sites in Nigeria and they found that over 80% of contractors did comply with some form of quality control plan and recommended that contractors be evaluated based their compliance or otherwise with quality plans.

TQM philosophy is applicable on various platforms in the construction industry from the office management to site operations, whether pre-construction phase or during construction as a necessary avenue for securing customer satisfaction and improving productivity while enhancing organisations' profitability.

Benefits of TQM

The potential benefits offered by TQM techniques are varied and the consensus from various studies is that it has been successfully applied in other industries and can be very beneficial in the construction industry. Hassin et al (2007) studied TQM implementation in the electrical generation industry and found that its adoption will be of pre-eminent importance to the industry in Libya. In considering application of TQM to environmental construction Kiwus and Williams (2001) conclude that TQM techniques may reduce the frequency and severity of schedule overruns. Other benefits for implementing TQM include: higher customer satisfaction, reduction in construction costs, improved employee job satisfaction, improved schedule performance, improved relationships with subcontractors, reduced rework, improved safety, higher productivity, lower employee turnover, speeding up construction work, improved methods of working, better control over the construction process, gaining competitive advantage, increase profitability, decreasing waste and rework, better coordination of activities and more customer focused (Hassin et al, 2006; Love et al, 2000; McIntyre and Kirschenman, 2000; Al-Momani, 2007; Khadour and Darkwa, 2008; Chini and Valdez, 2003; Love et al, 2004).

Obstacles to implementing TQM programme

The implementation of TQM in construction has been the subject of arguments the main ones being that diversity of construction products. Quality is sometimes a subjective construct based on the customers' perceived needs and degree of satisfaction. Secondly, the construction industry is considered unstable where several organisations suffer collapse within short intervals. Since TQM is a long-term endeavour some of these firms may not want to engage in an effort that may not provide any yield till after several years. Thirdly, it is the misconception of the cost of quality. Contractors often perceive TQM as an extra cost which they may not be willing to incur. Tutesigensi and Pleim (2008) identified reasons for lack of implementation of quality plans by small and medium construction firms and these include: lack of knowledge, perception that customers may not need such plans and lack of resources. The construction industry was found to lag behind manufacturing and other industries in its implementation of quality plans.

Gunning and McCallion (2007) enumerated ten obstacles to TQM as seen by contracting firms and they include: lack of commitment from management, lack of communications in organisations, cultural attitudes and lack of training. Organisations would need to devise strategy to bring all parties on board of their quality policies and plans so there can be better participation and cooperation on all levels. Two aspects addressed in literature is the need for a radical culture change and the commitment of top management in the implementation of TQM.

Hassin et al (2007) recommend that training and education are key factors in the implementation of TQM. Other factors include customer satisfaction, employee participation and quality policy. Love et al (2000) made a case for a cultural and behavioural shift in the mind-set of practitioners, academics and professional institutions if the construction industry is to improve its performance and competitiveness. This view was reiterated by Ramachandran (2010) and Mahmood and Mohammed (2008) stating that the implementation of TQM requires a culture change and change in management behaviour.

RESEARCH METHOD

The data for this study were obtained through a questionnaire survey of selected contracting organisations in the Federal Capital Territory (Abuja) and Kaduna metropolis. The opinions of Architects, Quantity Surveyors, Builders, Engineers and Project Managers were sampled with respect to their involvement in the building construction works. A simple random sample was adopted the objective of the sampling being to provide a practical means of enabling data collection process to be carried out while ensuring that sample provides good representation of the population (Osuala, 1987; Fellows and Liu, 1997). Seventy (70) questionnaires were distributed and 59 were successfully retrieved.

Various methods are open for research surveys, such as review of existing literature, field study which comprises of the administering of structured questionnaires, interviews, observations, e.t.c. (Fellow and Liu, 1997). For the purpose of this research, the use of structured questionnaire were considered the best method of obtaining the data as it provide adequate and a better means of collecting and gathering data and subsequent analyzing the data.

The questionnaire was designed to attain its objectives of this study. To facilitate easy response and analysis, the structured questionnaire were divided into two (2) sections A and B, section A contained the general information about the respondent, section B contained information about the use of and implementation of TQM in the Nigerian Construction Industry. There are three main methods of administering questionnaire: face to face, by mail and via telephone. Various factors are considered before selecting the method to be adopted. These factors include the response rates, the sample quality and control over who answers the questionnaire. The face-to-face method was adopted for the survey. Questionnaire duly filled by respondents were collected immediately in order to facilitate gathering of the data.

DATA ANALYSIS AND DISCUSSION

The data obtained from the questionnaire survey were analysed using tables, figures, charts percentages, simple means. A total of seventy (70) questionnaires were administered out of which fifty-nine (59) where retrieved representing eighty-four percent (84%) and eleven (16%) were not returned. Table 1 shows the distribution of respondents' organisation:

Table 1: Nature of the organisation

Organisation	Frequency	Percentage (%)
Construction firms	13	22
Limited liability company	40	68
Public liability company	6	10
Total	59	100

The majority of respondents (68%) were employed in limited liability companies while 22% were with construction organisations and 10% with public liability company. Of the construction firms surveyed, 68% engaged in both civil engineering and construction; Twenty (20%) engaged in building works only while only 12% were exclusively involved in civil engineering construction. The age of organisations ranged from over twenty years (34%), between 16-20 years (36%). Thirty percent of the respondents' organisations had existed for less than 15 years and at least 86% of the organisations have over twenty employees on their payroll.

Fifty-two percent (52%) of the respondents have between 10 -15 years work experience, 14% have over 15 years experience while 34% have less than 10 years experience in construction. At least 83% of the respondents were at middle and senior level management cadre.

The major clients for whom the respondents' organisations have worked for include the government (at local, state and federal levels) (75%); corporate bodies (22%) and private individuals (3%). The high proportion of clients from the government implies that government is the major client of construction and should be conscious of quality requirements. The respondents were required to indicate their perception of the focus of TQM and results showed that there were varying opinions as shown in Table 2.

Table 2: Focus of Total quality management (TQM)

TQM Focus	Frequency	Percentage
Continuous improvement	15	25%
Customer satisfaction	19	32
Preventing non-conformance	11	19
Employee involvement	14	24
Total	59	100

Adoption of TQM

A majority of the respondents (69%) (Table 3) responded that they do not adopt TQM in their organisation while 31% indicated that they do have an articulated TQM policy.

Table 3: Adoption of Total quality management (TQM)

Option	Frequency	Percentage (%)
Yes	18	31
No	41	69
Total	59	100

TQM is a new concept in Nigeria construction industry and this may explain why though there is some level of familiarity with it, it is yet to be widely adopted. Furthermore the factors that impede the implementation of TQM were investigated and these include: the extra cost and time required and lack of adequate training. Some of the reasons cited for lack of implementation also include lack of commitment to change and poor cultural attitude. It was the recommendation of 97% of the respondents that an extensive enlightenment campaign on the importance of TQM in construction will be required to further encourage its use. The response obtained from both building and civil engineering contracting organisations suggest the same view is shared on the use of TQM to help improve the quality of their construction and enhance project delivery within the cost and time limits.

The clients' goal is to have a finished product with minimal time and cost overruns therefore the measurement of quality will not just be an inspection at the end of the work but an essential part of each phase of construction. The implication for the contractors is that they need to put in place a system which will ensure that they meet or exceed their customers' requirements.

CONCLUSION

The circumstances which warrant the adoption of TQM in the Nigerian construction industry were identified, this is sequel to the fact that price is no longer the determining factor. TQM is a new concept in Nigeria construction industry and though there is some level of familiarity with it, it is yet to be widely adopted. The key factor impeding its implementation is the extra cost and time required. One of the reasons is the perception that TQM takes a long time to yield the desired benefits.

RECOMMENDATIONS

Contracting organisations are advised to implement TQM at the project level because it has been identified as a performance enabler. The TQM philosophy of continuous improvement, prevention of defects, conformance to specified standards, employee involvement and performance appraisal should be incorporated into the organisation as a whole and there should be commitment from the top management regarding the implementation of TQM.

Prospective building owners should insist on assessing the quality performance of contractors before awarding a contract, this will motivate contractors to improve and document their quality management procedure in order to be competitive and maintain a continuous flow of business. Quality and not lowest competitive bid should be a major criterion in the selection of contractors.

The government being the major client of the construction industry should come up with an award for excellence for quality construction to deserving organisations. This will serve as an incentive for conforming to quality standards in various areas of the construction industry.

REFERENCES

Agha, A.S. (2011) Total quality management in construction industry (available at http://faculty.kfupm.edu.sa/CEM/bushait/cem515/term-papers/TQMinconstructionindustry.pdf

Al-Momani, A. (2007) Total quality management in construction: a case study of Jordan. In: Hughes, W (Ed) *Procs of the Inaugural Construction Management and Economics 'Past, Present and Future' Conference*, 16th -18th July 2007 University of Reading, UK, 741-752

Anon (1999) Engineering News Record (ENR) 242 18: 30.

Boaden, R. and Dale, B. (1992) "Total quality management in the construction industry: a preliminary analysis". International Journal of Technology Management, 7: 4/5: 244-253.

Chini, A.R. and Valdez, H.E. (2003) "ISO 9000 and the U.S construction industry". Journal of Management in Engineering, 16: 2: 69-76.

Emison, G.A. (2004) "Pragmatism, adaptation, and total quality management: philosophy and science in the service of managing continuous improvement". Journal of Management in Engineering, 20: 2: 56-61

Fellows, R.F. and Liu, A. (1997) Research Methods for Construction. Blackwell Science Ltd. Oxford

Gunning, J.G. and McCallion, E.M. (2007) TQM in large Northern Ireland contracting organisations. *In*: Boyd, D (Ed) *Procs 23rd Annual ARCOM Conference,* 3-5 Septeber 2007, Belfast, UK, Association of Researchers in Construction Management, 577-586

Hassin, E., Tookey, J.E. and Vidalakis, C.(2007) Sustainable development and TQM implementation in Libya: A study of the electrical generation industry. *In:* Egbu, C.O. and Tong, M.K.L. (Eds) *Procs of the 3rd Scottish Conference for Postgraduate Researchers of the Built and Natural Environment (PRoBE)*, 20-22 November 2007, Glasgow Caledonian University, 203-215

Haupt, T.C. and Whiteman, D.E. (2003) "Deploying total quality management on construction sites: inhibiting factors" The International Journal of Construction Management, 3: 2: 51-68

Khadour, L. and Darkwa, J. (2008) "TQEM in the UK construction industry: some key findings from a survey". *In:* Dainty, A (Ed) *Procs 24th Annual ARCOM Conference,* 1-3 September 2008, Cardiff, UK, Association of Researchers in Construction Management, 239-246.

Kiwus, C.H. and Williams, T.P. (2001) "Application of TQM to environmental construction". Journal of Management in Engineering, 17: 3: 176-184.

Koh, T.Y. and Low, S.P. (2010) "Empiricist framework for TQM implementation in construction companies". Journal of Management in Engineering, 26: 3: 133-143

Love, P.E.D., Edwards, D.J. and Sohal, A. (2004) "Total quality management in Australian Contracting organisations: pre-conditions for successful implementation". Engineering, Construction and Architectural Management, 11: 3: 189-198.

Love, P.E.D., Li, H., Irani, Z. And Faniran, O. (2000) "Total quality management and the learning organization: a dialogue for change in construction". Construction Management and Economics 18: 321-331

Mahmood and Mohammed (2008) "A conceptual framework for the development of quality culture in the construction industry" *In:* Dainty, A (Ed) *Procs 24th Annual ARCOM Conference,* 1-3 September 2008, Cardiff, UK, Association of Researchers in Construction Management, 247-256.

Metri, B.A. (2005) "TQM Critical success factors for construction firms". Management, 10: 2: 61-72.

McIntyre, C.and Kirschenman, M. (2000) "Survey of TQM in construction industry in upper Midwest". Journal of Management in Engineering, 16: 5: 67-70.

Miller, C.C. (1993) Total quality management in construction. An unpublished Master's thesis, available at http://handle.dtic.mil/100.2/ADA268922

Osuala, E.C. (1987) Introduction to Research Methodology. Africana-FEP Publishers Ltd. Onitsha, Nigeria, pp105-117

Pheng, L.S. and Teo, J.A. (2004) "Implementing total quality management in construction firms" Journal of Management in Engineering, 20: 1: 8-15

Ramachandran, V. (2010) Total quality management in construction. Edwards, G. (Ed) available at http://www.brighthub.com/office/project-management/articles/86518

Sanni, A.A. and Windapo, A.O. (2008) Evaluation of contractor's quality control practices on construction sites in Nigeria. *In:* Dainty, A (Ed) *Procs 24th Annual ARCOM Conference,* 1-3 September 2008, Cardiff, UK, Association of Researchers in Construction Management, 257-265.

Tutesigensi, A. and Pleim, V. (2008) Why small and medium construction enterprises do not employ six sigma. *In:* Dainty, A (Ed) *Procs 24th Annual ARCOM Conference,* 1-3 September 2008, Cardiff, UK, Association of Researchers in Construction Management, 267-276 .

JOS PLATEAU VOLCANIC DEPOSITS AS SUSTAINABLE CEMENTITIOUS MATERIALS FOR PARTIAL REPLACEMENT OF PORTLAND CEMENT IN CONCRETE MIXTURES

Danjuma W. Dadu[1]

Department of Building, Faculty of Environmental Design, Ahmadu Bello University, Zaria, Nigeria

The costs of concrete mixtures are high in Nigeria. This is due to soaring prices of Portland cement (PC) in the country. There is a need therefore to reduce the PC contents in the concrete mixtures by its partial replacements with Sustainable Cementitious Materials of volcanogenic origins (natural pozzolanas). These materials are environment friendly (no CO_2 emissions) and are economical as little or no energy inputs are required prior to their applications. The compressive strengths tests of concretes with 15% partial replacements of the PC with the pozzolan indicated that the Portland Pozzolana Cement concrete mixtures gave Pozzolanic Activity Index varying from 90 to 99%. The Moisture Contents of 90 % of the samples tested were 0.10 to 2.30% by weight. It is thus, concluded that the Jos Plateau volcanic deposits possessed Pozzolanic Characteristics and are thus potential cementitious materials for partial replacements of the PC in concrete mixtures.

Key words: Jos, natural pozzolanas, partial replacements, pozzolanic activity, sustainable cementitious material.

INTRODUCTION

Concrete is the most commonly used construction materials for housing and other physical infrastructures worldwide. This is due to its outstanding strength, durability, availability of the raw materials and its ease to produce to any and forms and at cheaper costs than other building materials. Thus, Concrete is a material of preference in housing other construction activities. The essential constituent for the production of this material is cement. A growing economy such as Nigerian needs enormous amount of cement as a building material for its housing and other infrastructural developments. Oluwakiyesi (2011) stated that Nigeria requires about 224 million tons of cement for its estimated housing deficits of between 16 and 18 million housing units. But there is a shortage of cement as a building material in the country. This is as a result of a wide gap that exists between production capacity of the Local Cement manufacturing firms and the high demand of the commodity, such that Nigeria imports about 60% of its cement demands to meet up these shortfalls (Fiakpa, 2008). Consequently the costs of concretes and other cement products are high. These cements deficits can be palliated by the utilisation of Jos Plateau Volcanic Deposits for partial replacements of the ordinary Portland cement in concrete mixes. It has been established by Dadu *et al* (2010) that the chemical characteristics of the Jos Plateau

[1] wurim2004@yahoo.co.uk

Dadu, D.W. (2011) Jos plateau volcanic deposits as sustainable cementitious materials for partial replacement of Portland cement in concrete mixtures *In:* Laryea, S., Leiringer, R. and Hughes, W. (Eds) *Procs West Africa Built Environment Research (WABER) Conference*, 19-21 July 2011, Accra, Ghana, 691-701.

Volcanic Deposits indicated that the materials are potential pozzolans with good Pozzolanic Reactivity; the sum of the oxides of silica, aluminium and iron are over 76% by weight in all the materials samples reported; the report also showed that the materials were free from carbon and alkalis; the sulphur and calcium contents are found to be low, with values of 2% and 0.28% respectively. The Jos Plateau Volcanic Deposits thus, offer a ray of opportunities in the reductions of the cement contents in the concretes mixtures. The current investigations provided the levels of partial replacements of the materials with the OPC in concrete mixes.

Volcanic deposits as potential pozzolans.

The distinctive characteristic of the natural pozzolana stands from its occurrence from nature with varies from the Ordinary Portland cement (OPC) production. In Portland cement production, Neville (1996) stated that calcinations of lime stones ($CaCO_3$) create a reactive mixture of tri-calcium silicate ($3CaO.SiO_2$), di-calcium silicate ($2CaO.SiO_2$) and tri-calcium aluminates ($3CaO.Al_2O_3$) and tetra-calcium aluminoferrites ($4CaO.Al_2O_3Fe_2O_3$) is produced. Gypsum ($CaSO_4.2HO$) is then added to the product for the preservation of the cement. But with the Volcanic Pozzolans, the raw ingredients reactivity occurs naturally from the molten earth eruptions. Thus, properties of each volcanic deposit consequently depends on the nature and type of eruptions; the chemistry therefore, differs from deposit to deposit containing mainly the oxides of silica (SiO_2), alumina (Al_2O_3) and iron (Fe_2O_3) and other elements and alkalis in varying degrees. It is the siliceous elements in Pozzolanas react with $Ca(OH)_2$ to produce highly cementitious calcium silicate hydrates that yield high strength and reduces permeability resulting in the production of durable concretes. The pozzolanicity of the volcanic material according to Neville (1998) is the degree of the chemical reactions of the materials with calcium hydroxide (from cement hydration) at ordinary temperature to form cementitious compounds. In the cement hydration, it is the tri-calcium silicate and the di-calcium silicate that take part in the chemical reaction producing calcium silicate, water and calcium hydroxides {$CaO.SiO_2.H_2O$ and $Ca(OH)_2$} presented thus; $CaO.SiO_2 – 2CaO.SiO_2+H_2O => CaO.SiO_2.H_2O+Ca(OH)_2$.When the pozzolan is added to the hydrating cement a gel of a Cementitious substance of Calcium-Silicate- Pozzolana + $Ca(OH)_2$ + H_2O => C-S-H (a strong gel).This reaction is referred to as the Pozzolanic Reaction of the pozzolan (Neuwald, 2004).The reaction continues to produce additional C-S-H. This continuous reactivity of the OPC with the pozzolan is termed the Pozzolanic Activity of the pozzolana (Zhanng *et al*., 1996). This pozzolanic reactivity of the Natural Pozzolanas has accounted for the continued existence of ancient structures to date. Shetty (1982) reported the Wharf of Caligula for instance was constructed with volcanic ash from Mt Vesuvius in Pozzuoli over 2000 thousand years ago.

STUDY AREA

Wright (1989) asserted that the Jos Plateau is a major Volcanic Region in Nigeria presented by basaltic lava flows and cones formations. The major areas of the volcanism in Nigeria are Jos, Biu and Longuda Plateax. The approximately quantities of the volcanic deposits for Jos and Biu are 4.3 and 1.25 billion cubic metres respectively; while the deposits of Longuda Plateau stand at about 75 million cubic metres of the volcanogenic materials (Lekmang, 2006).Thus, the volcanic deposits in Nigeria are in large quantities, but the high volume of the volcanic deposits of the Jos Plateau makes it favourable Study Area for the evaluation of the characteristics of Natural Pozzolans in Nigeria.

The Jos plateau volcanic deposits as sustainable cementitious materials

The concept of this study is the utilisation of the Jos Plateau Volcanic Pozzolans as sustainable cementitious materials for the provision of affordable mass housing for the citizenry. The use of Natural Pozzolans in the industrialized world may not be cost effective due to the costs inherent in mining and abundant industrial wastes by products' pozzolans, such as fly ash and slags. But in developing communities especially Nigeria (with historic volcanism), the use of volcanic deposits is variable; the pre-requisite to their application are reliable tests methods that would ascertain its suitability for use in concrete. The volcanic deposits do not require complex mining procedures; they are excavated just like laterite in these developing communities and are accordingly free or obtained at little cost. This situation will invariably reduce cement-making costs and lead to the provision of affordable housing.

Primarily, the sustainability components of the application of the volcanic pozzolans as cementitious materials will lead to poverty reductions. This is because the utilisation of the natural pozzolans will generate local employments (in the mining and processing of the pozzolans to cementitious values) where the deposits of volcanic materials occur. Secondly, Ronald *et al* (2007) averred that the byproducts of Portland cement production are carbon dioxide and other environmental pollutants. The European Commission (2001) affirmed further that for every ton of Portland cement produce (during lime stone calcinations); about 1 ton of CO_2 is released into the atmosphere. Wilson and Ding (2007), in appraising environmental effects of OPC production avowed that the manufacture of OPC is responsible for more than 8% of all greenhouse gasses release by human activities world over. The direct correlation therefore between Portland cement production and carbon dioxide emissions is that; a reduction in the cement contents in our concretes mixes by its substitution with natural pozzolans in the construction activities would in tandem reduce CO_2 emissions (greenhouse gasses) into the atmosphere. Besides the environmental friendly and poverty alleviation potentials, the application of the natural pozzolans in partial replacements of the OPC in concrete will produce cheaper cementitious materials and thus lower construction costs, particularly in a less developed community such as Nigeria. For instance, the energy consumption in calcinations of the raw materials for the OPC production is about 1 barrel of fuel or ¼ ton of coal 1 ton of cement. European Commission (2001) asserted that this is about 50% of the total cost of producing 1 ton of Portland cement. Thus, the applications of Jos plateau volcanic deposits in concrete mixes and other cement products as sustainable cementitious materials are intended to lower construction costs, alleviate poverty and provide affordable housing to the citizenry as important goals of sustainable developments in Nigeria.

BENEFITS OF NATURAL POZZOLANS AS CEMENTITIOUS MATERIALS

Pozzolanas are cement of antiquities. Detwiler *et al* (1996) averred that making of hydraulic binders using these cements date back to 10th century BC. The word pozzolana, according to meaning Powder from Puteoli according to Jackson et al (2003), were a direct reference to the unconsolidated pyroclastic (ash) deposits of Campi flegrei and Vesuvius volcanic fields were the Romans first discovered the unique characteristics of the pozzolans. But today, American Society for Testing and Material (ASTM) C 618 (2005), defined pozzolans as a siliceous or siliceous and aluminous material, which ordinary possesses little or no cementitious values but when, in finely divided form and in the presence of moisture, chemically react with calcium hydroxide at ordinary temperatures to form compounds possessing cementitious properties. Kurtis (2002) classified the pozzolans into Natural and Artificial. The Artificial Pozzolanas are residues of waste products of Industrial Manufacturing Processes, which includes fly ash, activated or artificially burnt clays, slags, silica fume and ashes from agricultural industrial residues; among these are rice husk ash, sugar cane straw ash and ground nut shell ash .The Natural pozzolans are made up of the volcanic ash, pumicite, volcanic tuffs, diatomaceous earths, volcanic glass, lava, opaline chert and shales resulting from rapid cooling of lavas ejected during volcanic eruptions. The Natural pozzolans have economic benefits as they are cheaper to process (with low technological inputs and capital out lay) and requiring no burning of any sort prior to their applications. The volcanic deposits would thus not only argument the local cement productions, but also reduce the cost of cement in the country.

STUDY OBJECTIVES

The aim of this study is to investigate the pozzolanic characteristics of Jos Plateau Volcanic Deposits as potential pozzolans for innovative, sustainable and environmentally friendly cementitious materials for partial replacement of the Ordinary Portland Cement (OPC) in concrete mixes. Therefore, to achieve the objectives of the study, the investigations are to determine the levels of partial replacements of the OPC with the volcanic materials in the production of Portland Pozzolana Cement Concretes.

SCOPE OF STUDY

The scope of this study is to evaluate the level of partial replacement of OPC with the volcanic rocks from Jos Plateau in concrete mixtures. The collections of the samples were limited to outstanding volcanic land marks and materials exposed as results of physical activities such soil erosion, mining and road construction exploits in the area of the study. The materials were collected from 20 locations; JP1 (Mista Ali) JP2 (Kaskadi), JP3 (Miango). JP4 (Gwafan), JP5 (Furaka), JP6 (Lobel), JP7 (Fobur), JP8 (Vwang), JP9 (Kwi), JP10 (Kombun), JP11 (Kafi Abu), JP12 (Kuben), JP13 (Danwal), JP14 (Bang), JP15 (Kuba), JP16 (Niyes), JP17 (Wunat), JP18 (Kerang), JP19 (Larpia) and JP20 (Mile 8).

RESEARCH LIMITATIONS

The purpose of the investigations is to evaluate the pozzolanic activity of the Jos Plateau volcanic Deposits as potential pozzolans for replacements of OPC in our concrete mixes for low cost housing construction. Consequently, tests of physical characteristics such as soundness, setting time and pozzolanic activity index with lime of the Portland pozzolana cement concretes were not within the time frame and the objectives of this study. Long term deleterious activities that manifest after years of construction (Neville and Brooks, 2008) such as tests on resistance to sulpate attack, resistance to freezing and thawing and alkalis-aggregate reactions tests were not studied under the present work.

RESEARCH METHOD

Determination of the compressive strength

1. *Materials and samples preparations*.

The volcanic deposits' samples were ground manually to powder with an agate mortar and the sieving were carried out in accordance with the ASTM C 136 (2006) Method of sieve Analysis until all material passed 90µm (sieve no 170). According to Neville (1998), this fineness is necessary because the rate of hydration depends on the fineness of the cement particles and for rapid development of strengths in concretes. Shetty (2006) explained further that finer cement offers greater surface area for hydration, hence faster strength developments.

Locally available Ordinary Portland cements; the 'Dangote' brands were obtained from Zaria Building Materials Market. But preceding the utilisation of the cement, the determination of the Oxides Composition, LOI and the MC of the cement were investigated. The results (Table) showed excess of CaO -79.45% by weight as against ASTM C 150 Limits of 60-67%; very low value of SiO_2 - 8.56 as against ASTM C 150 limits of 17-25; and a high LOI of 8.8%,ASTM C 150 limits are 1-3% by weight of the cement.

Table 1. Chemical composition of 'Dangote' cement.

component	Content %	ASTM C 150(2004) Limits
CaO	79.46	60-67
SiO_2	8.56	17-25
$Al_2O_{3,}$	1.7	3-8
Fe_2O_3	3.95	0.5-6.0
MgO	0.03	0.1-4.0
SO_3	1.62	1-3
MnO	0.02	-
SrO	0.74	-
Alkalis	0.21	0.2-1.3
LOI	8.8	1-3
MC	0.3	-

The crushed stones sands met the specifications of ASTM C33 (2002).The sands were quartzite river sands; and the crushed granite stones were obtained from a Local Quarry. Tap water was used for the production and the curing of the concrete cubes.

2. *Compressive strengths portland pozzolana cement.*

The concrete cubes were prepared in 150mm steel moulds and tested in accordance to ASTM C 109 / 109M (2001) techniques. The Portland cement was replaced with 5%, 10%, 15%, 20% and 30% of the volcanic materials in the concrete mixtures. The water/cement ratio of 0.55 was used for all the mixes. This is in line with Neville (1998) recommendation that in partial replace concrete test, water/cement ratio of 0.60, 0.55 or 0.45 be applied for the concrete mixtures. The control cubes specimens were treated identically to the test specimens and compressive strengths of all the cubes were measured at 7, 14 and 28 days.

THE POZZOLANIC ACTIVITY INDEX WITH PORTLAND CEMENT

American Society for Testing and Material C 311(2000) recommended that the strength activity index be used to determine if a mineral admixture is in an acceptable level of strength development when in addition with hydraulic cement. The Pozzolanic Activity Index (PAIC) with Portland cement as explained by Neville and

Books (2008) is the ratio of compressive strength of the mixture with a specific replacement of cement by the pozzolana to the strength of

the mix without replacement. ASTM C 618 (2005) provides the determination as PAIC = $-$ 100.

Where A = average compressive strengths of test mix cubes (N/mm^2).

B = average compressive strengths of control mix cubes (N/mm^2).

These were established by the evaluation of the strength of the concrete with zero pozzolan and with the specific replacements at 28 days for all the samples investigated.

RESULTS AND DISCUSION

1. Control cubes

The control cubes tests (Table 2.) indicated that the compressive strengths at 7, 14 and 28 days were 20.18 N/mm^2, 23.93N/mm^2 and 26.0N/mm^2 respectively.

Table 2. Control cubes compressive strengths (N/mm^2)

Day	7	14	28
Compressive Strength(N/mm^2)	20.18(N/mm^2)	23.93(N/mm^2)	26.0(N/mm^2)

2. Compressive strengths portland pozzolana cement.

The Compressive strengths results (Table 3) showed that portland pozzolana cement concretes with 5%, 10% and15% of the volcanic materials partially replacing the OPC in the concrete mixtures certified the minimum recommendation of ASTM C 618(2005) that compressive strengths of PPC concrete should be at least 75% of the control cubes compressive strengths at 28 days crushing. For 20% replacements, 90% of the samples tested also met this recommendation.

Table 3. Compressive Strength (N/mm^2) of Portland pozzolana concretes

Sample		Percentage Replacement of Portland cement					Sample		Percentage Replacement of Portland cement				
JP1	Day	5%	10%	15%	20%	30%	JP11	Day	5%	10%	15%	20%	30%
Mista Ali	7	23.08	20.81	19.10	15.33	13.70	Kafi Abu	7	24.04	21.34	18.94	14.04	12.73
	14	25.57	23.81	23.36	22.19	14.81		14	23.36	22.47	20.17	15.78	13.34
	28	28.46	27.97	25.33	23.73	14.82		28	27.93	26.13	25.54	20.55	15.39
JP2	7	22.91	21.01	18.89	16.17	12.76	JP12	7	21.39	20.31	16.79	15.23	12.73
Kaskadi	14	24.54	23.13	21.44	19.09	13.33	Kuben	14	23.68	21.53	19.37	16.72	13.94
	28	27.19	26.36	24.29	22.63	13.18		28	28.36	26.23	24.74	20.21	14.75
JP3	7	24.08	23.81	21.66	20.37	13.15	JP13	7	20.40	17.68	16.93	14.35	13.89
Miango	14	25.72	25.01	23.41	22.19	15.85	Danwal	14	22.39	19.83	19.12	17.89	15.86
	28	29.63	27.24	25.73	25.09	18.08		28	24.22	23.16	22.45	19.49	17.38
JP4	7	24.58	21.17	19.78	14.92	14.00	JP14	7	23.66	18.47	19.94	16.12	11.28
Gwafan	14	26.24	24.26	23.85	21.63	13.29	Bang	14	27.38	22.03	22.16	19.16	13.71
	28	30.27	30.79	25.63	24.00	14.83		28	30.82	26.00	24.66	21.06	17.58
JP5	7	24.29	23.28	20.79	16.32	12.86	JP15	7	19.71	19.04	16.34	13.47	11.20
Furaka	14	25.81	24.76	21.63	18.83	14.56	Kuba	14	20.29	18.37	16.98	16.03	11.93
	28	29.71	26.02	25.13	20.37	17.72		28	26.58	20.95	18.23	16.77	14.67
JP6	7	19.93	19.05	19.86	18.17	13.25	JP16	7	23.37	21.31	18.43	13.79	13.03
Lobel	14	23.47	22.07	20.55	17.13	15.74	Niyes	14	24.18	22.14	20.54	14.55	13.96
	28	26.13	25.38	22.34	20.36	18.19		28	29.91	25.48	23.03	17.17	14.01
JP7	7	23.46	22.77	22.00	17.35	14.46	JP17	7	19.55	19.21	18.25	16.50	15.69
Fobur	14	24.73	23.61	23.05	18.91	16.00	Wunat	14	24.02	22.37	21.13	18.86	18.22
	28	30.14	23.93	23.96	21.50	18.36		28	26.06	24.06	22.78	21.50	20.61
JP8	7	22.17	21.58	20.47	15.94	15.13	JP18	7	21.39	20.91	19.61	16.12	11.85
Vwang	14	23.22	22.09	21.03	16.71	16.01	Kerang	14	22.25	24.67	22.10	20.14	14.55
	28	28.85	25.04	23.35	19.10	18.23		28	29.32	27.62	25.41	22.10	16.90
JP9	7	19.96	19.46	18.56	18.00	15.38	JP19	7	18.89	18.96	18.43	17.07	13.27
Kwi	14	21.38	20.57	19.01	19.79	15.99	Larpia	14	22.93	22.06	22.14	20.03	15.24
	28	24.77	23.15	22.41	20.09	18.88		28	27.23	25.19	24.83	23.17	18.89
JP10	7	22.38	18.69	16.51	15.82	15.79	JP20	7	19.90	19.31	18.90	16.00	14.63
Kombun	14	24.02	23.90	20.91	19.10	17.74	Mile 8	14	23.83	23.63	23.36	19.20	16.43
	28	26.88	24.64	22.25	21.32	19.94		28	26.02	25.92	25.11	22.61	18.59

3. Compressive strength of Average Samples Tested N/mm^2 .

The average compressive strength N/mm^2 (Figure 1) of the Jos Natural Pozzolana volcanic rock samples of 5, 10, 15, 20 and 30% replacements of OPC with the volcanic rocks materials at 28 days for the 20 samples investigated were evaluated as 27.97, 25.61, 23.86, 21.14 and 17.19 N/mm^2 respectively.

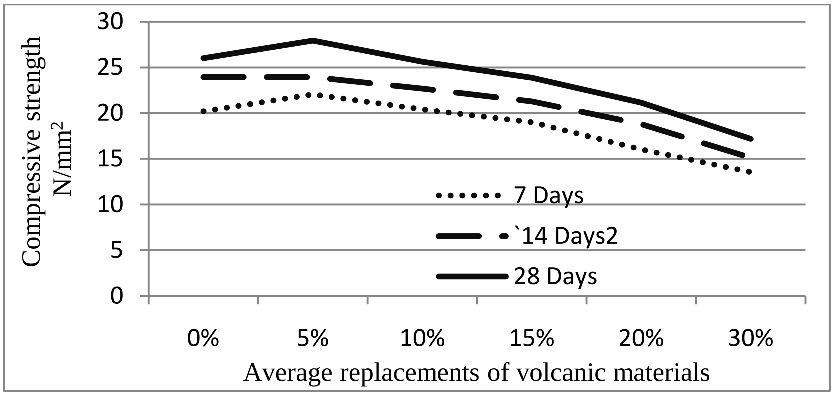


Figure 1. Average Compressive strength N/mm^2 of the Jos Natural Pozzolana

4. The Pozzolanic Activity Index with Portland cement (PAI-C) at 28 days.

The results (Figure 2) of the Pozzolanic Activity Index with Portland cement (PAI-C) with volcanic materials and the compressive strengths of the control specimens measured at 28 days. The activity index vary from 92 (JP5) to 116 (JP3, JP4 and JP7). The average index (105) of the 5% replacement is also presented.

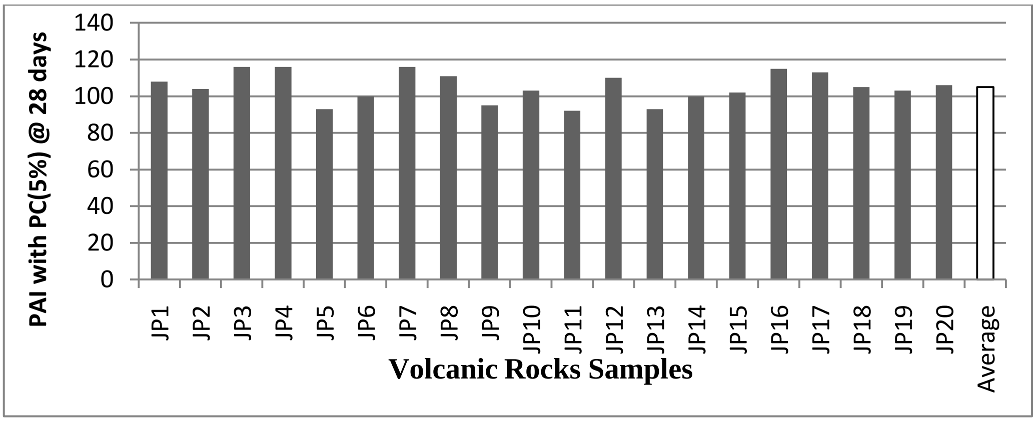


Figure 2. Pozzolanic Activity Index with Portland cement at 28 days.

Figure 3 is the PAIC with 10% replacement of the OPC with volcanic materials and the compressive strengths measured at 28 days. The activity index vary from 87(JP9) to 108 (JP1). The average index is 96.

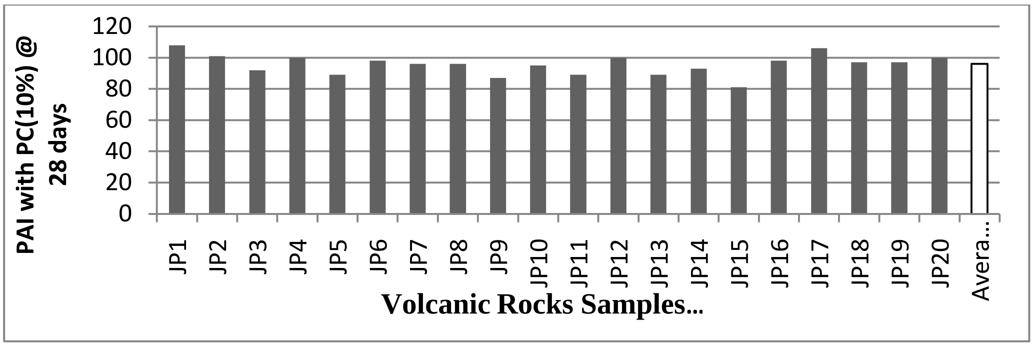


Figure 3 Pozzolanic Activity Index with Portland cement at 28 days.

Replacement of 15% of the OPC with volcanic materials and the compressive strengths measured at 28 days showed that the PAI-C (Figure 4) vary from 70 (JP15) to 98 (Samples JP1 and JP17) with an average of 90.

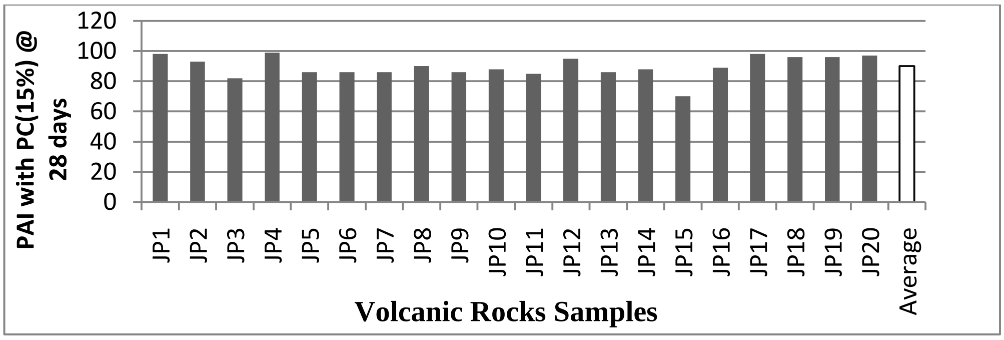


Figure 4 Pozzolanic Activity Index with Portland cement at 28 days.

The results(Figure 5) indicated that the PAIC with 20% replacement of the OPC with volcanic materials and the compressive strengths measured at 28 days provided activity index varying from 65 (JP5) to 91(JP1). The average index was 81for the 20% replacements.

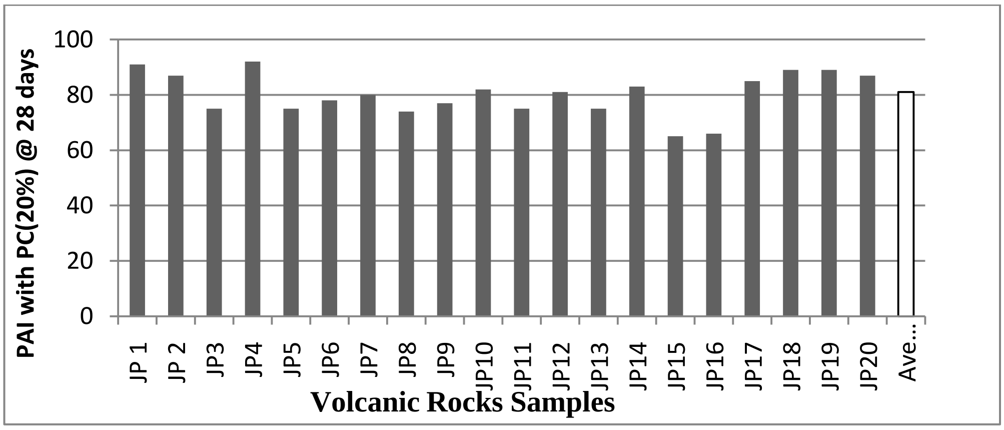


Figure 5 Pozzolanic Activity Index with Portland cement at 28 days.

The results (Figure 6) indicated that the PAI-C with 30% replacement of the OPC with volcanic materials only 4 samples {JP1 (75), JP7 (83), JP10 (77), JP14 (79)} representing 20% had its activity index within the recommended value of 75.

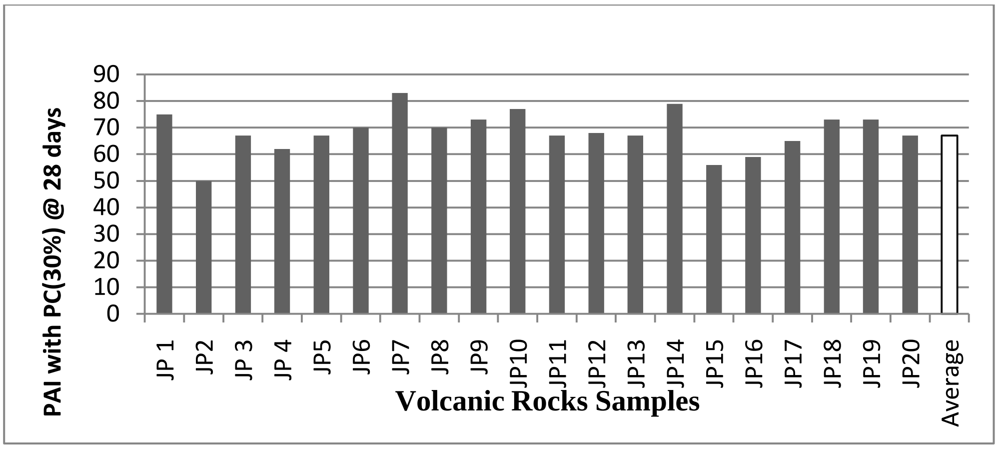


Figure 6 Pozzolanic Activity Index with Portland cement at 28 days

The results of Figures 2 to 6 showed that PAI with Portland cement at 5, 10, 15 and 20% replacements, with Portland cement is within the ASTM C 595(2006) specification of minimum of 75% at 28 days; this is the basis for a pozzolan to be utilised for pozzolan to use Portland Pozzolana Cement in concrete production. This according to ACI (2000) report, are indicators of the reactivity of the pozzolan. But with 30% partial replacements only samples JP1 (75%), JP7 (83%), JP10 (77) and JP14 (79%) representing 20% of the samples investigated met the Pozzolanic Activity Index specification of ASTM C 595(2006).

CONCLUSION

The results of the compressive tests showed that the pozzolan can partially replace up to 20% of Ordinary Portland Cement in the concrete production which is within the limits of ASTM C 618 (2005). ASTM C 595 (2005) classified the Portland Pozzolana Cement Concrete as type IP (cement for general concrete construction) and type P (for use when high strengths at early ages are not a requirement). ASTM C 595 (2005) however limits the pozzolana content in the concrete to between 15-40 % by weight. It is thus concluded, that the Jos Plateau Volcanic Deposits can utilised in partial replacement of Ordinary Portland Cement up to 20% as innovative, sustainable and environmentally friendly cementitious materials for partial replacement of the Ordinary Portland Cement (OPC) in concrete mixes; this will invariably reduce cement-making costs, leading to the provision of affordable housing.

RECOMMENDATIONS

The establishment of Blending Plants for the production of Portland Pozzolan Cements is recommended; since there are economic benefits of the utilisation of volcanic deposits as cementitious materials in providing cheaper housing. It is further recommended that the studies be carried out on physical characteristics such as soundness, setting time and pozzolanic activity index with lime of the Portland pozzolana cement concretes were also not carried out within the time frame and the objectives of the study.

REFERENCES

American Concrete Institute (2000).Use of Raw or Processed Natural Pozzolanas in Concrete. Committee Report R232, American Concrete Institute, Farmington Hills, Michigan, United States of America, pp. 1-10.

American Society for Testing and Material. (2004). Standard Test Method for Density, Relative Density (Specific Gravity), and Absorption of Coarse Aggregate. American Society for Testing and Material, West Conshohocken, Pa., No. C127

American Society for Testing and Material. (2000), Standard Specification for Portland cement concrete. American Society for Testing and Material, West Conshohocken, Pa.,No.C 150.

American Society for Testing and Material (2003). Standard Specification for Concrete Aggregates. American Society for Testing and Material, West Conshohocken, Pa., No's 33

American Society for Testing and Material. (2006).Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates. American Society for Testing and Material, West Conshohocken, Pa., No. C 136.

ASTM-(a) C 311(2005a): Standard Test Methods for Sampling and Testing Fly Ash or Natural Pozzolans for Use in Portland-Cement Concrete. American Society for Testing and Material, West Conshohocken, Pa., No.C311

American Society for Testing and Material. (2005), Standard Specification for Blended Hydraulic Cements. American Society for Testing and Material, West Conshohocken, Pa., No. C 595.

American Society for Testing and Material. (2005), Specification for Fly Ash and Raw or Calcined Natural Pozzolana or Use in as a Mineral Admixture in Portland cement Concrete. American Society for Testing and Material, West Conshohocken, Pa., No C 618.

American Society for Testing and Material (2001) Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or 50-mm Cube Specimens), American Society for Testing and Material, West Conshohocken, Pa., No. C 109/C 109M.

Dadu, D. W. Garba, M. M. Zubairu, I. K. Bustani, S. A. (2010). Investigations into The Pozzolanic Activities of Volcanic Deposits from the Jos Plateau: Interim Report on Chemical Characteristics. *In*: Laryea, S. S., Leiringer, R. and Hughes, W. (Eds).*Procs West Africa Built Environment Research (WABER) Conference*, 27-28 July 2010, Accra. Ghana. pp. 395-402.

Detwiler, R. J., Bhatty J.I. and Bhattacharja S. (1996). Supplementary Cementing Materials for Use in Blended Cements. *In; Research and Development Bulletin*, Portland cement Association, Skokie, Illinois.

European Commission (2001). Pollution Control on Best Available Techniques in the Cement and Lime Manufacturing Industries. *In European Commission Report, pp*. 10-14, Seville, Spain.

Fiakpa, L. (2008). *The Cement Barrier Crumbles*. Thisday Sunday, Jan 20. 3, pp 28-29.

Jackson, M., Sagnotti, L., Solheid. (2003) Pozzolana Cement. *Institute of Rock Magnetic Quarterly*. Minneapolis, *13.3:*2-10.

Kurtis, K. (2002), Supplementary Cementitious Materials. In: Pres to Precast Concrete Association, 2003, PCA CD2038.

Lekmang. I. C. (2006). Geochemical Study of the Basaltic Volcanism within the Jos Plateau Younger Granite Province North Central Nigeria. *In*; Pres to the Department of Geology and Mining, Faculty of Natural Science, University of Jos, 2006.

Neuwald, A.D. (2004).Supplementary Cementitious Material. Part 2; Pozzolanic Supplementary Cementitious Material, *In; Manufactured Concrete Magazine,* app. -17. Retrieved.www.precast.org/publicatios/mc/2005-janfeb/scm-part2.htm on 2 June, 2007.

Neville, A. M. (1998). *Properties of Concrete* 3rd Edition. A Pitman International London, pp. 118-162.

Neville, A. M. and Books J. J. (2008). Concrete Technology, Pearson education Ltd., India

Branch, New Delhi, Revised Edition, pp. 8-38.

Oluwakeyesi, T. (20011).NIGERIAN Cement Industry; Unbundling Potentials. *In*; Pres to Vetiva Capital Management Limited, 2010.

Ronald A. H., Thomas, D. E., Jr., and Christian, W.A. S. (2007). Natural Pozzolans for Sustainable Development: Mapping Poverty in the Philippine. *In*: Report to National Science Foundation.

Shetty, M. S. (2006). Concrete Technology*; Theory and Practice*, S Chad and Company, New Delhi, India, pp. 124– 238.

Wilson, John, W and Ding, Y. C. (2007).A Compressive Report on Pozzolanic Admixtures; The Cement Industry, Market and Economic Trends and Major Companies Operating In The Far East, with reference to Pagan Island; *In* Report to The Secretary, Department of Public, Lands, Commonwealth of Northern Mariana Island.

Wright, J. B. (1989). Volcanic Rocks in Nigeria. *In: Kogbe, C. A.* (Ed), *Geology of Nigeria. 2nd Edition, Rock View (Nigeria) Limited, Jos.* pp. 125– 175.

Zhanng, C., Aigin, W., Mingshu, T. and Xiaoyu, L. (1996). Filling Role of Pozzolanic Material, Cement *and Concrete Research*, 26: 943 – 947.

LEADER INFLUENCES ON TRAINING EFFECTIVENESS OF CONSTRUCTION PROFESSIONALS: THE CASE OF NIGERIA

Henry Onukwube[1]

Department of Building, University of Lagos, Lagos, Nigeria

Training can be defined as the systematic acquisition of skills, concepts or attributes that result in improved performance in another environment. Training effectiveness is a function of trainee characteristics, training design and contextual factors. The purpose of this study is to examine the extent to which leaders influence skill transfer, maintenance and generalisation. Using a survey research, 160 construction professionals that have attended continuous professional development (CPD) programmes of their respective professional bodies were asked to respond to the structured questionnaires. The data generated were subjected to both inferential and descriptive statistics. The findings in this study indicates that LMX, training motivation and outcome expectancy are positively related to training effectiveness The practical contributions of this study are twofold: The first has to do with leadership. The professional who has a good relationship with his or supervisor stands a much better chance of benefitting from the training. Secondly, Leaders can directly influence their employees' training motivation and this has a positive impact on how they transfer new skills, maintain them over time and how they use them in other domains of their jobs.

Keywords: construction professionals, leadership, Nigeria, training.

INTRODUCTION

A performance improvement intervention that is used almost universally in organizations is training. Training is defined as a planned learning experience designed to bring about permanent change in an individual's knowledge, attitudes, or skills (Noe, 1986).As organizations strive to enhance performance through their human capital, workplace learning professionals and trainers are increasingly expected to deliver results. Formal learning interventions in the contemporary workplace are designed and delivered with the expectation of improving organizational and employee performance. Ensuring that skills acquired during training are used in the workplace, or transferred to the job, remains of critical importance for researchers and practitioners. In recent years, investments in training activities have increased all over the world (Velada *et al*. 2007). However, unsettling questions continue to be raised about the return on this investment. The exact amount of transfer varies from author to author, some indicate that only 10% of all training-related expenditures actually result in the transfer of recently acquired skills and knowledge back to the job (Fitzpatrick 2001).According to Burke and Baldwin (1999), there is much evidence suggesting that a considerable part of organizations' investment in training does not result in optimal transfer. To improve job performance, the skills and behaviours learned and

[1] Onukwube12345678@yahoo.com

Onukwube, H. (2011) Leader influences on training effectiveness of construction professionals: The case of Nigeria *In:* Laryea, S., Leiringer, R. and Hughes, W. (Eds) *Procs West Africa Built Environment Research (WABER) Conference,* 19-21 July 2011, Accra, Ghana, 703-713.

practiced during training have to be transferred to the workplace, maintained over time, and generalized across contexts (Holton and Baldwin, 2003). This “transfer problem” presents a big challenge for organizations, given that training is considered to be a primary leverage point by which organizations influence their corporate performance (Kozlowski *et al.* 2000). As transfer of training remains an important issue for researchers and practitioners (Holton and Baldwin, 2003), it becomes essential to investigate relationships that include central, but less frequently studied training effectiveness predictors. Researchers have called for studies on training effectiveness, in an effort to include both individual and organizational contextual factors as antecedents of transfer of training (Colquitt *et al.*, 2000; Quinones, 1997). For example, although work environment aspects are important for training transfer (e.g. Burke and Hutchins, 2007), they are not sufficiently examined in existing literature. It has also been suggested that future studies look at the role of motivation in the relationship between contextual factors and learning, and other training outcomes (e.g. training transfer, maintenance and generalization). For example, Tracey *et al.* (2001) discuss the importance of future research examining the impact of training motivation on different effectiveness criteria, and similar research needs were suggested in other studies (Cheng and Ho, 2001;Tracey *et al.*, 2001). Specifically, whereas acknowledging that individual characteristics are related to training motivation and training outcomes, Colquitt and colleagues (2000) maintain that researchers tend to ignore situational aspects. Therefore, there are calls for studies where the social context is connected with training motivation and transfer (Colquitt *et al.*, 2000), and specifically for connecting leader–member exchange (LMX) and training dimensions. The aim of this study is to examine how leader member relationship (LMX) impact training effectiveness. More specifically, training effectiveness outcomes include transfer of training, training maintenance and training generalization. Transfer of training is defined as ‘the degree to which trainees effectively apply the knowledge, skills, and attitudes gained in a training context to the job’ (Baldwin and Ford, 1988).Training maintenance is defined as the reproduction of trained skills in a new setting, and training generalization refers to the adaptation of trained skills to a more complex task situation (Ford *et al.*, 1998).

THE RELATIONSHIP BETWEEN A LEADER AND A FOLLOWER

Leader member exchange (LMX) theory posits that leaders and members engage in a role development process during which differentiated role definitions develop between a leader and an individual employee (Graen and Cashman, 1975). Whereas low-quality relationships involve rudimentary exchanges that typify the basic employment contract, high-quality relationships are characterized by mutual trust, respect, and loyalty between leader and employee. Based on the concepts of social exchange (Blau, 1964) and reciprocity (Gouldner, 1960), LMX theory posits that the exchange relationship creates a feeling of obligation in members to reciprocate high-quality relationships (Graen and Uhl-Bien, 1995). As such, high-LMX employees are sometimes referred to as ‘trusted assistants’ who are committed to the leader and who enhance their leader’s effectiveness (Liden, Sparrowe, &Wayne, 1997). Research has demonstrated that LMX is related to important employee and organizational outcomes such as job performance, organizational citizenship behaviour, job satisfaction, organizational commitment, retention, and openness to organizational change (e.g., Hofmann, Morgeson, and Gerras, 2003; van Dam, Oreg, and Schyns, 2008). It is generally expected that high-LMX employees engage in more learning activities than do low-LMX employees (e.g., Driver, 2002; Maurer *et al*., 2002; Paparoidamis, 2005). Although researchers proposed that supervisor support is positively related to training transfer (e.g. van der Klink *et al.*, 2001; Velada *et al.*, 2007), there are no empirical studies examining the relationship between a leader and a follower. This relationship is frequently referred to as LMX (e.g. Gerstner and Day, 1997; Murphy and Ensher, 1999). Built into these exchange relationships is the fact that leaders form different relationships with each follower, making it possible that at any given time, a leader will have many different exchange relationships with various subordinates (Gerstner and Day, 1997; Wang *et al*., 2005) and discretionary behaviours, or behaviours that go beyond formal task requirements (Ilies *et al*.,2007). In addition, LMX has been linked to many different organizational outcomes and has been found to have a positive relationship with job satisfaction (Murphy and Ensher, 1999), organizational commitment (Gerstner and Day, 1997) and a negative relationship with turnover (Gerstner and Day, 1997). As related to training, Velada and coauthors (2007) recently investigated whether aspects of the work environment (performance feedback and supervisor support) predicted the transfer of training. Specifically, performance feedback from the supervisor that was received after training had a significant correlation with skill transfer. In their study, performance feedback was defined as an indication from management about how well an employee is performing on the job. Feedback concerning the newly acquired knowledge and skills, and how these relate to job performance, increases the probability of its transfer to the workplace (Velada *et al*., 2007). Although positively related to training transfer, the other component of the work context – supervisor support – did not predict skill transfer. This is a finding that is consistent with several other studies examining support coming from a vertical source e.g. Chiaburu and Marinova, 2005; vander Klink *et al.*, 2001). These inconsistent results of supervisor support on training transfer may be because support dimensions are proximal and specific to training transfer aspects. For example, supervisors engage in discussions with the employees (Lim and Johnson, 2002) and provide feedback (Velada *et al*., 2007). Unfortunately, more distal aspects and diffuse support aspects, such as the relationship of the employee with one’s direct leader (or LMX) and its influence on training effectiveness, have received little empirical attention. The current study focuses on filling this gap and examining how LMX impact training effectiveness.

PROCESSES LEADING TO TRAINING EFFECTIVENESS

The current study focuses on training motivation and outcome expectancy as individual factors having an effect on training outcomes. For example, there are particular training characteristics that are essential preconditions for learning, such as training motivation (Goldstein and Ford, 2002), the first individual factor investigated in the present study. Training motivation refers to the ‘intensity and persistence of efforts that trainees apply in learning-oriented improvement activities before, during, and after training’ (Burke and Hutchins, 2007). There is evidence suggesting that there are differences in the amount of training motivation among different trainees, and that it relates to the success of the trainees in the subsequent training program (Goldstein and Ford, 2002). For example, Scaduto *et al*; (2008) investigated both individual and contextual predictors of training transfer, maintenance and generalization. Their findings suggest that training motivation is directly related to all components of training effectiveness (positive correlation with training transfer, maintenance and generalization). Furthermore, high-quality leader–member relationships have a positive influence on employees’ levels of empowerment, which are described by

Kang and Stewart (2007) as a motivating factor and supported empirically in other studies (Liden *et al.*, 2000).In addition, because LMX relationships are based on social exchanges, there is a perceived commitment on the part of subordinates to reciprocate high-quality relationships (Hofmann *et al.*, 2003). One way in which subordinates can reciprocate these relationships is by engaging in discretionary behaviours. Reciprocation is not limited to these behaviours, and employees can also engage in such behaviours as paying attention to skill application in a work setting. More importantly, employees will be motivated to maintain the skills in time (training maintenance), and will go the extra mile and generalize these skills to new situations (training generalization).

The second individual factor of interest influencing training effectiveness is outcome expectancy. According to Stone and Henry (2003), outcome expectancy is defined as 'the consequence of an act and not the act itself'. Concretely, the central idea of expectancy theories is that the influence on an individual to take on a specific behaviour is a function of: (1) his or her expectations that the behaviour will result in a specific outcome; and (2) the sum of the valences (or values) that he or she gains from the outcome. In a training context, in most cases, learners who are motivated have two beliefs: (1) making an effort during training will result in learning; and (2) the material they learn will be useful for achieving valued outcomes back on the job (Brown and Ford, 2002).There is both theoretical and empirical support for the importance of this second belief, which is related to Vroom's (1964) expectancy theory (Brown and Ford, 2002). This theory suggests that the motivating force behind specific choices originates mainly from perceptions of the utility or value of that choice (Brown and Ford, 2002). According to Vroom's theory (1964) an individual is more likely to pursue choices, and make an effort, when he or she believes the result will be valued outcomes. Empirical support for the importance of utility perceptions demonstrated a high correlation between beliefs in the value of training and specific motivation to do well in training (Alliger et al., 1997) Leaders, through their complex relationships with followers, can have an influence on follower expectancies, in that they provide formal rewards for task performance and for discretionary behaviours (by having a choice on positioning specific employees in the in- or out-group through high or low LMX relationships). Therefore, a good relationship between the leader and the follower would include communication about what behaviours are tied to good – and bad – performance. If the organization has done a good job of aligning the training outcomes with necessary employee performance, then the benefits of training transfer would be apparent to the employee, subsequently adding to their outcome expectancy regarding the training. Put another way, if the leader and follower agree (through a good LMX relationship) on what is important from a performance standpoint, and if they see the training as contributing to this desired performance, then employee outcome expectancy would increase because training is a path to the performance desired by the leader (and the organization).

Therefore, based on the previous discussion, the following hypotheses are proposed:

H_{oa}: LMX will not be positively related to (a) training transfer, (b) training maintenance, and (c) training generalization.
H_{1a}: LMX will be positively related to (a) training transfer, (b) training maintenance, and (c) training generalization.
H_{ob}: Training motivation not will be positively related to (a) training transfer,(b) training maintenance, and (c) training generalization.

H_{1b}: Training motivation will be positively related to (a) training transfer,(b) training maintenance, and (c) training generalization.
H_{oc}: Training motivation will not mediate the relationship between LMX and training outcomes (transfer, maintenance, generalization).
H_{1c}: Training motivation will mediate the relationship between LMX and training outcomes (transfer, maintenance, generalization).
H_{od}: Outcome expectancy will not mediate the relationship between LMX and training outcomes (transfer, maintenance, generalization).
H_{1d}: Outcome expectancy will mediate the relationship between LMX and training outcomes (transfer, maintenance, generalization).

RESEARCH METHOD

The study embraces both quantitative and qualitative methods of data collection. Relevant information is sourced from construction professionals (Architects, Builders, Quantity Surveyors and Civil Engineers) who have participated in various continuous professional development programmes organised by their respective professional bodies. Respondents were asked to indicate their judgement on identified leader member exchange factors, training transfer factors, training maintenance factors, training generalisation factors, training motivation factors and outcome expectancy factors. A 5-point scale was used to assess the importance of these factors. Section A addresses questions on name and type of organisation, years of construction industry experience. For each factor, an important index was determined. Questions on section B to G are quantitative in nature. Section B comprises twenty four questions on leader member relationship, section C comprises fifteen questions on training transfer, Sections D, E, F and G comprise two, three, ten and three questions respectively on maintenance, generalisation, motivation and outcome expectancy. The population upon which the respondents were stratified comprises government establishment (120 respondents), contracting organisations (100 respondents) and consultancy firms (100 respondents) Using stratified random sampling technique; a total number of 160 respondents were selected for study from each group. One out of every two in the sample frame was selected.

Measures

In this study previously published scales was used to collect data relevant for the study. All measures were assessed using a 5-point Likert-type scale (1-strongly disagree; 2-disagree; 3-neither agree nor disagree; 4-agree; and 5-strongly agree). Cronbach's alpha is the most widely used criteria to measure the reliability of items for each construct.Leader–Member Exchange (LMX*):* This construct was measured with the LMX7 designed by Graen *et al.* (1982). It consisted of seven items; 'I always know how satisfied my supervisor is with what I do', $\alpha = 0.85$. Training motivation was measured using a scale developed by Noe and Schmitt (1986) (15 items, 'I try to learn as much as I can from training programs ', $\alpha = 0.79$). The training outcome *expectancy* was based on a scale developed by Stone and Henry (2003) and adapted for organizational outcomes (eight items, 'Working with the techniques from this course will result in obtaining better work outcomes', and 'Knowing and applying skills learned in class will help advance my career', $\alpha = 0.89$).Training outcomes were measured by *training transfer* (seven items, Xiao, 1996, 'I can accomplish the job tasks better by using new knowledge acquired from the training course', $\alpha = 0.83$), *training maintenance* (seven items, Gist *et al.*, 1991, 'I have monitored my progress in the use/review of the skills', α = 0.86) and training generalization (two items, Tesluk *et al.*, 1995, 'I make use of the acquired skills only in situations similar to those presented during the training program' [reverse-scored], α = 0.78) Statistical packages for social sciences (SPSS) were used for the processing of data in this study.

RESULTS

Data collected from Section A of the research instrument shows that 44(27.5%) of the respondents are Architects, 39(24.4%) are Quantity Surveyors, 37(23.1%) are Civil Engineers while the remaining 40 (25.0%) are Builders. Majority of the respondents 68 (42.5%) had more than 25 years construction industry experience, while 42 (26.25%) had experience ranging between (15- 20) years. Others are 30 (18.75%) for industry experience ranging between (10-14) years while the last group recorded 20 (22.5%) for industry experience of (5-9) years. The implication of this result is that most of the respondents had enough knowledge and experience to make useful contribution to this area of research.

Table 1: Demograghic Profile of Respondents

Professional Groups	Frequency	Cum. Freq.	Percentage	Cumulative Percentage
Architects	44	44	27.5%	27.5%
Quantity Surveyors	39	83	24.4%	49.9%
Civil Engineers	37	120	23.1%	75.0%
Builders	40	160	25.0%	100.0%
Total	160			
Industry Experience				
(5-9) years	20	20	12.5%	12.5%
(10-14) years	30	50	18.75%	31.25%
(15-20) years	42	92	26.25%	57.50%
More than 25 years	68	160	42.5%	100.0%
Total	160			

Relationship between LMX and Performance Outcomes

Means, standard deviations and correlations are presented in Table 2.Hypothesis 1**,** predicted direct positive relationships between LMX and the three performance outcomes. As expected, LMX was positively related to transfer ($r = 0.303$, $p < 0.05$), maintenance ($r = 0.253$, $p < 0.05$) and generalization ($r = 0.302$, $p < 0.05$) of training skills. Hypothesis 2 predicted a direct positive relationship between training motivation and the three performance outcomes.

Table 2: Means, standard deviations, correlations, and reliabilities

	Variable	Mean	SD	1	2	3	4	5	6
1.	Leader-member exchange	3.04	0.84	(0.91)					
2.	Training motivation	3.49	0.40	0.358**	(0.83)				
3.	Outcome expectancy	3.70	0.70	0.271*	0.423**	(0.93)			
4.	Training transfer	3.49	0.67	0.303*	0.466**	0.531**	(0.87)		
5.	Training maintenance	3.7	0.65	0.253*	0.446**	0.455**	0.433**	(0.92)	
6.	Training generalization	3.86	0.77	0.302*	0.237*	0.342**	0.330**	0.338**	(0.81)

*p<0.05; n=160, ** P < 0.01, D = standard deviation.

As expected, training motivation was positively related to transfer ($r = 0.466$, $p < 0.05$), maintenance ($r = 0.446$, $p < 0.05$) and generalization ($r = 0.237$, $p < 0.05$) of training skills. Therefore, Hypotheses 1 and 2 were supported. Additionally, outcome expectancy was positively related to transfer (r = 0.531, $p < 0.05$), maintenance (r = 0.455, $p < 0.05$) and generalization (r = 0.342, $p < 0.05$). Lastly, as shown in Table 1, LMX was positively correlated to both training motivation (r = 0.358, $p < 0.05$) and outcome expectancy (r = 0.271, $p < 0.05$).

Regression results

Hypothesis 1 was also supported from the regression analysis. As shown in Table 3, LMX is positively related to transfer (= 0.358, p < 0.05), maintenance (= 0.303, p < 0.05) and generalization (= 0.253, p < 0.05).

Hypotheses 3 and 4 predicted a mediating effect of training motivation and outcome expectancy, respectively. According to extant literature, the following relationships must be investigated in order to demonstrate mediation. First, the relationship between the predictor (LMX) and the outcome variables (transfer, maintenance and generalization) must be significant. As shown in Table 3, LMX was positively related to these outcomes. Second, the predictor must be related to the mediators. As shown in table 2, LMX was positively correlated to both training motivation and outcome expectancy. Third, the path between the mediators and the criteria must be tested, and the positive relationships between the training motivation and the transfer outcomes are supported (see Table 3, all correlation coefficients higher than 0.40, p<0.05). For Hypothesis 3, the effect of the LMX on the outcome variables, controlling for training motivation should decrease (for partial mediation), or become non-significant (for full mediation). After entering training motivation into the equation, the relationship between LMX and transfer (= 0.00, non significant [ns]), maintenance (= 0.00, ns) and generalization (= 0.00, ns), became non significant; hence, the mediating test was meaningful for all three of the outcome variables, supporting Hypothesis 3. Training motivation fully mediated the relationship between LMX and transfer (= 0.423, p < 0.05), maintenance (= 0.531, p < 0.05) and generalization (= 0.455, p < 0.05).

Table3: Direct and mediated regressions for training transfer, maintenance, and generalization

Predictors	Outcome variables					
	Training transfer		Training maintenance		Training generalization	
	Step 1 ( )	Step 2 ( )	Step 1 ( )	Step 2 ( )	Step 1 ( )	Step 2 ( )
Distal variable						
Leader-member exchange	0.358*	0.00	0.303*	0.00	0.253*	0.00
mediators						
Training motivation		0.423*		0.531*		0.455*
Outcome expectancy		0.237*		0.283*		0.305*
R^2	0.128*	0.179*	0.092*	0.282*	0.064*	0.207*
R^2	0.056*	0.168*	0.109*	0.271*	0.338*	0.196*
F	10.02*	14.84*	6.89*	26.70*	4.64*	17.79*
F		4.04*		8.33*		8.78*

Hypothesis 4 predicted a mediating effect of outcome expectancy. The same procedure used for the previous hypothesis was used to test this hypothesis .In addition to the relationship between LMX and the criteria (demonstrated above, for

Hypothesis 3), as shown in Table 2, LMX was positively related to outcome expectancy. The path between the mediator and the criterion must be tested using LMX and outcome expectancy as predictors of the outcome variables. After entering outcome expectancy into the equation, the relationship between LMX and transfer became, again, non significant (with standardized coefficients close to zero); hence, the mediating test was meaningful for all three outcome variables. There was support for Hypothesis 4, and outcome expectancy fully mediated the relationship between LMX and transfer (= 0.237, $p < 0.05$), maintenance (= 0.283, $p < 0.05$) and generalization (= 0.305, $p < 0.05$)

CONCLUSIONS

Theoretical and practical study contributions

The purpose of this study was to examine how leader member relationship (LMX) impact training effectiveness (training transfer, training maintenance and training generalization) This study focus on this particular aspect of the work environment to compensate for the scarcity of research in this area (Burke and Hutchins, 2007) and attempt to contribute both theoretically and practically to the training effectiveness and leadership research domains. In this study, empirical test was used to test the relationship among the study variables. The findings in this study suggests that leader member relationship was positively related to training effectiveness (Training transfer, maintenance and generalization).This results is supportive of previous research findings of (Scaduto *et al*, 2008; Chiaburu and Tekleab, 2005;Colquitt and others, 2000; Ilies *et al*, 2007 and Kozlowski *et al*; 2000).Knowing where one stands with the leader, having the certainty that the leader will use his or her power to help the employee solve work issues and, more generally, having an effective work relationship with one's leader (all aspects of LMX as evaluated in this study), are beneficial for training transfer. The results of the study also indicate that training motivation was positively related to training transfer, maintenance and generalization. This agrees with the findings of Scaduto *et al*., (2008). The study also found out that outcome expectancy was positively related to training transfer, maintenance and generalization. This result is consistent with the findings of (Stone and Henry, 2003; Brown and Ford, 2002). According to them, outcome expectancy influences training effectiveness. The central idea of expectancy theories is that the influence on an individual to undergo training is a function of his or her expectations that the training will result in a specific outcome and this will correspond to the sum of valences he or she expects to gain from such training. The study further discovered that training motivation fully mediated the relationship between LMX and training effectiveness and outcome expectancy mediated the relationship between LMX and training effectiveness.As suggested in prior theories, but captured to a limited extent in empirical work in a training setting, leaders are powerful motivating forces and can manage the outcome expectancies of their followers (e.g. Scaduto and others, 2008).The findings demonstrate the importance of leader–follower relationships. Showing processes through which the leader influences employees' training effectiveness, especially in managing the performance–outcome link (conceptualized as outcome expectancy) is important. The practical contributions of this study are twofold. The first has to do with leadership. The existence of direct relationships between LMX and training effectiveness has implications for the individual (in terms of training material learned and performed on the job) and for the organization. Therefore, less than ideal relationships and exchanges between employees and their leaders can stall training transfer and related outcomes (maintenance, generalization).

This point to the fact that the effectiveness of training programs and interventions extends beyond the individual participating in the training, the particular type of training and the intervention design features. The individual who has a good relationship with his or her supervisor (which enhances communication of organizationally relevant and important information) stands a much better chance of benefiting from the training, which will lead to positive outcomes, both for the individual and the organization. The second aspect is related to training motivation and outcome expectancy as intervening processes. Leaders can directly influence their employees 'training motivation and this has a positive impact on how they transfer new skills, maintain them over time and how they use them in other domains of their jobs. Of importance here is the fact that employees do not enter, remain and exit the training situation in a neutral state. The entire experience is influenced by their perception of the relationship with the direct leader, and this can both enhance, and hinder in the case of a negative LMX relationship, their motivation. Leaders are also a source for trainees' outcome expectancies, and this study shows the need to actively manage information in this particular domain. Practically, leaders can (and should) inform their followers on how their performance during training is related to outcomes of interest to the employees. In conclusion, this study has advanced knowledge of training effectiveness and leader influence on training transfer.

FUTURE RESEARCH DIRECTIONS

This study suggests a number of directions for future research. One area that needs more attention is on the reasons for the low rates of organizations that incorporate training activities to improve transfer before, during, and after training. While many studies have attempted to improve transfer through various interventions, relatively few have sought to understand why it remains a problem. In this regard, more research is needed on both transfer generalization and maintenance.

REFERENCES

Alliger, G. M., Tannenbaum, S. I., Bennett,W., Traver, H. and Shotland, A. (1997) "A meta-analysis of the relations among training criteria", Personnel Psychology, 50, pp 341–58.

Baldwin, T. T. and Ford, J. K. (1988) "Transfer of training: a review and directions for future research", Personnel Psychology, 41, pp 63–103.

Blau, P. M. (1964) Exchange and power in social life. Wiley, New York.

Brown, K. G. and Ford, J. K. (2002) "Using Computer Technology in Training: Building An Infrastructure for Active Learning", in K. Kraiger (ed.), Creating, Implementing, and Managing Effective Training and Development San Francisco, CA: Jossey-Bass, pp 192–233.

Burke, L. A. and Baldwin, T. T. (1999) "Workforce training transfer: a study of the effect of relapse prevention training and transfer", Human Resource Management, 38, 227–43.

Burke, L. A. and Hutchins, H. M. (2007) "Training transfer: an integrative literature review", Human Resource Development Review, 6, pp 263–96.

Cheng, E. W. L. and Ho, D. C. K. (2001), "A review of transfer of training studies in the past decade", Personnel Review, 30, pp 102–18.

Chiaburu, D. S. and Tekleab, A. G. (2005) "Individual and contextual influences on Multiple dimensions of training effectiveness", Journal of European Industrial Training, 29, pp 604–26.

Colquitt, J. A., LePine, J. A. and Noe, R. A. (2000) "Toward an integrative theory of Training motivation: a meta-analytic path analysis of 20 years of research", Journal of Applied Psychology, 85, pp 679–707.

Driver, M. (2002) “Learning and leadership in organizations: Toward complementary communities of practice,” Management Learning, 33, pp 99–126.
Fitzpatrick, R. (2001) “The strange case of the transfer of training estimate,” Industrial-Organizational Psychologist, 39(2), pp 18–19.
Ford, J. K., Smith, E. M., Gully, S. M. and Salas, E. (1998) “Relationships of Goal orientation, meta cognitive activity, and practice strategies with learning outcomes and transfer”, Journal of Applied Psychology, 83, pp 218–32.
Gerstner, C. R. and Day, D. V. (1997) “Meta-analytic review of leader-member exchange theory: correlates and construct issues”, Journal of Applied Psychology, 82, pp 827–44.
Goldstein, I. L. and Ford, J. K. (2002) Training in Organizations: Needs, Development, and Evaluation, 4th ed., Wadsworth Group, Belmont, CA.
Gouldner, A.W. (1960) “The norm of reciprocity: A preliminary statement,” American Sociological Review, 25, pp 161–177.
Graen, G., and Cashman, J. F. (1975) “A role-making model of leadership in organizations:A development approach.” In J. G. Hunt and L. L. Larson (Eds.), Leadership frontiers Kent, OH: Kent State University Press, 1 (1), pp 143–165
Graen, G. B. and Uhl-Bien, M. (1995) “Relationship-based approach to leadership: development of leader-member exchange (LMX) theory of leadership over 25 years: applying a multi-level multi-domain perspective”, Leadership Quarterly, 6, pp 219–47.
Hofmann, D. A., Morgeson, F. P. and Gerras, S. J. (2003) ‘Climate as a moderator of the relationship between leader-member exchange and content specific citizenship: safety climate as an exemplar’, Journal of Applied Psychology, 88, pp 170–8.
Holton, E. F., III and Baldwin, T. T. (2003) Improving Learning Transfer Systems in Organizations, Josey-Bass and Pfeiffer, San Francisco.
Ilies, R., Nahrgang, J. D. and Morgeson, F. P. (2007) “Leader-member exchange and citizenship behaviours: a meta-analysis”, Journal of Applied Psychology,92, pp 269–77.
Kang, D. and Stewart, J. (2007) “Leader-member exchange (LMX) theory of leadership and HRD: development of units of theory and laws of interaction”, Leadership and Organization Development Journal, 28, pp 531–51.
Kozlowski, S. W. J., Brown, K. G., Weissbein, D. A., Cannon-Bowers, J. A., and Salas, E. (2000). “A multilevel approach to training effectiveness”. In K. J.Klein and S. W. J. Kozlowski (Eds.), Multi level theory, research, and methods in organizations: Foundations, extensions, and new directions Jossey-Bass, San Francisco, CA, pp.157–210.
Liden, R. C., Wayne, S. J. and Sparrowe, R. T. (2000), “An examination of the mediating role of psychological empowerment on the relations between the job, interpersonal relationships, and work outcomes”, Journal of Applied Psychology, 85, pp 407–16.
Liden, R. C., Sparrowe, R. T., and Wayne, S. J. (1997). “Leader–member exchange theory: The past and potential for the future”. Research in Personnel and Human Resources Management, 15, pp 47–119.
Lim, D. H. and Johnson, S. D. (2002) “Trainee perception of factors that influence learning transfer”, International Journal of Training and Development, 6, pp 36–48.
Murphy, S. E. and Ensher, E. A. (1999) “The effects of leader and Subordinate characteristics in the development of leader-member exchange quality”, Journal of Applied Social Psychology, 29, pp 1371–94.
Maurer, T. J., Pierce, H. R., and Shore, L. M. (2002) “Perceived beneficiary of employee development activity: A three-dimensional social exchange model.” Academy of Management Review, 27, pp 432–444.
Noe, R. A. and Schmitt, N. (1986) “The influence of trainee attitudes on training effectiveness: test of a model”, Personnel Psychology, 39, pp 497–523.
Paparoidamis, N. G. (2005) “Learning orientation and leadership quality: Their impact on salespersons’ performance.” Management Decision, 43, pp 1054–1063.

Quinones, M. A. (1997) "Contextual influences on training effectiveness", in M. A. Quinones and A. Ehrenstein (eds), Training for a Rapidly Changing Workforce: Application of Psychological Research American Psychological Association, Washington, DC, pp. 177–201.
Tracey, J. B., Hinkin, T. R., Tannenbaum, S. and Mathieu, J. E. (2001) "The influence of individual characteristics and thework environment on varying levels of training outcomes", Human Resource Development Quarterly, 12, pp 5–23.
Van Dam, K., Oreg, S., and Schyns, B. (2008) "Daily work contexts and resistance to organizational change: The role of leader–member exchange, development climate, and change process characteristics." Applied Psychology: An International Review, 57, pp 313–334.
Van der Klink, M., Gielen, E. and Nauta, C. (2001) "Supervisory support as amajor condition toenhance transfer", International Journal of Training and Development, 5, pp 52–63.
Velada, R., Caetano, A., Michel, J. W., Lyons, B. D. and Kavanagh, M. J. (2007) "The effects of training design, individual characteristics and work environment on transfer of training", International Journal of Training and Development, 11, pp 282–94.
Vroom, V. H. (1964) Work and Motivation, Wiley, New York.
Wang, H., Law, K. S., Hackett, R. D., Wang, D. and Chen, Z. X. (2005) Leader-member exchange as a mediator of the relationship between transformational leadership and followers, performance and organizational citizenship behaviour", Academy of ManagementJournal, 48, pp 420–32.
Scaduto, A; Linday,D and Chiaburu, D.S (2008) "Leader Influences ontraining effectiveness: Motivation and Outcome expectation processes" International Journal of Training and Development, 12(3), pp 158-170
Stone, R. W. and Henry, J. W. (2003) "The role of computer self-efficacy and outcome expectancy in influencing the computer end user's organizational commitment", Journal of End User Computing, 15, pp 38–53.

MALAIKA CHILDREN'S VILLAGE, MKURANGA, TANZANIA: A CASE STUDY OF SUSTAINABLE CONSTRUCTION IN AFRICA

Ifeyinwa Dimoriaku[1] and Rita Obiozo[2]

[1]*Corner Stone Architects, New York, USA*

[2]*Department of Architecture, Enugu State University of Science and Technology, Enugu, Enugu State, Nigeria*

Sustainable construction should not be seen as something that is exclusive to expensive projects, as it has the potential to be applied to any development. Even switching of small aspects of a development to more sustainable materials or designs is a step forward. Malaika Children's village, Mkuranga, in Tanzania represents a case study of effective sustainable practices by planning, design, construction, and maintenance as well as theme formation and concept. The village is a Hydraform sustainable construction demonstration, designed in 2008 to accommodate 320 AIDS orphans and offer them a normal life with a unique living concept based on family houses. It is an excellent example of current sustainable construction practice that showcases the problem as well as the solutions employed. In highlighting the case of sustainable construction with this very successful project - still in progress - this paper offers tangible evidence of the construction industry's adoption of more sustainable practices in Africa for more provocative cost efficient results!

Keywords: compressed earth blocks, efficient water system, phased construction, sustainable construction, Tanzania.

INTRODUCTION

The American Institute of Architects defines sustainability as the ability of society to continue functioning into the future without being forced into decline through exhaustion or overloading of the key resources on which that system depends (Mendler and Odell, 2000). Sustainable Design in buildings and construction requires a holistic view of land, infrastructure and buildings in order to use material, energy and water resources efficiently, improve the health of ecosystems and address health issues relating to the indoor environment. Sustainable design can lead to a variety of economic benefits – energy, water and materials savings as well as reduced maintenance and other operational costs (Mendler and Odell, 2000).

This paper will start by highlighting the issues that designers should consider in order to ensure a sustainable building project. The Malaika Children's Village project will then be examined in detail in order to draw attention to the design considerations which make it a good case study of sustainable construction.

SUSTAINABLE DESIGN

[1] idimoriaku@yahoo.co.uk

[2] ritax2k@gmail.com

Dimoriaku, I. and Obiozo, I. (2011) Malaika Children's Village, Mkuranga, Tanzania: A case study of sustainable construction in Africa *In:* Laryea, S., Leiringer, R. and Hughes, W. (Eds) *Procs West Africa Built Environment Research (WABER) Conference*, 19-21 July 2011, Accra, Ghana, 715-724.

The following are ten issues designers should consider as part of a sustainable design approach:-

1. Select And Develop Sites To Promote Livable Communities:

Seek out opportunities to redevelop existing sites, structures and infrastructure. Develop links to public transit and strategies to develop pedestrian friendly, mixed-use communities. Provide areas of dedicated open space and green ways.

2. Develop Flexible Designs to Enhance Building Longevity:

Consider future needs and design to accommodate them. Design for ease of expansion.

3. Use Natural Strategies to Protect and Restore Water Resources:

Design the site to limit disruption to existing vegetated areas and use natural storm water treatment systems to purify runoff and promote groundwater recharge.

4. Improve Energy Efficiency while Ensuring Thermal Comfort:

Improve the building envelope and develop passive solar strategies to improve comfort and reduce energy demand. Coordinate daylighting with high – efficiency electric lighting.

5. Reduce Environmental Impacts Related to Energy Use:

Explore opportunities to reduce reliance on fossil fuels and use cleaner sources of power.

6. Promote Occupant Health and Well – being in the Indoor Environment:

Enhance the indoor environment by providing a connection to nature and daylight. Use natural ventilation.

7. Conserve Water and Consider Water Reuse Systems:

Conserve water with the use of low flow plumbing fixtures and water efficient appliances. Consider collection of rainwater, reuse of gray water for nonpotable uses and construction of wetlands for biological wastewater treatment.

8. Use Environmentally Preferable Building Materials

Evaluate the environmental impact, resource efficiency and performance of proposed building materials over their full life cycle. Seek out non-toxic materials from, renewable, sustainably acquired resources that minimize waste and pollution from manufacturing, installation and maintenance.

9. Use Appropriate Plant Material

Use plant material native to the region’s climate, soils and water availability to ensure survival while reducing maintenance and irrigation requirements.

10. Plan for Recycling During Construction, Demolition and Occupancy

Provide collection bins for recyclable materials at the point of use on each floor and an area for materials collection at the loading dock. Where appropriate, consider vertical chutes to make collection easier. Require contractors to develop a construction waste management plan prior to construction (Mendler and Odell, 2010).

MALAIKA CHILDREN'S VILLAGE

It has been a long standing dream of Jamilla, the founder of Malaika Kids Network to establish a safe "home" environment for the street children in Tanzania (Coneboy, 2010). Malaika Kids is an international network of charities which raises fund for and builds homes for orphans with the support of volunteers and companies [Malaika Kids UK (2011). *Our approach*]. In the past six years AIDS has spread rapidly in Tanzania. The most tragic consequence of the AIDS epidemic is the enormous increase in the number of street children who are in need of a caring home environment, regular meals and a proper education.

The Malaika children's village has been designed to accommodate 320 children. The aim is to offer the children a normal life with a unique living concept based on family houses. The children's village hopes to help the children grow up into young independent adults with a future to look forward to (Coneboy, 2010).

The project was actualized with the support of the government - which provided land for the project - and local companies – which donated services and equipment for the project [Malaika Kids UK (2011). *Support from the district commissioner in Mkuranga*]. Building started under the supervision of architect Kees Dwarhuis in 2008. The first cluster of homes and a school room have been built (Coneboy, 2010).

DESCRIPTION OF THE VILLAGE

The smallest unit in the village is the family house. Each family house accommodates ten children: five boys and five girls. Each house consists of two dormitory buildings (one for the boys and one for the girls - so that the boys and girls can sleep separately) and a living room. In the living room there is space reserved for the carer to sleep.

Figure 4: *Aerial View of a Cluster.*
Source: Malaika Kids UK website.

Figure 5: *A Shower Block.*
Source: Malaika Kids UK website.

The family houses are built in clusters (see Figure 1). A cluster consists of four family houses, a central meeting room and a shower block. The family houses are to be built around the central meeting room, where there is a communal dining facility. Each 'family' eats together at their own table. There is also sufficient space to organize communal activities. The meeting room also has a kitchen. It has been proposed that the meals will also be cooked here until the village has grown to its full size. Then, there will be a central kitchen where the food can be picked up, so that it only needs to be warmed up in the cluster

Each cluster has been designed to have one shower block (see Figure 2) with toilets, showers and a space for doing the washing. That is the only place in the cluster where there is running water. By placing the shower blocks on the edge of the village, the village can easily be supplied with water via one ring main. All parts of a cluster and their linking walkways are covered and therefore always easy to reach, even in the rainy season.

A nice detail is that the clusters have been linked with attractive covered walkways where the residents of the various clusters can easily meet each other. By linking the clusters, a courtyard is formed between the dormitory buildings of two clusters. Such a courtyard offers a secure space where the smallest children can play peacefully and safely. In the middle of the village there is space for sports fields. The children can play football there – by far the most popular sport in Africa – and other sports and games. It is also part of the plan to build classrooms at the entrance of the village, where the children can go to school. There are also plans for a computer building to give the village children extra opportunities to develop [Malaika Kids UK (2011). *The building of the village*].

CHOICE OF BUILDING MATERIAL

The buildings, the surrounding walls of the village and the walls of the structures within the village were constructed with Hydraform blocks (Sarah Coneboy, 2010). Hydraform blocks are special building blocks that have been designed to have a profile which allows them to be stacked on top of each other without using mortar. This system was specially developed by a South African company "Hydraform" for the African market in order to build simply but well at low cost. The advantages are that the Hydraform blocks can be manufactured on site - earth from the site can be used to make the blocks (See pics. 1 and 2). Moreover, the blocks are thick, the thickness of the blocks helps to keep the buildings cool [Malaika Kids UK (2011). *Building has begun!*].

Pic 1: Making Hydraform blocks on the building site with a special machine.
Source: Malaika Kids UK website.

Pic 2: The Hydraform blocks ready for the first building.
Source: Malaika Kids UK website.

EFFICIENT USE OF WATER

In order to supply the village with water it was proposed that three wells would be drilled and water pumped up from approximately 30 metres deep. At each well, a water tower and two storage tanks of 10.000 litres would be placed. The aim is to give the village a total storage capacity of 60.000 litres. A conscious choice has been made for three wells with separate storage capacity in order to always have clean water, even during maintenance or some calamity. With an expected usage of approximately 12.000 litres per day when the village is fully occupied, there would still be sufficient water for five days even if not all tanks were in use. The storage tanks would be connected to a ring main which would provide the village and all the shower blocks (and a number of other buildings) with water. By placing the wells, water towers and storage tanks at the top of the village, there would be sufficient water pressure in the shower blocks.

Each cluster of 4 family houses has a communal shower block, with showers, toilets, and facilities to wash and dry clothes. The eight shower blocks are all on the edge of the village, supplied with running water, and are the only places in the village where there is clean water. This creates a relatively efficient and effective water system which is easy to install and maintain [Malaika Kids UK (2011). *Clean water*].

In addition, rain water is collected and drained away as much as possible. This is achieved by collecting the rain water from the roofs in guttering and the water on the ground via a system of drainage channels. The rain water is collected and drained away as much as possible. This is achieved by collecting the rain water from the roofs in guttering (see Figure 3 and Pic 5 on p. 9) and the water on the ground via a system of drainage channels (see Figure 4). This is to ensure that there is no damage to buildings or the land during the rainy season. Where the buildings are not connected to each other, they are linked by covered walkways, so that the children's village can also function well during the rainy season. These centrally located walkways would be built above the central drain (see Figure 4).

The treatment of waste water has also been well planned. The shower and washing water would be used to flush the toilets. The flushed waste water would be collected in two consecutive septic tanks and then cleaned further by a soak away. When the cleaned water eventually disappears into the land, it will no longer be polluted, so that the wells 80 metres further up will not be contaminated [Malaika Kids UK (2011). *Treating waste water responsibly]*.

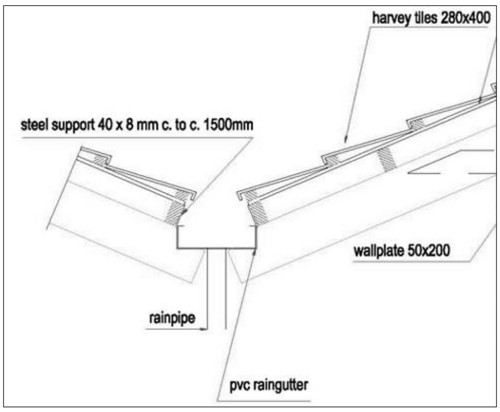


Figure 6: Rainwater Collection by the Means Gutters.
Source: Malaika Kids UK website.

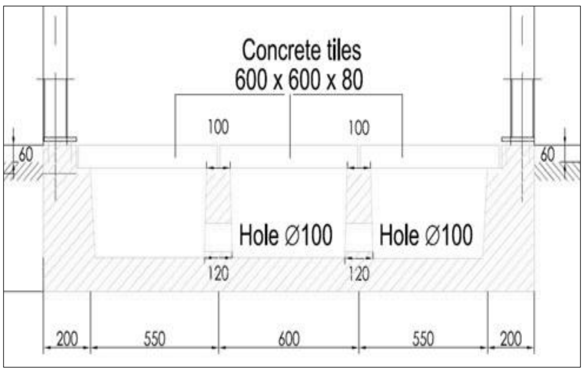


Figure 7: Section Showing the Central of Shared Drains in the Foundation of Covered Walkways
Source: Malaika Kids UK website.

OPTIMAL USE OF SITE CHARACTERISTICS

The land, where the children's village building is sited is in Mkuranga, an hour's journey south of the capital of Tanzania (Dar-es-Salaam). It is an 18 hectare piece of land with major differences in elevation: from the middle the land goes up 14 metres high on the one side and on the other side 8 metres. That may appear difficult, but actually offers many advantages.

On the village map (see Figure 5), it can be seen that the plan consists of three strips of land: two strips each with four living clusters and in between a strip of land with sport and playing fields. Each stretch is approximately 250 metres long and 60 metres wide and would be levelled during the preparation of the land for building. Due to the slope of the land, each strip of land is two metres lower than the previous strip, whereby a slope of 45º brings you from one strip to the next. This means that on one side of the playing fields, there would be a natural stand for the children when a game is being played. Also by placing the water sources and storage tanks at the top of the village, the shower blocks will automatically have sufficient water pressure. The drainage of rain water will also be made easier by the differences in height. This allows for optimal use of the natural characteristics of the land [Malaika Kids UK (2011). *Made to measure for the terrain*].

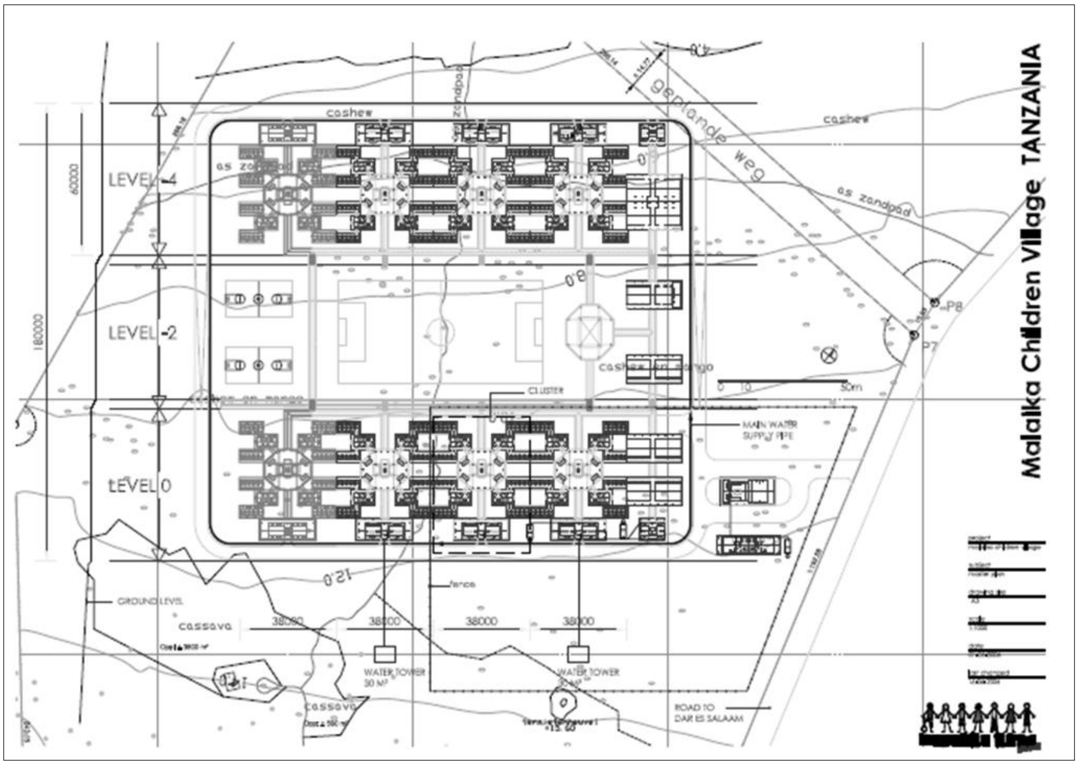


Figure 8: Village Map Showing the Location of the Master plan on the Land.
Source: Malaika Kids UK website.

PHASED CONSTRUCTION

The village was designed to have a modular formation (see Figure 6). The building elements were repeated and the facilities were designed cleverly so that the village could be built and maintained with much less funds. With this type of design it is possible to build one cluster at a time, so that a quick start can be made with building and populating the village - more can be added as more funds become available and as more children need a place [Malaika Kids UK (2011). *The Master Plan in Short*].

The construction of the village was planned in phases. The first four phases are as follows (see Figure 7):-

Phase 1 – Preparation of the land for building (laying out of adjacent horizontal terraces of land); Construction of the first cluster, on the highest strip (this cluster consists of four family houses with eight dormitories, a central hall with kitchen and a shower block) and putting in place the infrastructure and 500 metres of fencing.

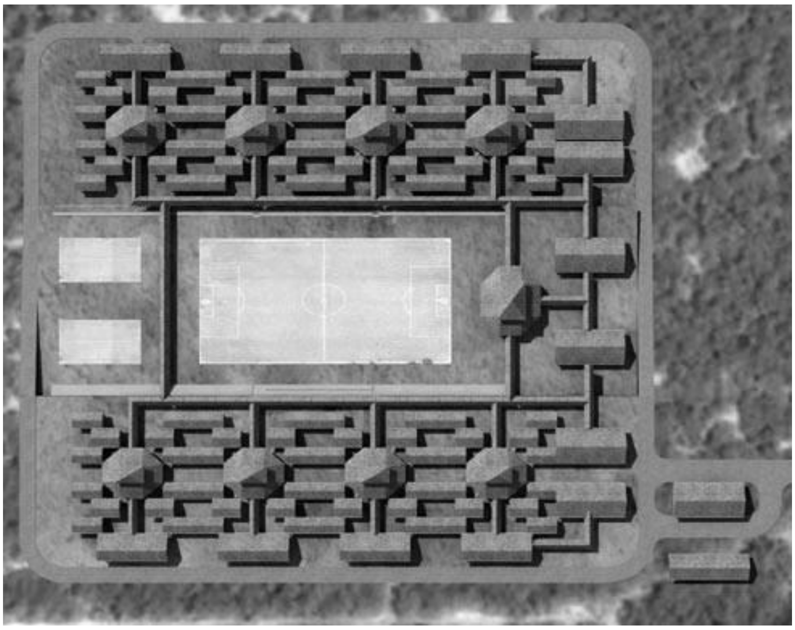


Figure 6: The Master Plan of the Village in 3D.
Source: Malaika Kids UK website.

Phase 2 – Drilling of a well, construction of a water tower, the placing of two storage tanks and the construction of the first part of the main water pipes.

Phase 3- Construction of two school buildings and an office.

Phase 4 – Construction of a second cluster (like the first cluster this will consist of four family houses, a central hall with kitchen and a shower block).This cluster will be connected to the main water pipes [Malaika Kids UK (2011). *The first building phases*].

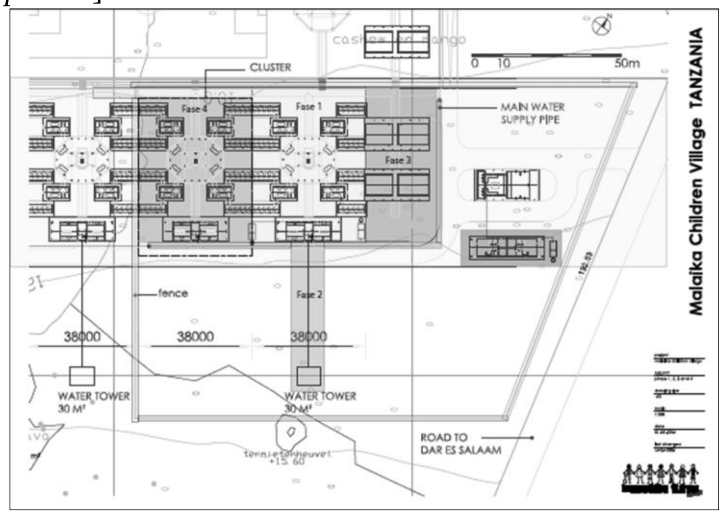


Figure 7: The First Four Construction Phases.
Source: Malaika Kids UK website.

PROGRESS MADE SO FAR IN THE CONSTRUCTION

Four family houses and a shower block are ready for use (see Pics 3, 4 and 5).

Pic 3: The Family Houses Showing the
Source: Malaika Kids UK website.

Pic 4: The Completed Shower Block Courtyard.
Source: Malaika Kids UK website.

Pic 5: The Completed Shower Block (Guttering of the Shower Block also connects to Neighbouring Buildings) Source: Malaika Kids UK website.

Pic 6: Roofing of the School Buildings.

The school buildings have also been completed (see Pic 6).The Central Dining Room (see Pic 7) was the last building of the first cluster to be constructed. It is located in the middle of the cluster and is supposed to form the focus of all activities of the four "families" living around this building. As it has no walls the building is really open – actually a roof on pillars [Malaika Kids UK (2011).*Great progress in Mkuranga*].

Pic 7: Kids Playing on a Swing with the Completed Central Dining Room in the background.
Source: Malaika Kids UK website.

The first well has been drilled (see Pic 8) [Malaika Kids UK (2011). *The first well has been drilled*] and the first water tower is also ready (see Pic 9) [Malaika Kids UK (2011). *The first water tower is ready!*]. In July 2010, the first phase of the village was opened. Four family houses, a school and several general buildings are now operational. Preparations for the construction of the second phase are on their way [Malaika Kids UK (2011). *The building in phases*].

Pic 8: Cement Lined Well with Lid (Ready for Placement of the Water Pump
Source: Malaika Kids UK website.

Pic 9: The Finished Water Tower.
Source: Malaika Kids UK website.

CONCLUSION

The Malaika Children's Village project is a good case study of sustainable construction. The choice of Hydraform blocks as a building material in this project is in line with the design recommendations for a sustainable construction project. Hydraform blocks are environmentally preferable because they are sustainably acquired, easy to install and easy to maintain. Moreover, since Hydraform blocks keep buildings cool, this means that their use results in energy savings.

Conservation of water is an important aspect of sustainable construction. It can be seen that the acquisition and use of water in this project has been properly planned so that the natural water resources are properly harnessed, used and reused. The site of the village has been developed in such a manner that it is user friendly - accommodating recreational activities while maintaining the natural characteristics of the land i.e. its sloppy nature. The modular formation of buildings and the design of building elements and facilities have enabled phased construction of the buildings in the village thereby making it easy to expand gradually as the need arises.

In 2002, a document "Agenda 21 for sustainable construction in developing countries" was published by the International Council for Research and Innovation in Building and Construction (CIB) in conjunction with United Nations Environment Programme - International Environmental Technology Centre (UNEP-IETC). (CSIR Research Space, 2010). The Agenda recommended active involvement of government, industry, non-governmental organizations, professionals and clients in order to ensure that sustainable construction is adopted by developing countries (AKANI, 2001). The case study cited in this article shows an example of a project in a developing country where government, industry, non-governmental organizations, professionals and clients have cooperated to realize a sustainable design project.

REFERENCES

AKANI, (2001). "Agenda 21 for sustainable construction in developing countries." Akani newsletter. November 2002 issue. (available at http://www.buildnet.co.za/akani/2002/nov/01.html).

CSIR Research Space, (2010). "Agenda 21 For Sustainable Construction In Developing Countries: A Discussion Document" (available at http://researchspace.csir.co.za/dspace/handle/10204/3511)

Malaika kids uk (2011). Building has begun! (available at http://www.malaika-kids.org.uk/resources/amgate_7158_103_tich_r943780299266/)

Malaika Kids UK (2011). Clean water. (available at http://www.malaika-kids.org.uk/resources/AMGATE_7158_103_TICH_R646301355052/)

Malaika kids uk (2011). Great progress in mkuranga (available at http://www.malaika-kids.org.uk/resources/amgate_7158_103_tich_r1505441915878/

Malaika kids uk (2011). Made to measure for the terrain. (available at http://www.malaika-kids.org.uk/resources/amgate_7158_103_tich_r6451087842911/)

Malaika Kids UK (2011). Our approach. (available at http://www.malaika-kids.org.uk/resources/AMGATE_7158_103_TICH_R23390541888/

Malaika Kids UK (2011). Support from the district commissioner in Mkuranga (available at http://www.malaika-kids.org.uk/resources/AMGATE_7158_103_TICH_R587852652979/

Malaika Kids UK (2011). The building in phases. (available at http://www.malaika-kids.org.uk/resources/AMGATE_7158_103_TICH_R650341719139/)

Malaika Kids UK (2011). The building of the village. (available at http://www.malaika-kids.org.uk/resources/AMGATE_7158_103_TICH_R6441168036956/

Malaika Kids UK (2011). The first building phases. (available at http://www.malaika-kids.org.uk/resources/AMGATE_7158_103_TICH_R649324258751/

Malaika Kids UK (2011). The first water tower is ready! (available at http://www.malaika-kids.org.uk/resources/AMGATE_7158_103_TICH_R861467215209/

Malaika Kids UK (2011). The first well has been drilled (available at http://www.malaika-kids.org.uk/resources/AMGATE_7158_103_TICH_R8601249908842/

Malaika Kids UK (2011). The Master Plan in Short. (available at http://www.malaika-kids.org.uk/resources/AMGATE_7158_103_TICH_R642392614480/)

Malaika Kids UK (2011). Treating waste water responsibly. (available at http://www.malaika-kids.org.uk/resources/AMGATE_7158_103_TICH_R647591410104/)

Mendler, S.F. and Odell, W. (2000). "The HOK Guidebook to Sustainable Design." John Wiley & Sons, New York. P.1-5.

Coneboy, S. (2010). " Malaika Children's Home." (available at http://www.hydraform.com/PressReleases/ArticleDetail.asp?PublicationID=42.

MANAGEMENT OF BUILDING CONSTRUCTION DISPUTES IN NIGERIA

Henry Onukwube[1]
Department of Building, University of Lagos, Akoka, Yaba, Lagos, Nigeria

The relationships between the stakeholders in most building construction end up in disputes. Efforts have been made over the years to avoid or improve on the management of dispute without much success. The aim of this study is to identify the most preferred dispute resolution method in the area of study. This study adopted descriptive survey research and the focus is on medium and large construction firms in Lagos state. The respondents for the study were (architects, builders, quantity surveyors, civil engineers, project managers, mechanical and electrical engineers).Data collected was mainly primary data with some elements of information obtained from secondary data through literature review. The random sampling technique was used to select the respondents for the study. The data collected were analysed using descriptive and inferential statistics. The result of data analysis indicates that the most preferred method is arbitration, this closely followed by negotiation, conciliation There is need to popularise these methods through Seminars, workshops and conferences by various stakeholders involved in the administration of building projects.

Keywords: dispute resolution, Nigeria.

INTRODUCTION

According to Dike (2005), it is a known fact that construction related disputes account for a high percentage of abandoned projects in Nigeria as well as contentious matters in our law court. The process of adjudication in court has over the time resulted in difficulties to the litigants in getting access to justice. The courts are also overburdened and facilities are inadequate, especially in Nigeria, to attend to matters with the deserved urgency. Formalism, legalism and excessive cost among other things have led to the quest for alternatives to the traditional court system (Onyeador, 2006). The Nigerian construction industry has managed to develop and adopt many unique methods to resolve disputes that occur in projects. However, the justification for implementing these methods has been primarily upon contractual requirements, government regulations, court order or basic reactionary instinct but not on measured utility(Onyeador,2006). Despite being an industry keenly focused on quantitative results, many researchers in the field argue that parties involved in a dispute fail to analyse the actual utility associated with each dispute resolution method in a particular situation. Selecting a dispute resolution process is the first step to resolve a dispute and this is an important decision because of the resource implications (Kersuliene, *et al*., 2010). Determination of rational method for dispute resolution is an issue of special relevance. This is so because of a few reasons: first of all, resolution of disputes requires complex legal, technological, engineering, economic, etc.

[1] Onukwube12345678@yahoo.com

Onukwube, H. (2011) Management of building construction disputes in Nigeria *In:* Laryea, S., Leiringer, R. and Hughes, W. (Eds) *Procs West Africa Built Environment Research (WABER) Conference*, 19-21 July 2011, Accra, Ghana, 725-734.

knowledge; secondly, disputes frequently stop development of business projects; thirdly, for disputant parties it is very important that their disputes have a minimum impact on their amicable business relations in future. Problems of rational dispute resolution generally are large and complex, involving many interested parties, often with sharply differing beliefs and values. It is an extremely important decision of the parties involved to justify the choice of any selected method. Researchers like (Bingham 2002; Chan and Suen 2005; Koolwijk 2006; Gebken and Gibson 2006; Gabuthy *et al.* 2008; Ma *et al.* 2008) have shown continuous interest in Alternative dispute resolution. Problems of rational dispute resolution generally are large and complex, involving many interested parties, often with sharply differing beliefs and values. It is an extremely important decision of the disputant to justify the choice to find a rational option. There are quite many researchers dedicated to dispute resolution by applying mathematical methods. Cheung and Yiu (2007) mathematically described mediation process in construction. Kronaveter and Shamir (2007) proposed a solution model for long-lasting conflicts over international waters. Rauschmayer and Wittmer (2006) stated, that the combination of deliberative and analytical methods has a high potential for the resolution of environmental conflicts. However, selecting methods and tools for a specific case often remains indistinct. They described the resolving environmental conflicts by combining participation and multi-criteria analysis. Chan *et al.* (2006) presented a dispute resolution selection model based on the analytical hierarchy process and multi-attribute utility technique (MAUT).Goltsman *et al.* (2009) compared three common dispute resolution processes – negotiation, mediation, and arbitration. Dispute resolution has raised fresh questions about both decision-making in selecting the most suitable dispute resolution option (Wang 2009). Disputes can be more complex when shared interpretations cannot be assumed. In spite of this, there is a lack of scientific research that could substantiate decisions of parties when selecting the most rational way of dispute resolution (Wang, 2009) This study is set up to address the following questions: (a) Are there any significant difference in the importance attached to the key selection factors that affect the decision in the selection of dispute resolution methods? (b) Can the use of a dispute resolution model help us in selecting the most appropriate dispute resolution method?

RESEARCH PROBLEM

The problem in question is on how to select the most appropriate resolution method that can address the nature of the dispute and the disputing parties' needs. The industry's approach in the selection of dispute resolution method has been heavily criticized, where too much reliance is placed on intuitive judgments rather than on rational approach. Decisions of such may have created biases, due to personal preferences and experiences (Gold 1991; Cheung and Suen2002). Given the industry's reliance on the subjective approach to dispute resolution selection, there is a need for a more systematic approach (Gold 1991; Miller 1995). Previous studies (Chan 2002; Gold 1991; Cheung and Suen 2002) suggested that research may play an important role in refining the knowledge of dispute resolution, particularly in the development of a systematic dispute resolution model. Hence the aim of this paper is to advance the knowledge of dispute resolution by developing a dispute resolution model for the built environment.

DEFINITION OF CONCEPTS USED IN THE STUDY

Negotiation

Negotiation provides a method for guiding parties through a process that focuses discussion more on understanding and meaning and less on blaming, control, or who gets authority over what.

Mediation

Mediation is a flexible process conducted confidentially in which a neutral person actively assists parties in working towards negotiated agreements of a dispute or difference, with the parties in the ultimate control of the decision to settle and the terms of resolution.

Conciliation

This is a dispute resolution method in which the disputant parties appoints a conciliator. The conciliator is usually given power to evaluate the relative strengths of the case, issue a binding opinion, if the parties agree to that ahead of time.

MINI Trial

This is a settlement process in which the parties present summaries' versions of their respective cases to a panel of officials who represent each party (plus a neutral official) and who have authority to settle the dispute. After the parties have presented their best case, the panel convenes and tries to settle the matter.

Arbitration

Arbitration is a binding, non judicial, and private means of settling disputes based on an explicit agreement by the parties involved in a transaction. Such an agreement is typically embodied in the terms of a contract between the parties.

Litigation

This is the process of taking of taking a case through court. In litigation, there is a plaintiff (one who brings the charge) and a defendant (one against whom the charge is brought).

THE KEY SELECTION FA CTORS

Factors used in selecting the most appropriate resolution methods are varying. A number of relevant studies have been conducted. Goldberg and his research team (1992) stressed the procedural aspects of dispute resolution in selecting a successful dispute resolution forum. They included willingness of the disputants, control by third party, degree of formality, nature of proceeding, enforceability, and confidentiality. It was also suggested that such factors as time, cost, preservation of business, binding decision, control by parties, flexibility, and confidentiality are important too. David (1988) came to the point of view that the parties' relationship is the key to successful joint ventures, and therefore critical selection factors should include impartiality, parties' control, continuing parties' relationships, and confidentiality. Taking into account of the above-mentioned studies together with the works of Brown and Marriott (1999), Cheung (1999), Kersuliene *et al.* (2010) and Chan *et al* (2006), fifteen selection factors were identified and used for this study.

IDENTIFYING DISPUTE RESOLUTION METHODS

Dispute resolution methods commonly used for typical construction projects include negotiation, mediation, concialiation, mini- trial, arbitration, dispute resolution adviser, adjudication, expert determination and litigation. In recent years, alternative dispute resolution (ADR) has gained favour over litigation for its low cost and speedy resolution, Woolf (1996). Having considered the works of Kersuliene et al (2010) and Chan et al (2006), the following dispute resolution methods (negotiation, mediation, concialiation, mini- trial, arbitration and litigation) were selected and used for this study. In each particular case, analysis of negative and positive features of various dispute resolution methods allows evaluating the perspective of judicial litigation and application of other dispute resolution methods.

RESEARCH METHOD

Through literature review, a list of potential key selection factors and a list of commonly used dispute resolution methods were compiled. The lists were verified and refined with interview discussions with a small group of dispute resolution experts from institute of construction industry arbitrators'. Having identified the selection factors and the most commonly used dispute resolution methods, an interview survey was then conducted to collect the utility factors (U factors), which was important for the development of the Model. A total of 40 respondents who are members of construction industry arbitrators were selected and interviewed for this study. The selection of the experts was based on the following criteria:

Practitioners who have over five year's experiences in handling disputes within the built environment and practitioners who exhibit a good understanding of the alternative dispute resolution and litigation processes. The final selected experts included project architects, engineers, builders, quantity surveyors, services engineers, project managers and others comprising mainly of lawyers, figure 1 shows the distribution of the respondents. Structured questionnaire were also used to collect data from the respondents. The sample frame for the study comprises construction professionals who are registered members of construction industry arbitrators. Using stratified random sampling the various members of construction industry arbitrators were selected. Each of the professionals selected have being involved in settling construction disputes and are well experienced in dispute resolution .The differences in the number of various professionals that participated is due to their population in the sample frame. The data collected were analysed using statistical package for social sciences (SPSS).

Questionnaire on Multi-Attribute Decision Making (MADM) for Dispute Resolution

Statements were made on (a) the object of the dispute (b) the goals of the disputant parties and(c) attributes and feasible ways of dispute resolution and using a 5- point likert scale of 1 for strongly disagree and 5 for strongly agree the respondents were asked to tick the options based on the extent to which they agree or disagree with the statements.

Reliability and Validity

Cronbach's alpha is the most widely used criteria to measure the reliability of items for each construct. α for (MADM) questionnaire =0.93. Confirmatory factor analysis shows that all factor loadings and path coefficients are statistically significant. The t values are above the required value of 1.96, all factor loadings are above (0.60).These high and significant factor loadings indicate good convergence validity.

RESULTS

Figure 1 shows that Architects constitute the largest majority of the respondents 14 (35%), others are: Civil engineers 7(17%), Quantity Surveyors 6(15%), Services Engineers 6(15%) Builders 3(8%), others 3(7%) and Project managers (1) 3%.The distribution of the sample population represents professionals with vast experience in dispute resolution hence their contributions is presumed to be very useful in achieving the objective of this study.

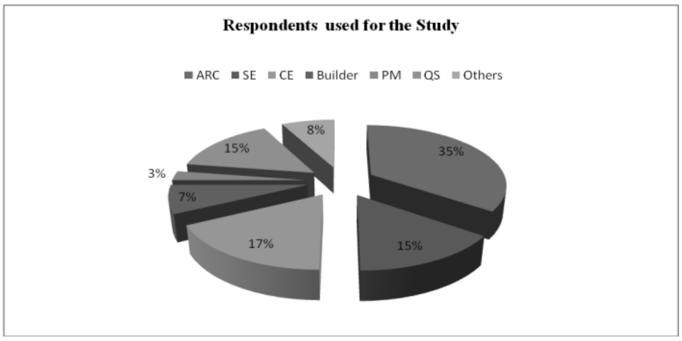


Figure 1: Respondents used for the Study

DATA COLLECTION OF UTILITY FACTORS

An interview exercise was carried out to collect the utility factors (U factors), which was an essential input for the development of dispute resolution model. A total of 40 practitioners in the field were interviewed. The aim of the interview survey was to collect and formulate a set of mean utility scores for the selection factors. It was anticipated that the mean U factors obtained would reflect the common view of the practioners. The interview survey started with a general introduction to the practioners of the research study, purpose, the use of multi purpose utility technique, and the instructions about completing the questionnaire. The respondents were then asked to insert the utility scores against the identified selection factors for each dispute resolution method. The scale range of utility scores adopted was from a scoreboard of 10–110. The reason for adopting the scale range was to avoid any possible occurrence of a zero value in the outcome. After the briefing, the respondents were given enough time to fill in the scores, while the interviewer would stand by to answer any queries. Because of their unique features, the degree of relevance/usefulness of the dispute resolution methods against each individual selection factor is expected to be different.

Findings on the Utility Factors

Expedition of Dispute Resolution

First place is taken by negotiation (90.5), followed by arbitration (80.5) and Conciliation (80.5), mediation (70.5), litigation (30.25) and mini-trial (20).The survey results are consistent with the unique features of negotiation in that negotiation seeks to achieve a win- win situation for the disputant parties and this facilitates early settlement of such disputes.

Price of Dispute Resolution

Price represents the total amount spent by the parties in reaching settlement. Extant literature in this area of study documents that litigation is more expensive than other methods of settling disputes. The result of this study confirms that, in that litigation with utility score of (80.5) is the first and the most expensive of all the methods listed in the survey.

Possibility of Appeal

First place is taken by litigation (90.5), followed by mini-trial (80.5) arbitration (60.5), mediation (60.25) and conciliation (60.25).The survey results are consistent with the unique features of litigation. This result is consistent with practice in that the courts are structured in such a way for the aggrieved party to appeal.

Confidentiality

First place is taken by conciliation, mini-trial and arbitration with (60.5) utility score each. This is followed by negotiation (50.5), mediation (50.25) and finally litigation (20). The survey results are consistent with the unique features of conciliation, mini-trial and arbitration that parties to a dispute are not allowed to disclose any information or materials to the public unless with formal consent of the parties (Brown and Marriott 1999). Hence, they are more preferable when parties want to keep their disputes away from high profile coverage.

Authority of the Person solving the Dispute

First place is taken by litigation (90.5), followed by mini-trial (80.5) negotiation (80.5).The first position given to litigation is consistent with practice in that judges are vested with much authority when dispensing justice.

Preservation of Business Relationships

Maintaining a continuing business relationship is vital to effective business management. A good business relationship is established on the basis of trust, common interests, and mutual respect. The survey results show that first place is taken by negotiation (70.5) followed by mediation and conciliation (60.5)The results are reasonably accurate, as part of their functions, these methods are designed to sustain a continuing strategic relationship. Negotiation always try to satisfy the aspirations of the parties by coming up with a "win-win" settlement.

Addressing Power Imbalance

First place is taken by mini- trial (80.5), followed by arbitration and litigation (70.5) This result is not supportive of the work done by Chan *et al* (2006).In their study mediation is the most influencing method for this factor.

Third Party Control on the Process

First place is taken by mini-trial (90.5) followed by arbitration and negotiation (80.50), conciliation (70.50), mediation (60.5) and litigation (40.25)Some of the results are consistent with the current practice while some are not. In litigation, the contents and the pace of hearing are virtually controlled by the court and this implies that litigation supposed to take the first place but the result is contrary. Even though arbitration is less formal and the arbitrator is an impartial, facilitative third party, the arbitration process remains highly regulated by rules and the arbitrator directs the hearing process.

Enforceability

First place is taken by litigation, mini-trial and negotiation (90.5) followed by conciliation (80.50), Arbitration (70.5) and mediation (60.25) Some of the results are consistent with the current practice while some are not. The result is supportive of the study done by Chan *et al*(2006),although the researcher is of the opinion that arbitration should be more enforceable than negotiation and conciliation.

Establishing Relative Importance Index for Identified Factors

Table 1: Summary of the mean item score for selection criteria

Selection criteria	Coding	Mean item score	Ranking
Expedition of dispute resolution	(SF 1)	0.90	1
Price of dispute resolution	(SF 2)	0.90	1
Authority of the person solving the dispute	(SF 3)	0.90	1
Enforceability	(SF 4)	0.90	1
Possibility to appeal	(SF 5)	0.80	5
Parties ability to control	(SF 6)	0.80	5
Remedies	(SF 7)	0.80	5
Type of contract	(SF 8)	0.80	5
Addressing power imbalance	(SF 9)	0.70	9
Third party control in the process	(SF 10)	0.60	10
Relationship between parties	(SF 11)	0.60	10
Preservation of business relationship	(SF 12)	0.50	12
Degree of formality	(SF 13)	0.50	12
Confidentiality	(SF 14)	0.40	14
Flexibility	(SF 15)	0.30	15

Where SF = selection factor.

Given the myriad of utility factors used in this study, it is essential that the relative importance of each factor be determined. The challenge, of course is to identify the relative importance of the utility factors as this will be used in the derivation of dispute resolution model. Relative importance index (RII) was first published by Mayer *et al* (1997).It allows for a relative quantification of the importance of identified factors. Mean item score is used for the quantification of the importance of these factors.

Mean Response Analysis / Mean Item Score

This method of analysis had been employed by many construction management researchers: (Akintoye, 1997), (Odeyinka, 2000), to mention a few. The Mean Item

Score (MIS) is determined as follows: Mean Item Score

Where n1 = number of respondents who answered ‘not important’

n2 = number of respondents who answered ‘somewhat important’
n3 = number of respondents who answered ‘of little importance’
n4 = number of respondents who answered ‘important’
n5= number of respondents who answered ‘very important’

Four of the identified factors, expedition of dispute resolution, price of dispute resolution, authority of the person solving the dispute, enforceability with mean item score of (0.90) were highly ranked by the respondents. Equally ranked are possibility to appeal, parties ability to control, remedies and type of contract with M.I.S (0.80).

Developing a Dispute Resolution Model

The completed Model is shown in Table 3. It consists of the following components: (1) selection factors; (2) mean item score (3) commonly used dispute resolution methods, and (4) mean u factors. The scores of the selection factors are obtained by multiplying the u factors by the mean item score. The total scores (TS) for each dispute resolution method is summation of all individual scores. The order of preference is then determined by the relative TSs, where the higher the scores, the higher the order is. The order of "1" identifies that the selected method, in comparing to the other methods, is relatively the most appropriate dispute resolution method, followed by the order of 2, and so on.

Table 2: Model for Selection of Dispute Resolution Method

		Negotiation		Mediation		Conciliation		Mini-trial		Arbitration		Litigation	
Selection factors	M.I.S	UF	Score (s)	UF	Score (s)	UF	Score (s)	UF	Score (s)	UF	Score (s)	UF	Score (s)
SF 1	0.90	90.5	81.45	70.5	63.45	80.5	72.45	20	18.00	60.5	72.45	30.25	27.23
SF 2	0.90	60.5	54.45	60.5	54.45	60.5	54.45	40.5	36.45	60.5	54.45	80.5	72.25
SF 3	0.90	40.25	36.23	60.25	54.23	60.25	54.23	80.5	72.45	60.5	54.45	90.5	81.45
SF 4	0.90	50.5	45.45	50.25	45.23	60.5	54.45	60.5	54.45	60.5	54.45	20	18.00
SF 5	0.80	80.5	64.45	50.25	40.20	70.5	56.40	80.5	64.40	70.5	56.40	90.5	72.40
SF 6	0.80	60.5	48.40	50.25	40.20	70.5	56.40	80.5	64.40	70.5	56.40	40.25	32.20
SF 7	0.80	70.5	56.40	60.5	48.40	60.5	48.40	50.5	40.40	50.5	40.40	20	16.00
SF 8	0.80	60.5	48.40	50.5	40.40	60.5	48.40	80.50	64.64	70.5	56.40	70.5	56.40
SF 9	0.70	60.5	42.35	70.5	49.35	60.5	42.35	50.25	35.18	70.5	42.30	20	14.00
SF 10	0.60	80.5	48.30	60.5	36.30	70.5	43.30	90,5	54.30	80.5	48.30	40.25	24.15
SF 11	0.60	60.5	36.30	40.5	24.15	50.5	30.30	70.5	42.30	60.5	36.30	70.5	42.15
SF 12	0.50	90.5	45.25	60.25	30.13	80.5	40.25	90.5	45.25	70.5	35.25	90.5	45.25
SF 13	0.50	60.5	30.25	40.25	20.13	60.5	30.25	60.5	30.25	60.5	30.25	80.5	40.13
SF 14	0.40	60.5	24.10	70.5	28.20	80.5	32.20	80.5	32.20	80.5	32.20	60.5	24.20
SF 15	0.30	90.5	27.15	60.5	18.15	80.5	24.15	50.5	15.15	70.5	21.15	40.25	12.08
Total scores (TS)			688.88		592.97		686.98		669.58		691.15		577.89
Order of preference		2		5		3		4		1		6	

CONCLUSIONS

Theoretical and Practical Study Contributions

This study is set up to fill this gap in literature by examining the following objectives: (a) Prioritising the key selection factors that affect the decision in the selection of dispute resolution methods (b)Identifying the most commonly used dispute resolution method and developing a dispute resolution selection model. This study focus on the development of dispute resolution selection method to compensate for the scarcity of research in this area (Wang, 2009) and attempt to contribute both theoretically and practically to dispute resolution domains. A model on dispute resolution methods was developed in this study. The model can be used to improve consistency in decision making process. It can reduce not only subjectively but also provides the users with the much needed flexibility. As Chan (2006) pointed out, by making the dispute resolution process more flexible, systematic, and objective, the chance of getting the dispute resolved will be maximized. The model can be used to structure and analyze the dispute and select the most appropriate dispute resolution method. The model facilitates an understanding of the various dispute resolution mechanisms. Finally, the model may act as a supplementary back up tool, when the intuitive judgment of the user on the dispute resolution method selection requires a further objective confirmation.

Future Research Directions

In the multi-attribute decision making (MADM) context, the evaluation of each alternative provide the basis for comparison of the alternatives and consequently facilitate the selection. There may be need to develop a similar model using Analytic hierarchy process(AHP).

REFERENCES

Akintoye, A.S. and Macleod, M.J. (1997) "Risk Analysis and Management in Construction. International Journal of Project Management. 15, (1) 31-38.

Bingham, L. B. (2002) "The next step: research on how dispute system design affects function", Negotiation Journal 18(4),375–379.

Brown, H., and Marriott, A. (1999) "ADR: Principles and practice", 2nd Ed., London, Sweet and Maxwell.

Chan, E.; Suen, H. C. H.; Chan, C. K. L. (2006) "MAUT-based dispute resolution selection model prototype for international construction projects", ASCE, Journal of Construction Engineering and Management – Part I: Taxonomies of dispute sources, mediator tactics and mediation outcomes", Building and Environment 42(2): 752–761.

Cheung, S. O. (1999)"Critical factors affecting the use of alternativedispute resolution processes in construction." Int. J. Proj. Management17(3), 189–94.

David, J. (1988) "Dispute resolution for lawyers-overview of range of Dispute resolution processes," The Univ. of Sydney, Faculty of Law Continuing Legal Education, Sydney, Australia.

Dike ,E (2005) Arbitration practice and procedure in the settlement of Domestic Commercial Disputes in Nigeria. Macmillian Publishers, Lagos, Nigeria.

Gabuthy, Y; Jacquemet, N.; Marchand, N. (2008) "Does resorting to online dispute resolution promote agreements? Experimental evidence", Economic Review 52: 259–282.

Gebken, R. J.; Gibson, G. E. (2006) "Quantification of costs for dispute resolution procedures in the construction industry", Journal of Professional Issues in Engineering Education and Practice 132(3),264–271.

Goldberg, S. B., Sander, F. E. A., and Roger, N. H. (1992) "Dispute resolution negotiation, mediation, and other processes, Little, Brown and Company, Boston, Mass.

Goltsman, M.; Hörner, J.; Pavlov, G.; Squintani, F. (2009) "Mediation, arbitration and negotiation", Journal of Economic Theory 144(4), 1397–1420.

Koolwijk, J. S. J. (2006) "Alternative dispute resolution methods used in alliance contracts", Journal of Professional Issues in Engineering Education and Practice 132(1), 44–47.

Kronaveter, L.; Shamir, U. (2007) "Negotiation support system for resolution of disputes over international water resources", in A. Castelletti, R. Soncini-Sessa, *Topics on System Analysis and Integrated* Water Resources Management. Elsevier Ltd., 189–205.

Kersuliene,V;Zavadskas,E.K andTurskis,Z (2010) "Selection of Rational Dispute Resolution Method",Journal of Business Economics and Management, 11(2), 243-258.

Ma, J.; Hipel, K. W.; De, M.; Cai, J. (2008) "Trans boundary water policies: Assessment comparison and Enhancement", Water Resources Management 22(8): 1069–1087.

Odeyinka, H. A. (2000) "An Evaluation of the use of Insurance in Managing Construction Risks". Construction Management and Economics. 18 (1) 512-524.

Onyeador, S.O. (2006) Alternative Disputes Resolution Construction. The case of the Niger Delta. Proceedings of Biennal Conference and General meeting of Nigeria Institute of Quantity Surveyors,15-16th September, Ibadan, Nigeria.

Rauschmayer, F.; Wittmer, H. (2006) "Evaluating deliberative and analytical methods for the resolution of environmental conflicts", Land Use Policy 23(1), 108–122.

Wang, F. F. (2009) "Online Dispute Resolution" Technology Management and Legal Practice from an International Perspective. Chandos, Oxford.

Woolf, M. R. (1996) Access to justice: The final report to the Lord Chancellor on the civil justice system in England and Wales, HMSO, London.

MANAGING THE ADVERSE HEALTH AND SAFETY INFLUENCE OF SUBCONTRACTING: FINDINGS OF A QUALITATIVE INQUIRY

Patrick Manu[1], Nii Ankrah[2], David Proverbs[3], Subashini Suresh[4], and Emmanuel Adukpo[5]

1, 2, 4 School of Technology, University of Wolverhampton, Wolverhampton, WV11LY, UK
3 Faculty of Environment and Technology, University of the West of England, Bristol, BS16 1QY, UK
5 Black Star Advisors, Ghana

Despite the economic benefits of subcontracting, it is widely known to be one of the factors influencing adverse health and safety (H&S) outcomes on projects. Given the increasing complexity of construction technologies which inevitably means that specialisation in construction will grow, it is expected that there will be even more subcontracting in the future, and hence the need for measures to address the adverse H&S influence of subcontracting. In the UK, beyond the legal health and safety requirements which offer some opportunity for mitigating the H&S impact of subcontracting, there is limited insight as to how main contractors manage this adverse impact in terms of their in-house H&S practices. Using semi-structured interviews with key management personnel of 6 UK contractors, the research question, "*how do main contractors manage the adverse H&S influence of subcontracting, in terms of their in-house H&S practices*?" was investigated. The inquiry revealed that beyond the legal requirements, two strategic measures adopted by the investigated contractors are: restricting the layers/tiers of subcontracting on projects; and having a regular chain of subcontractors. These measures are aimed at addressing the communication, teamwork, competence, and safety culture issues that are associated with workforce fragmentation introduced by subcontracting. Given that the adverse H&S influence of subcontracting is an international phenomenon, these findings provide a learning opportunity for all construction contractors within and outside UK, particularly the large and medium contractors who often sublet work packages.

Keywords: health and safety, interview, procurement, subcontracting.

INTRODUCTION

As indicated by International Labour Organisation (ILO) (2001) subcontracting grew significantly over the 1970s and 1980s and it continues to be practised in several countries. Evidently, and despite its economic benefits, subcontracting has adverse occupational health and safety consequences in construction as well as other industries. This adverse H&S influence has long persisted (cf. Mayhew and Quinlan, 1997, Yung, 2009) and it is anticipated that given increasing specialisation in the construction industry the adverse impact of subcontracting could worsen with an

[1] Patrick.Manu@wlv.ac.uk
[2] Nii.Ankrah2@wlv.ac.uk
[3] David.Proverbs@uwe.ac.uk
[4] S.Subashini@wlv.ac.uk
[5] Selorm@primroseproperties.net

Manu *et al.* (2011) Managing the adverse health and safety influence of subcontracting: findings of a qualitative inquiry *In:* Laryea, S., Leiringer, R. and Hughes, W. (Eds) *Procs West Africa Built Environment Research (WABER) Conference,* 19-21 July 2011, Accra, Ghana, 735-744.

increase in subcontracting. This creates the need for measures which have far reaching mitigation effect on the adverse H&S influence of subcontracting.

In the UK, the most influential driver of H&S improvement is the legal framework within which specific regulations, particularly the Construction Design and Management Regulations 2007 (CDM 2007), offer some mitigation against the factors responsible for the adverse H&S influence of subcontracting (Manu et al., 2011). Arguably, in striving for H&S excellence as captured by headlines such as "*One death is too many*" (of Donaghy, 2009), the mitigation offered by the regulations is insufficient as the adverse H&S influence of subcontracting continues to persist. Aside the regulatory requirements, there is however limited insight as to the measures implemented by main contractors (i.e. the employers of subcontractors) to address the adverse H&S influence of subcontracting. Seeking to shed light on this grey area, with the wider aim of providing learning opportunity for contractors, particularly those who often sublet work packages, this research embarked on an inquiry into *how* main contractors manage the adverse H&S influence of subcontracting. In the sections that follow, a review of H&S literature highlighting the adverse H&S influence of subcontracting in construction is presented. With this background, the research methodology adopted for the study is presented. The findings that emerged from the data collection and analysis are subsequently presented and discussed. Concluding remarks are finally provided.

SUBCONTRACTING AND ITS OCCUPATIONAL H&S OUTCOMES IN THE CONSTRUCTION INDUSTRY

In several countries including the UK, over the last three decades, the traditional mode of long term employment relation between an employer and employee has been supplemented by a variety of employment forms such as self employment, casual/temporary, part-time and contract/subcontract employment (ILO, 2001; Mayhew and Quinlan, 2001; LFS, 2004). The growth in these forms of employment have been driven by a mixture of economic priorities, technological and regulatory shifts, and increased product market uncertainty (Bielenski et al., 1999; and Chiang, 2009). Subcontracting has for some time been an integral part of the construction industry (cf. Stinchcombe, 1959; Eccles, 1981; and Lai, 2000), where it typically involves the subletting of the execution of a section(s) of a project to a contractor(s) who in most cases is a specialist.

In the UK over 90% of construction companies are micro to small organisations and majority of them obtain work as subcontractors, therefore forming an important group in the supply chain in the UK construction sector (Kheni et al., 2005; UK Office for National Statistics (ONS), 2008). Earlier research also estimates that 80% of construction work undertaken by UK main contractors is subcontracted (Saad and Jones, 1998 cited in Thorpe et al. (2003) and Kheni et al. (2005) and this further shows the importance of subcontractors.

Subcontracting is typically a payment-by-results system where payment is based on the amount of work completed rather than the period of time spent on the worksite. Thus returns are enhanced by the completion of tasks in the shortest possible time, leading to subcontractors pushing themselves hard, working excessive hours, or cutting corners in regard to safety where it impedes production (Mayhew et al., 1997). Pressures to complete a job quickly may be increased where intense competition amongst subcontractors drives down the price of services performed. Work intensification results as the subcontractor's profit must be derived from working harder and longer resulting in occupational health and safety (OHS) outcomes such as fatigue, stress, burn-out and failure or delays in seeking treatment for work-related injuries (Mayhew et al., 1997).

In countries such as Spain, Malaysia, Philippine, Poland, Hong Kong and China, subcontracting has been associated with adverse H&S outcomes in the construction industry (Byrne and Van der Meer, 2001; ILO, 2001; Wong and So, 2002; Yung, 2009). Similarly in the UK construction industry subcontracting has persistently been found to have adverse H&S consequences (Mayhew and Quinlan, 1997; UK Health and Safety Laboratory (HSL),1999; Loughborough University and UMIST, 2003; Ankrah, 2007; and Donaghy, 2009) clearly emphasising the need for concerted efforts to address the adverse H&S effects of subcontracting.

As noted by Bomel Limited (2007) in the context of the UK construction industry, H&S legislation is the most influential environmental influence on H&S, and in that regard the Construction Design and Management Regulations 2007 (CDM 2007) has particularly been noted as offering some mitigation against the adverse H&S influence of subcontracting (Manu et al., 2011). Despite the usefulness of such regulations, the reporting of the adverse influence of subcontracting persists (cf. Ankrah, 2007; Donaghy 2009). Arguably, this signals that the mitigation offered by the regulatory measures is not enough. In the spirit of striving for H&S excellence, the identification of other measures/practices that are effective in mitigating the adverse H&S influence of subcontracting is thus warranted. Indeed the identification of such measures/practices will provide useful organisational learning opportunities among contractors who often sublet work packages. To this end, this research sought to investigate *how main contractors manage the adverse H&S impact of subcontracting, with a particular focus on their in-house H&S measures/practices.*

As such an investigation will require an appropriate research method, the next section presents the research methodology adopted for the investigation.

RESEARCH METHOD

Given the exploratory and interpretive focus of the research i.e. *how* principal contractors manage the adverse H&S impact of subcontracting, a qualitative inquiry was deemed appropriate. As indicated by Fellows and Lui (2008) qualitative inquiries are suitable for obtaining meaning and as such are appropriate for answering questions relating to "why" and "how".

As micro to small[*] contractors usually obtain work as subcontractors it was considered appropriate to target medium[*] to large contractors who are more likely to operate as main contractors on projects. Using the UK Kompass directory and also using contacts in industry, invitation was sent to 54 medium to large UK contractors. H&S is a very sensitive issue in the UK due to the legalities surrounding it and for that matter obtaining participation in H&S research is difficult (cf. Gibb et al., 2002). Given this terrain, in order to obtain participation, using the contacts in industry and contacts in H&S research was deemed very appropriate and eventually proved to be very useful. From the invitations, the participation of 6 medium to large contractors was obtained, 5 of whom are among the top 20 UK contractors. Semi-structured interviews (using an interview guide) were held with key personnel in management

[*] Micro enterprise has annual turn-over ≤ 2 million Euros. Small enterprise has annual turn-over ≤ 10 million Euros. Medium-sized enterprise has annual turn-over ≤ 50 million Euros. Larger company has annual turn-over > 50 million Euros.

roles (i.e. company director, project manager, construction manager, site manager, and health and safety manager) within the companies to capture the measures/practices they implement to mitigate the adverse H&S influence of subcontracting. The interviewees were asked a series of questions relating to their H&S management system, their perspectives on the H&S implications of subcontracting, and the measures they implement.

The interviews were audio-taped and averagely they took an hour. For the analysis of the interviews, the recorded interviews were transcribed. The transcripts were analysed systematically through iterative re-reading and coding of the transcripts which enabled the attainment of a profound understanding of each interviewee's view point and hence the extraction of issues relating to *how* the contractors manage the adverse H&S influence of subcontracting (cf. Choudhry and Fang, 2008; and Creswell, 2009).

FINDINGS

Table 1 provides a brief profile of the 6 contractors showing their size and their extent of use of subcontractors.

Table 1: Profile of construction companies

Contractor	Size (based on annual turn over)	Extent of subcontracting on projects
A	Large	*High
B	Large	*High
C	Large	*High
D	Large	*High
E	Medium	*High
F	Large	*High

* All construction works on projects are subletted

All the contractors use subcontractors for the physical execution of the entire works they do but provide the site management personnel to manage the operations of the subcontractors. Depending on the scope of a project, the site management personnel could include project manager/director, site manager, construction manager, quantity surveyor, and health and safety manager. There was a general acknowledgement by the contractors that subcontracting has adverse H&S implications. For instance the interviewee for Contractor B (a H&S manager) commented that, *"One of the big challenges for the industry is the subcontract culture… it is not unheard of for a team to turn up on site and they don't even know who we are because they've been contracted by somebody who has been contracted by somebody…So there is communication issue straight away."* Despite its adverse effects, it was noted by one interviewee (as quoted below) that perhaps, the industry can not do without it because it is not economically viable to have directly employed labour.

> *"If everybody worked for us it would be much easier to control but commercially that is probably not a viable way to work these days and that's why everybody has gone to subcontracting."*(H&S Manager)

Subcontracting was identified with a number of H&S issues/factors responsible for its adverse H&S influence. These are communication problems, competence issues especially in multi-layer subcontracting, interest of subcontractors in making their profit with less commitment to H&S, and unfamiliarity of subcontractors with the H&S practices of the main contractor. As a means of addressing these H&S issues, the contractors implement H&S measures/practices as part of their overall H&S management system. These measures consist of those which stem from regulatory requirements, in particular the CDM 2007 and those measures which are the contractors' own in-house measures/practices. From the interviews, the identified measures which stem from regulatory requirements are: conducting H&S training and induction for the subcontractor workers (CDM 2007 Regulation 22(2)(a)(b)); consultation with the subcontractor workers/representatives on health, safety and welfare matters (CDM 2007 Regulation 24(b)); undertaking competence assessment for subcontractors (CDM 2007 Regulation 4(1)(a)); and ensuring the preparation of risk assessment by subcontractors for their works (CDM 2007 Regulation 4(b)(1) and 19(2) which have their roots in the Management of Health and Safety at Work Regulations 1999 Regulation 3(1)). When appointing subcontractors to work on projects, all the contractors ensure that subcontractors (as organisations and their operatives) have the needed competence for carrying out the works. Among the criteria used by the contractors for ensuring competence are experience, qualification, and industry certification. Also before their subcontractors commence the execution of works on site, the contractors require that the subcontractors provide risk assessments (and method statements based on the risk assessments) which they vet and agree with the subcontractors.

Another regulatory requirement adhered to by the contractors is the provision of H&S induction and training for subcontractors. These are to provide the subcontractors with information about site risks, precautions and rules. As a way of consulting with subcontractor workers on health, safety and welfare matters, all the contractors hold regular meetings with subcontractors to discuss H&S. The frequency of the meetings ranged from being daily to monthly.

In addition to the above regulatory measures, all the contractors also implement some in-house measures/practices to further enhance their management of the adverse H&S influence of subcontracting. Two key measures/practices implemented by the contractors are:

8. Restricting the layers/tiers of subcontracting on projects.

   "Sub-sub-sub-contracting is not good. When that happens the people down there become distant from the main contractor and you don't know who they are. So we don't allow subcontractors to sublet without our permission." (Site Manager)

9. Keeping a regular chain of subcontractors.

   "We have a supply chain management process in place… Hopefully, if they (i.e. the subcontractors) are working with us regularly, they will know our processes, procedures, and what we want them to do." (H&S Manager)

The contractors try to restrict the layers of subcontracting by not allowing their subcontractors to further sublet works. This is to prevent multi-layer/tier subcontracting of which one interviewee mentioned that even clients are not very pleased with. Where it is not possible to restrict the levels of subcontracting for some reasons, the contractors do a competence check on the other layers of sub-contractors to also ascertain their suitability for the works. To illustrate, the interviewee for Contractor D (a H&S manager) gave an example of an on-going large project where their Mechanical and Electrical (M&E) subcontractor (i.e. the 1st tier subcontractor) will sublet the fire alarm installation to another subcontractor (i.e. the 2nd tier subcontractor). With this arrangement the interviewee mentioned that the M&E subcontractor will have to inform them that they will be subletting the fire installation so that in addition to the competence check that will be undertaken by the M&E subcontractor they will also check the competence of the fire alarm subcontractor.

Keeping a regular chain of subcontractors also emerged as being a very useful measure not only in terms of H&S but also in terms of ensuring quality. This is because, by the contractors using the same subcontractors, the subcontractors tend to get used to the contractors' H&S practices, processes, procedures, and requirements. Also the assurance of repeat business helps to enhance the subcontractors' commitment to quality and H&S.

> *"The subcontractors obviously get a repeat business with us. They ensure that the quality of their work is good because they want regular business. Because H&S is important to us, they make sure that when we ask for tool box talks fortnightly, they do it."*

DISCUSSION

The sole use of subcontractors for the physical execution of works (i.e. no directly employed operative) by the investigated contractors means that a considerable portion of the value of works undertaken by the contractors goes to subcontractors. Contractor A for instance estimates that about 70% of the money they spend as a business goes to subcontractors and suppliers. Subcontractors are therefore an important part of the contractors' supply chain, and in the wider picture they also are an important part of the construction industry's supply chain.

The unanimous recognition by the contractors that subcontracting has adverse H&S consequences once again echoes the finding of earlier studies (cf. Ankrah 2007, Chiang, 2009, Loughborough University, 2009). The commercial justification for the practice of subcontracting as mentioned by one interviewee aligns with the reported drivers/reasons for subcontracting (cf. Hunter et al., 1993; Bielenski et al., 1993, 1999; and Chiang, 2009). The practice of subcontracting for its economic benefits suggests the inevitability of subcontracting in construction. This also suggests that a reasonable approach for dealing with its adverse H&S influence will not be to stop subcontracting entirely but rather to implement measures that will tackle the H&S issues/factors responsible for its adverse H&S influence.

The H&S issues that were identified as being responsible for the adverse H&S influence of subcontracting are consistent with earlier reports (cf. Hsieh (1998), Loughborough University and UMIST (2003), Ankrah (2007)). Loughborough University and UMIST (2003) for instance indicated that subcontracting introduces communication and teamwork problems and Hsieh (1998) also noted that subcontracting has the tendency to divide the construction organization into "islands" or self-centered decision-making units with conflicting interests. As noted by Manu et al. (2011) any effort aimed at addressing the adverse influence of subcontracting must be geared towards addressing these issues.

As expected, the contractors implement measures required by the CDM 2007 which offer some mitigation against the H&S issues responsible for the adverse H&S influence of subcontracting. In addition to the legal requirements adhered to by the contractors, the in-house measures implemented by the contractors also provide mitigation against the H&S issues introduced by subcontracting. By restricting the levels/tiers of subcontracting, the contractors are able to minimise fragmentation of the workforce and by so doing are able to manage better, competence, communication, commitment, teamwork, as well as supervision. That also helps to ensure clarity of on-site working relationships. As noted in several reports (cf. Wong and So, 2002; Loughborough University, 2009; and Tam et al., 2010) and again highlighted in this study by one of the interviewees (that, "*it is not unheard of for a* *team to turn up on site and they don't even know who we are because they've been contracted by somebody who has been contracted by somebody"),* multi-layer subcontracting is common place within the construction industry and addressing it has been challenging given its economic benefits. In Hong Kong for instance, there have been past debates concerning the legal restriction of the layers of subcontracting in construction. Whereas Linehan (2000, cited in Wong and So, 2002) argued for legislation to restrict multi-layer subcontracting on the basis of ensuring better safety performance, So (2000, cited in Wong and So, 2002) argued against such legislative restriction on the basis of avoiding an interference with the market value of subcontracting. Although there is no such legislation in UK which restricts multi-layer subcontracting, it appears from the evidence gathered that some contractors have found it necessary and useful to impose such restrictions by themselves, and in situations where they are unable or unwilling to, they take further steps to manage the inherent H&S problem of fragmentation of the workforce.

As previously mentioned, the benefits of using the same chain of subcontractors goes even beyond H&S. Using a regular chain of subcontractors helps to build trust, it helps in quality assurance, and it also gives assurance of repeat business (cf. Entec UK Ltd, 2000). Touching on the H&S benefits, using the same subcontractors enables the contractors to minimise workforce fragmentation in terms of the H&S practices and H&S commitment of the workforce. Entec UK Ltd (2000) reported that companies who work constantly with the same set of contractors/sub-contractors tend to have better health and safety performance. Contractor A for instance mentioned that they have very close long-term working relationship with their supply chain organisations and by that they (i.e. their supply chain organisations) know their values, they know their people, and they know their H&S requirements very well. Overall, working with a regular chain of subcontractors enables the contractors to minimise differences in safety culture within the workforce.

USEFULNESS OF FINDINGS

As noted by the interviewee for Contractor A (a director), the sharing of knowledge on H&S practices is useful in promoting a safe construction industry. In view of that, Contractor A shares videos of their H&S excellence programme with their peer contractors and as well as their clients to provide the opportunity for inter-organisational benchmarking and learning. Clearly, the measures/controls identified from the interviews particularly those in-house measures/practices provide inter-organisational learning opportunity for contractors. Other medium and large UK contractors could thus adopt or carefully adapt these measures into their organisations to mitigate the adverse H&S influence of subcontracting.

In the broader picture, given that the adverse impact of subcontracting is a global construction issue (cf. ILO, 2001) both the regulatory measures and the in-house measures also provide similar learning opportunity for contractors in other countries. In other countries, contractors who often sublet work packages could thus similarly make efforts to restrict the layers of subcontracting on sites and also keep to a regular chain of subcontractors in order for their values and H&S practices to be assimilated by their subcontractors. For countries which do not have similar H&S regulatory requirements as the UK, the CDM 2007 requirements which offer some mitigation against the adverse impact of subcontracting (cf. Manu et al., 2011) also provide learning opportunities for the contractors and as well as the government authorities (in terms of policy) in those countries. Such regulatory measures could be adopted by the contractors as their own in-house measures or could be considered by the appropriate government authorities for inclusion in their H&S legislation.

CONCLUSIONS

The adverse H&S influence of subcontracting continues to persist in the UK construction industry and in the construction industry of other countries and this undeniably creates the need for redressing this adverse influence. In the UK, efforts towards doing this are seen in regulatory requirements, notably the CDM 2007, which offers some mitigation against the adverse H&S influence of subcontracting. Aiming to shed light on measures implemented by contractors other than the regulatory requirements, 6 medium to large contractors were investigated to capture *how* they manage the H&S influence of subcontracting. As expected the investigation revealed the compliance of the contractors with regulatory measures which offer some mitigation against the adverse H&S influence of subcontracting. Beyond these, it also emerged that the contractors have their in-house H&S measures which they implement to complement the regulatory measures. In the spirit of inter-organisational benchmarking and learning, these in-house measures provide learning opportunity for other medium to large UK contractors who often sublet work packages. Stretching beyond the UK context, both the regulatory measures and in-house measures provide learning opportunity for the contractors and government authorities of other countries. It is anticipated that through the carefully adoption or adaptation of these measures the construction industry as a whole could make useful strides in tackling the adverse H&S influence of subcontracting.

REFERENCES

Ankrah, N. A. (2007) An investigation into the impact of culture on construction project performance. PhD Thesis. School of Engineering and the Built Environment, University of Wolverhampton.

Bielenski, H. (1999) New patterns of employment in Europe. In: Ferrie, J., Marmot, M., Griffiths, J. & Ziglio, E. (Eds.) Labour Market Changes and Job Insecurity: A challenge for Social Welfare and Health Promotion. Denmark, WHO.

Bomel Limited (2007) Improving the effectiveness of the Construction (Design and Management) Regulations 1994. Research Report :538. HSE.

Byrne, J. and Van Der Meer, M. (2001) The construction industry in Spain: Flexibilisation and other corporatist illusions. International Conference on Structural Change in the Building Industry's Labour Market, Working Relations and Challenges in the Coming Years. Institut Arbeit und Technik, Gelsenkirchen, Germany.

Chiang, Y. (2009) Subcontracting and its ramifications: A survey of the building industry in Hong Kong. International Journal of Project Management, 27(1)**,** pp. 80-88.

Choudhry, R.M and Fang, D. (2008) Why operatives engage in unsafe work behaviour: investigating factors on construction sites. Safety Science 46(4), pp. 566–584.

Creswell, J. W. (2009) Research design: Qualitative, quantitative, and mixed method approaches, 3rd Edition. California: Sage Publications.

Donaghy, R. (2009) One death is too many - Inquiry into the underlying causes of construction fatal accidents: Report to the secretary of state for work and pensions. The Stationery Office, UK.

Eccles, R. G. (1981) Bureaucratic and craft administration revisited: the impact of market structure on the nature of the construction firm. Administrative Science Quarterly, 26**,** pp. 449–69.

Entec UK Ltd. (2000) Construction health and safety for the new millennium. Contract Research Report 313/2000. HSE.

Fellows, R. and Lui, A. (2008) Research methods for construction, 3rd Edition. West Sussex: Blackwell Publishing Ltd.

Gibb, A.G., Haslam, R.A., Gyi, D.E., Hide, S., Hastings, S. and Duff, R. (2002) ConCA-Preliminary Results from a Study of Accident Causality. In: Rowlinson, S. (Ed.) Triennial Conference CIB W099, May 2002, University of Hong Kong, Hong Kong.

Loughborough University and UMIST (2003) Causal factors in construction accidents. HSE Research Report 156, HSE.

HSE (2009) HSE construction intelligence report. HSE.

Hsieh, T.-Y. (1998) Impact of subcontracting on site productivity: Lessons learned in Taiwan, Journal of Construction Engineering & Management, 124(2), pp. 91-100.

HSL (1999) The impact of procurement and contracting practices on health and safety - A review of literature. Report: RAS/99/02. HSL.

Hughes, P. and Ferrett, E. (2008) Introduction to health and safety in construction, 3rd Edition. Oxford: Elsevier Ltd.

ILO (2001) The construction industry in the twenty-first century: Its image, employment prospects and skill requirements. Geneva, ILO.

Kheni, N. A., Dainty, A. R. J. and Gibb, A. G. F. (2005) Health and safety management practices of small subcontractors. In: Khosrowshashi, F. (Ed.) 21st Annual ARCOM Conference, University of London, Association of Researchers in Construction Management.

Lai, L. W. C. (2000) The Coasian market–firm dichotomy and subcontracting in the construction industry. Construction Management and Economics, 18(3), pp. 355–62.

LFS (2004) Number of people self-employed; United Kingdom; 1985 to 2003. Office for National Statistics.

Linehan, A. J. (2000) Subcontracting in the Construction Industry, A speech presented in Safety and Health Conference in Hong Kong, 22-23 March 2000.

Loughborough University (2009) Phase 2 Report: Health and safety in the construction industry: Underlying causes of construction fatal accidents –External research, HSE.

Loughborough University and UMIST (2003) Causal factors in construction accidents. HSE Research Report 156, HSE.

Manu, P., Ankrah, N., Proverbs, D. and Suresh, S. (2011) The adverse health and safety influence of subcontracting. Proceedings of the Institution of Civil Engineering - Management, Procurement and Law, Special Issue on Health and Safety, doi: 10.1680/mpal.10.00008.

Maurno, D. (1992) Working with Contractors. Record, 69**,** pp.3-10.

Mayhew, C. and Quinlan, M. (1997) Subcontracting and occupational health and safety in the residential building industry. Industrial Relations Journal, 28(3)**,** pp.192-205.

Mayhew, C. and Quinlan, M. (2001) Effects of changing patterns of employment on reporting occupational injuries and making worker' compensation claims. Safety Science Monitor, 5(1), Article 1.

Mayhew, C., Quinlan, M. & Ferris, R. (1997) The effects of subcontracting/outsourcing on occupational health and safety: Survey evidence from four Australian industries. *Safety Science*, 25(1-3)**,** pp. 163-178.

ONS (2008) Construction Statistic Annual: 2008 Edition. ONS.

Saad, M. and Jones, M. (1998) Unlocking specialist potential. Reading Construction Forum.

So, K. C. (2000) The Multi-layers subcontracting system. An article of interview from the Hong Kong newspaper of Hong Kong Economic Post, 12 May 2000.

Stinchcombe, A. L. (1959) Bureaucratic and craft administration of production: a comparative study. Administrative Science Quarterly, 4**,** pp. 168–87.

Tam, V. W. Y., Shen, L. and Kong, J. S. Y. (2010) Impacts of multi-layer chain subcontracting on project management performance. International Journal of Project Management, 28(6), pp. 593-600.

Thorpe, A., Dainty, A. R. J. & Hatfield, H. (2003) The reality of being preferred: Specialist subcontractor perspectives on restricted tender list membership. Journal of construction procurement, 9**,** pp. 47-55.

Wong, F. & So, L. (2002) Restriction of the Multi-Layers Subcontracting Practice in Hong Kong - Is it an Effective Tool to Improve Safety Performance of the Construction Industry? In: Rowlinson, S. (Ed.) Triennial Conference CIB W099, May 2002, University of Hong Kong, Hong Kong.

Yung, P. (2009) Institutional arrangements and construction safety in China: an empirical examination. Construction Management and Economics, 27(5)**,** pp. 439 - 450.

MERGING ARCHITECTURAL AND SCULPTURAL FORMS IN THE BUILDING INDUSTRY

Victor Kweku Bondzie Micah[1] and Owusu-Ansah Ankra

School of Applied Arts, Department of sculpture, Takoradi polytechnic, P.O. Box 256, Takoradi, Ghana

Long before time sculpture, painting and architecture were treated as inter related area, and was evidential in the books that were published before the 1960’s on these areas of study. Over the years, however, authors and practitioners of these disciplines have tried frantically to separate this seriously interrelated subject matter by not involving each other in practice, in trying to do so have negatively affected the buildings that are put up. Most architects are refusing to see their creations as art pieces, and or should incorporate art works. Some in their desperate quest in satisfying their cliental demands refuse to see artist near their creations, as is perceived as that the artist work will distort their design. This paper seeks to establish the relationship between sculptural and architectural forms as bed fellow. In so doing comparative analysis will be made of architectural forms with sculptural forms incorporated in it and those with no sculptural forms included. Also, this will bring to bare the importance of consulting with sculptors before designing, in the design process, and finally in the execution stages of the architectural forms. The above, are classical examples of sculptural and architectural forms merged. The fusion concept are rendered in Fiber glass, Cement, Auto body filler, Terracotta and other materials based on cliental demands. The merger which most has termed “*Archisculpture*” should be sustained by both professionals to create aesthetics in our homes, employment, and psychologically therapeutic, ease tension and accommodate human kind with our creations.








[1] victormicah@ymail.com

Micah, V.K.B. and Ankra, O. (2011) Merging architectural and sculptural forms in the building industry *In:* Laryea, S., Leiringer, R. and Hughes, W. (Eds) *Procs West Africa Built Environment Research (WABER) Conference*, 19-21 July 2011, Accra, Ghana, 745-745.


AKOMA

MINING ACTIVITIES IN NIGERIA URBAN ENVIRONMENT: IMPETUS FOR COMMUNITY DEVELOPMENT OR ENVIRONMENTAL DETERIORATION?

Samson A. Adeyinka[1], **Albert Ayorinde Abegunde**[2], **Nathaniel Adeoye**[3], **S.A. Adeyemi**[4]

[1]Department of Urban and Regional Planning, Obafemi Awolowo University, Ile-Ife, Nigeria
[3]Department of Geography, Obafemi Awolowo University, Ile-Ife, Nigeria

Mining as part of human activities on land is an expanding industry that can provide sustainable economic, environmental and social benefits to communities and regions where it is taking place. Nonetheless, the extraction process often times have adverse effects on their immediate physical environment. This paper examines residents' perception of the effects of mining activities on their environment. Data needs were collected through the administration of structured questionnaires in a systematic random manner on 10% (554 respondents) of the households in Ijero Local Government Area of Ekiti State, Nigeria. A total of 21 variables were analysed to determine the Resident Tolerance Index (RTI) value for residents on each of the variables. The study reveals that the RTI was found to be between 'not tolerable' and 'not at all tolerable. The paper further noted that only three variables such as 'high influx of people', 'increase in sales and services', and 'improved economic condition' with RTI values above 3.0(just tolerable) were the accrued benefits to the residents while the remaining 17 variables with RTI values of less than 3.0 were considered to have adverse effects on the environment. In conclusion, the paper recommended that government should ensure that mining activities are controlled by enforcing appropriate legislations on the miners and at the same time provide adequate infrastructural facilities like potable water and electricity to enhance economic development in the area and ensure a sustainable community development.

Keywords: environmental degradation, residents, socio-economic, sustainable development.

INTRODUCTION

In the world of geography, endowment in mineral resources is seen as an impetus towards development. This is because, over history, communities that have unique natural and man-made resources are at early advantage of attaining social and economic development above their counterparts that are less privileged (Fuentes and Mies, 2008). For instance, the discovery of gold brought sudden development to Lawis Ponds and Summer Hills Creek areas of Victoria in Australia; long before nineteen century (Evans, 1988). Mining of jasper also transformed the awkward regions of Erie Creek and Isintok in Calgari, Alberta, Canada to prosperous

[1] adeyinkasa@yahoo.co.uk
[2] abajesulo@yahoo.com, stegunde@yahoo.co.uk

Adeyinka *et al.* (2011) Mining activities in Nigeria urban environment: Impetus for community development or environmental deterioration? *In:* Laryea, S., Leiringer, R. and Hughes, W. (Eds) *Procs West Africa Built Environment Research (WABER) Conference,* 19-21 July 2011, Accra, Ghana, 747-760.

settlements (Jasper Mining Corporation Annual Report, 2006; 2009). Arising from these, exploration of mineral resources in any African community is expected to raise the hope of such "privileged" area from underdevelopment to a desired zone.

In the contrary, mining opportunities have formed the source of community degradation and conflicts; housing shortage and environmental problems; loss of cultural heritage and economic value among others (Abegunde, Olayiwola and Adedokun, 2007). According to Aigbedion and Iyayi (2007), the three stages of mineral development notably; exploration, mining and processing have caused different types of environmental damages. In Nigeria, large scale oil extraction and production have led to adverse environmental impact on the soil, forest and water of Niger Delta communities and have ultimately affected peasant agriculture in the area (Dayo, 1999). This is why Ikoni (2000) and Abegunde et al (2007) concluded in their works that despite the economic benefits associated with mining, more often than not, it is accompanied with adverse effects on the physical environment.

In furtherance of earlier studies on both negative and beneficial effects of mining activities on both human and physical environments, this study is based on perception of residents on the merits and demerits of mining activities on their environment. It attempted to first understand the socio-economic characteristics of these residents; as directly or indirectly influenced by mineral exploration and evaluated the influence of mining activities on their present and future community development. Along this line, the study probed the opinions of residents on the best way mining activities should be carried out in their vicinity to promote socio-economic and physical development of their communities. Specifically, the study focused on a typical homogenous region of a Africa (Ijero local Government Area) to draw the attention of their policy makers and researchers on the voice of the people on the empirical contribution of mining activities to community development in post millennium era.

Mining Industry in Nigeria

According to National Environmental Study/Action Team (NEST) (1991), mining started many centuries before the arrival of Europeans and of Arabs who preceded them. It was carried out by traditional methods with locally available technology. Gold, clay, iron ore, tin, salt and soda were among the most important minerals worked. The minerals were used in the body adornment, for fabrication of weapons, tools and vessels, for building construction, in the diet and so on. Thus mining occupied a highly respected position in the traditional economies of large part of Nigeria and contributed greatly to intra-tribal and inter-tribal commerce as well as conflict.

Following the arrival of British in the last century, the number and variety of minerals mined in Nigeria increased and truly commercial-scale mining commenced. Among the many other mineral which occur in Nigeria are petroleum, natural gas, coal, limestone, lead, zinc, sand, feldspar, diamond, sapphire, gemstone, tantalite, marble, columbite, zircon and uranium.

Specifically, organized mining in Nigeria as documented by Online Encyclopedia began in 1903 when the Mineral Survey of the Northern Protectorate was created by the British Colonial Government. A year later, the mineral Survey of the Southern protectorate was founded. Coal was first discovered in Enugu in 1909, and the Ogbete mine had opened and began regularly extracting coal by 1916. By 1920, coal production had reached 180, 122 long tons (201, 737 short tons). Nigeria's peak coal production was in the late 1950s and 1960 production was at 565, 681 long tons (633, 563 short tons) (http//www.enwikipedia.org/wikli/minig_in_nigeria-53k).

Bitumen was first discovered in 1900 and its exploration started in 1905. Bitumen deposits are found in Lagos State, Ogun State, Ondo State and Edo State. Gold production began in 1913 and peaked in the 1930s. The Nigeria Mining Corporation (NMC) was formed in the early 1980s to explore for gold. Lack of funds and the lure of easier profits from oil production led to its failure. Columbite and tantalite are used to produce elements like nobium and tantalum. Columbite and tantalite are collectively known as coltan in Africa. In Nigeria, the pegmatite deposits of coltan are often the sources of several precious and semiprecious stones such as beryl, aquamarine and tourmaline. These pegmatite are found in Nassarawa State near Jos as well several areas in Southeast and Southwest Nigeria (http//www.enwikipedia.org/wiki/mining_in_nigeria-53k).

The mining of minerals in Nigeria accounts for only 0.3% of its GDP, due to the influence of its vast oil resources. The domestic mining industry is underdeveloped, leading to Nigeria having to import minerals that it could produce domestically, such as salt or iron ore. Rights to ownership of mineral resources is held by the Nigerian government, which grants titles to organizations to explore, mine, and sell mineral resources.

Organized mining began in 1903 when the Mineral Survey of the Northern Protectorates was created by the British colonial government. A year later, the Mineral Survey of the Southern Protectorates was founded. By the 1940s, Nigeria was a major producer of tin, columbite, and coal. The discovery of oil in 1956 hurt the mineral extraction industries, as government and industry both began to focus on this new resource. The Nigerian Civil War in the late 1960s led many expatriate mining experts to leave the country.

Coal was first discovered in Enugu in 1909, and the Ogbete Mine had opened and begun regularly extracting coal by 1916. By 1920, coal production had reached 180,122 long tons (183,012 t). Nigeria's peak coal production was in the late 1950s, and by 1960 production was at 565,681 long tons (574,758 t). The Nigerian Civil War caused many mines to be abandoned. After the war ended in the early 1970s, coal production was never able to recover. Attempts to mechanize the industry in the 1970s and 1980s were ultimately unsuccessful, and actually hindered production due to problems with implementation and maintenance.

The Nigerian government is currently trying to privatize the Nigerian Coal Corporation and sells off its assets. While the domestic market for coal has been negatively affected by the move to diesel and gas-powered engines by organizations that were previously major coal consumers, the low-sulfur coal mined in Nigeria is desirable by international customers in Italy and the United Kingdom, who have imported Nigerian coal. Recent financial problems have caused a near shutdown of the NCC's coal mining operations, and the corporation has responded by attempting to sell off some of its assets while it waits for the government to complete privatization activities.

The discovery of oil in 1956 halt the mineral extraction industries as government and industries both began to focus on these new resources (NEST. 1991:43). This fact is corroborated by Lawal (undated) who observed that, despite the mineral potential Nigeria possesses (proven reserves in 33 types of minerals in over 400 locations); solid mineral exportation constitutes a mere 1% to its GDP. This extremely low share is mainly due to Nigeria's dependence on oil but also largely due to the under developed mining sector, primarily resulting from inadequate and inefficient policies for mineral exploration development.

On ecological effect of mining, environmental officials with the government of Plateau State believe that 1,100 tin and columbite mines, abandoned after the mining boom of the 1960s, now pose serious health risks to as many as 2 million people living in the area. Radioactive mine tailings were reported to be a danger to local people living around mining fields in Jos, Barikin-Ladi, Bukur, Bassa and Riyom districts.

Mining Activities and their Effects on the Built Environment

The effect of mining activities has generated a surge of interest among environmentalists in recent years. Such scholars include Aigbedion and Iyayi (2007), Lungu and Shikwe (2006), Aghalimo (2000), Akabzaa and Darimani (2001), Organization for Economic Cooperation and Development (OECD,2002) among others.

According to OECD (2002), cited in Danielson and Lagos (2001), although the mining industry occupies a relatively small parts of the land surface, it does have significant and often irreversible impacts. By its nature, mining has a permanent environmental impact in that a non-renewable natural resource is exhausted. On the other hand, the physical non-renewable resource may be deemed sustainable if there is an effective conversion of the natural capital, represented by the resource, to social capital that would allow for long-term livelihoods. This assumes that the resilience of the natural environment is not compromised, undermining social and economic sustainability (Ali and Fairchealaigh, 2007).

Aghalimo (2000) studied the petroleum exploitation in Nigeria and observed that, the impacts of oil exploitation on the mineral producing communities are in three folds. Firstly, it leads to environmental pollution, secondly, it destroys the ecosystem and the ways of life of the people and thirdly, oil producing communities are generally undeveloped.

In the same vein, Aghalimo (2000), worked on the petroleum and environmental degradation in Nigeria. The study also indicates that, the increased proliferation of oil producing areas have left a number of imprints on both the physical and cultural landscape. They noted that the attitude demonstrated by petroleum prospecting companies portrayed a disregard for environmental welfare, forgetting that their activities are highly unfriendly with the environment. Thus petroleum deposits in the area constitute much of a liability to the immediate environment as the nature of relationship between the petroleum prospectors and the environment is tenuous. The effect of these unguided modes of environmental interactions is that man's presence and future are heavily threatened.

Aigbedion and Iyayi, (2007),observed that the three stages of mineral development viz: exploration, mining and processing, have caused different types of environmental damages, which include ecological disturbance, destruction of natural flora and fauna, pollution of air, land, water, instability of soil and rock masses, landscape degradation and radiation hazards. The environmental damage has in turn resulted in waste of arable land as well as economic crop and trees.

In a study conducted in Sub-Saharan countries by OECD (2002), it was established that environmental concern often times be subordinated to decisions by traditionally powerful ministries such as finance and industry. There are historical reasons for this, in particular the priority given to economic development in government policy. In the past this may have been at the expense of the environment. In Ghana for instance, the cost of environmental degradation to the economy in 1988 was estimated to be $189 million of which at least $17 million was as a result of mining activities. This is equivalent to 4.00 percent of GDP, whilst GDP growth was 5.00 percent. This growth occurred entirely at the expense of the country's natural resources base, and is unsustainable (OECD, 2002).

Oyedika and Nwosu (2008) argued that the uncontrolled mining activities and illegal mining in developing countries have left a lot of environmental hazards and enormous amount of waste and different types of pollutants in the environment. Mining activities, apart from the fact that they have deleterious effects on the environment, they are capable of endangering the lives of people living around the mines and sometimes constitute health risk. For instance, Onyedika and Nwosu (2008:418), observed that in mineralized areas of Ishiagu in Ebonyi state of Nigeria, one of the major sources of lead and associated cadmium to the environment arise from lead and zinc mining activities by industrial and local miners. However, high level of heavy metal in the soil could indicate similar concentration in plant by accumulation at concentration causing serious health risk to human health when consumed. In the same vein, the dust arising from mining operation in Tarkwa Area in Ghana, as observed by Akabzaa and Darimani (2001:56), has a high silica content which has been responsible for silicosis tuberculosis in the area. The same dust is deposited on the vegetation, making it unpalatable for both human and live stock consumption. Other environmental related diseases identified in the area include, vector borne diseases such as malaria, chistomiasis and onchocerciasis, skin diseases due to high level of cyanide reaching downstream from mine run-off, eye diseases, mental cases, and accidents resulting from galamseys activities. Sexually transmitted diseases (STDs) have also assumed an increased trend in the Wasa West District. Reported cases of syphilis and HIV have been on the increase in the area since 1992. For instance, reported cases of HIV rose from 6 in 1992 to 100 in 1996 (Akabzaa and Darimani, 2001:62).

Air and water pollution pose major problems as far as physical environmental impact of copper mining is concerned in Zambia (OECD, 2002). For instance, hyperlink air pollution include dust from waste dumps and tailings, which have contributed to increased bronchial disease and from CO_2, NO_x and SO_x emissions from smelter stacks such as lead and cadmium poisoning near Kabwe. Water pollution is also a problem with some rivers having copper levels of 80 times more than the accepted level in the early 1990s.

As documented by NEST (1991:38), two women that were illegal gold miners were buried alive in Niger state, and died instantly when the hole they entered in search of gold caved in, while their fellow gold digger who was in the hole with them, however escaped with multiple injuries. In a similar story in Jos 1982, between September and December according to NEST (1991:39), two children were reported drowned in ponds in the Jos environs when playing around the ponds abandoned by the miners. Miners as well have sometimes died in explosions or suffocation. In 2002, at least 48 workers were killed when a compressor used to pump clean air failed (Punch, 2008 pg 80).

Mining operation normally upset the equilibrium in geological environment, which may trigger off certain geological hazards such as landslide, subsidence, flooding, erosion and tremors together with their secondary effects (Aigbedion and Iyayi, 2007:36). The December 2004 tsunami which took Sri Lanka by surprise was the natural disaster ever experienced in Sri Lanka killing 35,322 people, losing 150,000 livelihoods, damaging unprecedented number of houses, infrastructure, schools, tourist hotels, and other commercial buildings. A country report published in 1992 by the Federal Environmental Protection Agency (FEPA) indicated that Nigeria possess more than 5,000 recorded species of plant, 22,090 species of animals including insects and 889 species of birds, and 1,489 species of micro organisms. It is estimated that 0.4% of the plant species are threatened and 8.5% endangered, while 0.14% of the animals and insects threatened and 0.22% endangered. The decrease in the population of the nation's biodiversity can be attributed to activities of man in the environment which include mining of minerals (Nigeria National Biodiversity and Action Plan, undated). Scarification of land often results due to existence of numerous pits some of which have been abandoned and are more than 10 metres deep and 50 metres wide. Many of them contain permanent water bodies which are veritable breeding places for mosquitoes that cause malaria and yellow fever. All of them constitute permanent physical danger for both human beings and livestock (OECD, 2002; NEST, 1991).

In their investigation on the impact of mining investment in Ghana, Akabzaa and Darimani (2001:47) observed that the principal elements of the environment land, water, air have been severely impacted by mining operations. The continued viability of these elements to support the well being and development of rural population in Tarkwa Area is currently in doubt. The large-scale mining activities, generally has continued to reduce the vegetation of the area to level that are destructive to biological diversity. Currently, surface mining concession has taken over 70% of the total land area of Tarkwa. It is estimated that at the close of mining, a company would use 40-60%.

METHOD OF STUDY

Primary data for this study were collected through field observation and administration of structured questionnaire. The focus was on the household heads who were residents' in the mining areas of Ijero Local Government, Ekiti State, Nigeria. Information obtained from them focused on their socio-economic background and also sought to identify residents' purposes of coming to the study area. Others are the residents' length of stay, distances from their homes to mining sites, their perceived effects of mining operations on the physical environment and means to sustainable community development in the study area. Reconnaissance survey revealed that there were five thousand, five hundred and forty (5,540) residential buildings in the study area out of which five hundred and fifty four houses, representing 10% of the total were randomly sampled. The study also noted that these houses were all numbered and located along streets, making them accessible during questionnaire administration. Fifty two copies of the questionnaire were either not properly filled or attended to, thus were rejected. This study was based on the remaining five hundred and two copies that were counted worthy of being analysed.

The random selection was done by writing numbers one to ten in each separate sheet of paper, each rolled and thoroughly mixed together in a carton, after which one of the rolled papers was picked. At the point of selection, number one was randomly picked. In other words, in each street, the first house was randomly selected followed by the selection of every tenth building along the line of movement. In the course of selecting the household heads, either female or male family head that was available in each family was selected. Where the two were on ground, the latter was given consideration. This is because, males were saddled with responsibilities of the households in African communities above their female counterparts. Where there were more than one household in a building, the oldest, in term of time of stay in the community was chosen for questionnaire administration.

ANALYISIS AND DISCUSSION

Socio-economic Characteristics of Residents in the Mining Environment of the Study Area

Information on the socio-economic characteristics of the people in Table 1 revealed that about two-third of them were males (58.,2%), married (64.3%) and came to reside in the study area in less than eleven years to the time of this study. In the same vein, about half of them were young adults (51.3%), within the age range of 21-40 years; having tertiary education (46.8%), earning below N10,000 (equivalent of 65 Dollars) per month (51.3%). Their high level of literacy, and short time of residency in the study area and early adulthood period of their age as at the time of this study are clear indications that most of them (64.6%) possibly came to seek for employment in the mining environment. This could be why more than half of them (53.0%) chose to live very close to the mining sites.

Table 1: Socio-economic Characteristics of Residents in the Study Area

Variable	Frequency	Percentage (%)
Age Distribution of Respondents		
18-20 years	29	5.7
21-30 years	134	26.7
31-40 years	125	24.6
41– 50 years	77	15.6
51- 60 years	63	13.1
Above 60 years	71	14.1
Total	495	100.0
Sex Distribution		
Male	292	58.2
Female	210	41.8
Total	502	100.0
Monthly Income (in Nigeria Naira)		
Less than 10,000	258	51.3
10,000-20,000	113	22.6
20,001-30,000	63	12.5
30,001-40,000	26	5.2
40,000-50,000	14	2.7
Above 50,000	28	5.7
Total	502	100.00
Respondents' Distribution by Marital Status		
Married	322	64.3
Single	138	27.3
Divorced	09	1.8
Widowed	33	6.6
Total	502	100.00
EDUCATIONAL STATUS		
NO FORMAL EDUCATION	87	17.3
PRIMARY EDUCATION	73	14.5
SECONDARY EDUCATION	107	21.3
TERTIARY	235	46.8
Total	502	100.0
RESPONDENTS' LENGTH OF STAY		
Below 10 years	325	64.7
11-20 years	91	18.2
21-30 years	30	6.0
31-40 years	18	3.5
Above 40 years	38	7.6
Total	502	100
Respondents' Purposes of Coming to Stay		
Employment (Working)	324	64.6
Education	39	7.7
Farming	06	1.2
Business	104	20.7
No response	29	5.7
Total	502	100.0
Distance between Residence and the nearest Mining Site (in Kilometres)		
BELOW 2 KM	266	53.0
2.1-4.0KM	84	16.8
4.1-6.0KM	145	28.9
ABOVE 6KM	07	1.3
TOTAL	502	100

Observable Effects of Mining Activities on Residents of Ijero Ekiti, Nigeria

The residents' perception of the effects of mineral extraction process in the study area was measured through the residents' tolerance index (RTI) (Afon, 2006). To measure this, twenty one variables relating to mining effects were identified, as reflected in Table 2. It is believed that how tolerant the residents were would indicate the effects these activities have on their livelihood. To this end, a high level of tolerance is an indication that mineral extraction has a positive effect and vice versa. To calculate the residents tolerance index (RTI), the residents were instructed to rate each variable using one of the five ratings: *very tolerable*, *tolerable*, *just tolerable*, *not tolerable* and *not at all tolerable*. Each of this was respectively assigned a value of 5, 4, 3, 2 and 1. The summation of weight value (SWV) for each mining effect is obtained through the addition of the product of responses for each rating of the mining effect and their respective weight values. Mathematically, this is expressed as:

$$\text{SWV} = \sum_{i=1}^{5} P_i V_i \text{ ....equ. (1)}$$

Where: SWV is the summation of weight value,

P_i is the respondent rating a particular mining effect and

V_i is the weight value assigned to each variable.

The residents' tolerance index (RTI) for each variable effect is arrived at by dividing the summation of weight value by the addition of the number of respondents to each of the five ratings. This is expressed mathematically as:

$$\text{RTI} = \frac{SWV}{\sum_{1}^{5} P_i} \text{ ....equ. (2)}$$

Where RTI is the residents' tolerance index, SWV and P_i are as defined previously. The closer the RTI of a particular variable is to five, the higher is the assured residents' tolerance about the mining effects on the physical environment. The residents' tolerance index obtained for the study area based on the identified mining effects is as presented in Table 2. The Table also reflects the average RTI denoted by $\overline{RTI}$ for the identified variables. This is obtained by summing up the RTI for each variable and dividing it by the total number of variables (N = 21). The deviation of the residents' tolerance index is also presented in the Table. To calculate this, the average residents' tolerance index is subtracted from the residents' tolerance index for each variable. This is denoted as RTI - $\overline{RTI}$.

From the Table, it can be seen that the highest RTI was 3.31, while the lowest was 1.75. The value of RTI has a direct variation with the level of tolerance derived from an attribute (Afon, 2006). The average RTI for the study area denoted as: $\overline{RTI}$, was 2.42. Their deviations around the mean of the highest and the lowest RTI were 0.89 and -0.67 respectively. The variables with positive deviations about the mean of RTI, were those considered by the residents as beneficial to them, or the effects of which were considered not too injurious to their present well being. As seen in the table, three of the variables with high tolerance among the respondents include; 'high influx of people', 'increase in sales and rental services' and 'improved economic condition'. Their residents tolerance indexes (RTI) were 3.31, 3.21 and 2.94 respectively. This means that mining activities in the study area is capable of generating meaningful economic benefits to host communities, and by this promoting community economic development. That is why their deviations around mean are positive and significant (between 0.7221 and 0.2704).

Other variables which have positive deviation in Table 2 are *overstretched of the available infrastructures, earth shake, earth movement during blasting, cracks on building due to blasting and landslide.* The Table shows that residents seemed not to have significantly noticed the negative effects of these variables nor were they presently affected by them. This could be why their ratings were above half of 5. Despite the positive deviation of these variables around the mean of RTI, the residents' tolerance index on these variable fell between *just tolerable* and *not tolerable*. The implication of this is that though these variables are presently less hazardous to the people, they can still pose serious threats to their' lives in the nearest future. This raises the question about the ultimate goal of mining activities in some developing nations; whether they are towards community development or degradation. This is because some of these effects may not be pronounced at present as hazardous, but may constitute serious threats to residents and the built environment in the future. This finding corroborates Aigbedion and Iyayi (2007), that mining operation may trigger off certain geological hazards such as landslide, earth shake, earth movement, flooding erosion and tremors as secondary effects.

The variables with negative deviation around the mean of RTI, were the variables that the residents showed low level of tolerance for; or considered affecting the physical environment of their area negatively. These are negative effects that are physically visible and directly felt by residents. Such variables include: *dust in air, illegal mining, loss of farmland, land dispute, blocking of drains, erosion due to mining excavation, smokes, increase in crime rate, fumes, loss of domestic animals in the mine, communal clash, siltation, run off to streams.* Their deviations around the mean of RTI were -0.07, -0.08, -0.08, -0.17, -0.18, -0.19, -0.22, -0.23, -0.32, -0.46, -0.5, -0.60 and -0.67 respectively. The residents' tolerance index (RTI) on some of these variables fell between *just tolerable* and *not tolerable*, while others were between *not tolerable* and *not at all tolerable*. This implies low level of tolerance by the residents. For instance, contaminated stream sources which the residents use for domestic purposes could cause water borne diseases (see Plate1). Similarly, loss of farmland (see Plate 2), loss of domestic animals in the mine, land dispute and communal clash may result in serious social problem capable of destroying peaceful coexistence of people in the area in future. Physical observations in the mining area showed that their land is exposed to soil erosion (Plate 3) and opened up their farmland to degradation through dug-out holes, polluted their water, artificial lakes (Plate 4) and are changing the ecological nature of the soil through digging and extraction respectively. This could be why the computed RTI variance in Table 2 was 0.1845, with a standard deviation of 0.43 and co-efficient of variance of 17.77%. From this computation, it could be inferred that the scattering of responses around the mean of RTI was low. In essence, the level of tolerance expressed by the residents on the mining effects in the study area was close and not too far from each other.

Computation of RTI Values in Table 4.11

Column 1:	Serial number
Column 2:	Identified mining effects
Column 3:	Number of Individual respondents rating each mining effect with 5 (very tolerable)
Column 4:	Number of individual respondents rating each mining effect with 4 (tolerable)

Column 5: Number individual respondents rating each mining effect with 3 (just tolerable)
Column 6: Number of individual respondents rating each mining with 2 (not tolerable).
Column 7: Number of individual respondents rating each mining effect with 1 (not at all tolerable).
Column 8: Addition of the product of individual respondents rating a particular effect and their respective weight values. For instance, SWV for high influx of people = (136 x 5) + (73 x 4) + (73 x 3) + (89 x 2) + (61 x 1) = 1430.
Column 9: Resident's tolerance index equals summation of weight value (SWV) divided by the addition of individual respondents rating each effect of mining. For instance RTI for high influx of people = 1430/ (136 + 73 + 73 + 89 + 61) = $\frac{1430}{432} = 3.31$
Column 10: The deviation equals to mean of residents' tolerance index for all the 21 mining effects subtracted from resident's tolerance index value for each mining effect. e.g $\frac{50.87}{21} = 2.42$,

Deviation (RTI - $\overline{RTI}$) = 3.31 – 2.42 = 0.89
Column 11: Square of values in column 10; for instance $(.89)^2 = 0.7221$

Residents' Perception of Means of carrying out Mining Activities towards Community Development in Ijero Ekiti, Nigeria

The residents' tolerance index (RTI) method adopted earlier in this research work is also employed in the computation of the residents' agreement index (RAI) used to measure the level of agreement of respondents to the suggested means of carrying out mining activities in the study area to attain sustainable community development. To do this, the residents were instructed to rate the five suggested measures using any one of the five ratings: *very much agree, agree, just agree, not agree* and *not at all agree*. Each of this was also assigned a value of 5, 4, 3, 2, and 1. The closer the residents' level of agreement on each variable to 5, the better is the adequacy of suggested measure.

As revealed in Table 3, the highest residents' agreement index was 4.30, while the lowest was 3.73 and the average residents' agreement index ($\overline{RAI}$) was 4.06. The variables with positive deviation about the mean of RAI were the measures the residents considered important for reducing the effects of mining activities and at the same time improving their living condition. The variables represented the measures through which the physical effects of mining activities could be reduced to a barest minimum and as well beneficial to the host communities. These variables were: "mining companies should be involved in the provision of infrastructural facilities", "mining activity should be carried out, and using modern equipment" and "mining activity should be done under close monitoring". Their deviations around the mean of RAI were: 0.24, 0.17 and 0.01 respectively. The residents' level of agreement on these variables was high. For instance, the provision of infrastructural facilities by the mining companies (RAI= 4.30) would help in reducing the overstretching of the available infrastructure due to excessive population attracted by mining activities. Furthermore, the use of modern equipments (RAI= 4.22) will to a large extent reduce the adverse effects of mineral extractions on the physical environment and at the same time increase efficiency of the mining operators.

The variables with negative deviation around the mean of RAI were; appropriate mining legislation should be put in place and properly implemented (-0.11) and community should participate in the mineral extraction process (-0.33). However, the negative deviation around the mean of RAI on these variables does not necessarily mean that they are less important. This is because the value of residents' agreement index (RAI) for the two variables were 3.99 and 3.73 respectively. This implies that the responses fell between *agree* and *just agree*, meaning that the variables were still relevant in ensuring that mining activities are properly controlled.

Table 3: Residents Perceived Means of Carrying out Mining Activities towards Community Development in Ijero Ekiti, Nigeria

S/N	Effect of mining	Rating and weight value								
		Very much agree WV (5)	Agree WV (4)	Just agree WV (3)	Not agree WV (2)	Not at all agree WV (1)	SWV	RAI	Deviation RAI - $\overline{RAI}$	(RAI-$\overline{RAI}$)^2
1	Mining companies should be involved in the provision of basic infrastructures	271	142	37	21	15	2091	4.30	0.24	0.576
2	Mining activity should be done using modern equipment	192	245	35	12	7	2076	4.22	0.17	0.0289
3	Mining activity should be done with close monitoring	153	248	55	22	6	1972	4.07	0.01	0.0001
4	Appropriate mining legislation should be put in place	153	201	97	36	8	1976	3.99	-0.11	0.0121
5	Community should participate in the extraction process	117	214	82	59	16	1821	3.73	-0.33	0.1089
	Total	**886**	**1050**	**306**	**150**	**52**	**9936**	**20.28**		**0.2076**

Source: Authors' field work, 2010

$$\sum RAI = 20.28,\ \overline{RAI} = \frac{\sum RAI}{(N=21)} = \frac{20.28}{5} = 4.056 \qquad \overline{RAI} = 4.06\ \text{Variance} = \frac{\sum\left(RAI-\overline{RAI}\right)^2}{N} = \frac{0.2076}{5} = 0.4152$$

Standard deviation (SD) $\sqrt{Variance} = \sqrt{0.4152}$

SD = 0.20376457 = 0.20

$$\text{Co-efficient of variation} = \left[\left(\frac{SD}{\overline{RAI}}\right)x100\right]\% = \left[\left(\frac{0.2}{4.06}\right)x100\right]\% = 4.926108 = 4.93\%$$

Findings also revealed that sustainable community development through small scale mining may not be feasible in the study area except proper laws to regulate its activities are enacted. It further showed that public participation in the extraction process is highly important in communities like that of Ijero. That is why the computed RAI variance was 0.4152, with a standard deviation of 0.20 and co-efficient of variation of 4.93%. Based on this computation, it could be deduced that the scatter around the mean of RAI was low, the level of responses by the residents were very close and not far from each.

CONCLUSION

The study revealed that mining activities in the study area attracted socio-economic benefits to the study area through influx of people, resulting in increased sales of goods and rental services. These, according to the residents have led to improved living standard of the people in the mining communities. On the contrary, mining activities in the area have also resulted in dust in air, illegal mining and excavation, loss of farmland, land dispute, blockage of drains, erosion due to mining excavation, smokes from mining equipments and machines, increase in crime rate, fumes, loss of domestic animals in the mine, communal clash, siltation and run off to streams due to exposure of top soil to weather effects. Hidden in mining activities but not perceived by residents are future negative effects on the built environment in the study area. These include over stretching of their inadequate infrastructural facilities, earth shake and movement during blasting, cracks on buildings due to blasting and landslide among others.

The opinion of residents on sustainable community development in the study area would require close and proper monitoring of mining activities through the use of modern mining equipment by the mining companies. In addition, willing, and qualified residents should be encouraged to participate in mineral extraction process, and by this become stakeholders in minerals extracted in their communities. The study concludes that there is the need to critically assess the benefits and effects of mining activities before they allowed in the built environment. Moreover, there is the need to legislate public oriented laws on mining activities in African nations to protect residents. Companies that are allowed to carry out mining operations should reciprocate by providing basic infrastructural facilities in the host communities. It is opined that preparation of a comprehensive impact assessment by professionals in environmental sciences before mining operations would forestall unforeseen adverse effects of mining activities in the mining environment.

REFERENCES

Abegunde, Albert; Olayiwola, Lasun and Adedokun, Oladejo (2007): "An Analysis of Environmental Effects of Indusrtial Pollution of oilf firms activities on on-shore water bodies in Warri Region, Nigeria*". Ife Planning Journal.* Department of Urban and Regional Planning, Obafemi Awolwo University, Ile Ife, Nigeria.

Afon A.O. (2006): "The use of Residents' Satisfaction Index in Selective Rehabilitation of Urban Core Residential Areas in Developing Countries". *International Review for Environmental Strategies, vol.6, no1, pp. 137-152.*

Aghalimo, S.O. (2000): "Petroleum Exploitation and Environmental Degradation in Nigeria". In Jimoh and ifabiyi (editors), *Contemporary Issues in Environmental Studies*. Pg. 141-146.

Aigbedion, I. and Iyayi, S.E. (2007): "Environmental Effects of Mineral Exploitation In Nigeria". *International Journal of Physical Science vol. 2 (2) pp 033-038* February, 2007 (http://www.academic journals.org/IJPS).

Akabzaa, T. and Darimani, A. (2001): "Impact of Mining Sector Investment in Ghana: A study of Tarkwa Mining Region". A draft report prepared by Thomas, A and Abdulai, D. for SAPRI January 20, 2001.

Ali, S.H. and Farcheallaigh, C.O. (2007): "Extractive Industries, Environmental Performance and Corporate Social Responsibilit"y: Greenleaf Publishing Limited: (http:/www.greenerpublisher.com/gmi52).

Dayo, F.B. (1999): "Nigerian Case Study. UNIDO Project". Systems Associates Limited, Lagos, Nigeria.

Evans, Joe (1988): "The First Payable Goldfield Found in Australia (OPHIR)" *Gold Gem and Treasure, January 1988.* http://users.tpg.com.au/dtdan/ophir.htm.

Federal Environmental Protection Agwency (FEPA) (1992): "Environment and Development; Implementing World Bank Policy." *Development Community,* Volume 17. Washington D.C.

Fuentes, J.R. and Mies, V. (2008): "Development paths, natural resources and dynamic comparative advantages", Global Development Network Library (GDN). http//www.gdn.org

Hooge, Lois (2000) "Mining's impact on community development in south Africa: the Kwagga programme". Paper prepared for the Workshop on Growth and Diversification in Mineral Economies. Organised by the United Nations Conference on Trade and Development (UNCTAD), Cape Town: 7 to 9 November.

Ikono, U.D. (2000): "Environmental crises in Nigeria and the oil Multi-national Companies". *Social responsibility for sustainable development of Nigier Delta Area*. Department of Public and Private Law, Faculty of Law, Benue State University, Makurdi, Nigiera.

Jasper Mining Incorporation (2009): "Jasper Mining Incorporation 2006 Annual Report, Management's Discussion and Analysis" (Form 51-102F1). December 31.

Jasper Mining Incorporation (2006): "Jasper Mining Incorporation Annual Report".

National Environmental Action/Study Team, (1991): *Nigerian Threatened Environment: A National Profile.* Intec Printers Limited, Ibadan.

Lungu, J. and Shikwe, A. (2006): "Cooperative Social Responsibility Practices in Small Scale Mining on the Copper Belt": A Baseline Study Sponsored by ZCTU, CCJDP and DECOP with the financial support from the Netherlands Institute for Southern Africa April – August 2006.

Organization for Economic Cooperation and Development, (2002): "Environmental Impacts of Foreign Direct Investment in the Mining Sector in Sub-Saharan Africa". Conference on *Foreign Direct Investment and the Environment, Lesson to be Learned from the Mining Sector*: Prepared by Colin Noy Boocock. 7-8 February, OECD Headquarters, 2 rue Andre Pascal, 75775 CEDEX 16, Paris, France.

Onyedika, G.O. and Nwosu, G.U (2008): "Lead, Zinc and Cadmium in Root Crops from Mineralized Galena-sphalerite Mining Areas and Environment". *Pakistan Journal of Nutrition 7 (3): 418-420, 2008.* (http//:www.Pjbs.Org/pjnonline/fin915.pdf-lead zinc & cadmium).

Punch News paper (March 31st, 2008): Hope Faded for 65 Miners. Pg 80.

Wikipedia (2010): "Australian gold rushes", Wikipedia, the free encyclopedia. http://en.wikipedia.org/wiki/Australian_gold_rushes

APPENDIX

Plate 1: Contaminated dammed stream used for domestic purposes in the study area.

Plate 2: A piece of land exposed to soil erosion in Ijero Ekiti, Nigeria.

Plate 3: An artificial lake created by mining operation in Ijero Ekiti.

ON THE ACCURACY OF COST ESTIMATES: IDENTIFYING FLAWS IN BILLS OF QUANTITIES FOR BUILDING PROJECTS IN NIGERIA

Haruna Musa[1], Yahaya Makarfi Ibrahim and Ahmed Doko Ibrahim
Department of Quantity Surveying, Ahmadu Bello University, Zaria, Nigeria

Previous researches indicate that accurate cost estimates play significant roles in construction project decisions. The accurate cost estimates by quantity surveyors are crucial elements in the success of construction project processes. However, the reliability of bills of quantities as forms of cost estimates has been questioned by researchers. This study therefore aims at identifying flaws in the preparation of accurate cost estimates in bills of quantities prepared in Nigeria. The study was carried out by the use of a document analysis approach to analyse bills of quantities for seventeen building projects. The results indicate that there is the presence of inaccuracies inherent in bills of quantities for building projects in Nigeria. The findings suggest that accurate cost estimates in the Nigerian construction industry will ensure the survival of business and individuals in the industry. It was recommended that consultant quantity surveyors should explore and use computers to aid them in using various estimating techniques at their disposal for better service delivery.

Keywords: accuracy, bills of quantities, building project, cost estimate, Nigeria.

INTRODUCTION

The subject of cost estimating in construction projects is a topic of debate or discussion among quantity surveyors, cost engineers, estimators and other stakeholders in the construction industry. Cost estimating is crucial to construction contract tendering, providing a basis for establishing the likely cost of resource elements of the tender price for construction work (Akintoye, 2000). According to Holroyd (2000) the cost we estimate must be as accurate as possible. He further asserts that business and individual survival in an organization depends on this accuracy. In his submission, Geddes (1996) is of the opinion that sound estimating is produced from a combination of experience and recorded cost data of similar works carried out over time.

Cost estimating, according to Akintoye (2000) as cited in Kwakye (1994) can be described as the technical process or function undertaken to assess and predict the total cost of executing an item or items of work in a given time using all available project information and resources. The Code of Estimating Practice produced by the Chartered Institute of Building (CIOB, 1997 P. xiii) defines estimating as ‘the technical process of predicting costs of construction’. According to Holroyd (2000), the estimating of cost follows the same process, whichever industry or environment we work in and wherever it is. He also added that the cost we estimate must be as

[1] hmusa@abu.edu.ng

Musa, H., Ibrahim, Y.M. and Ibrahim, A.D. (2011) On the accuracy of cost estimates: Identifying flaws in bills of quantities for building projects in Nigeria *In:* Laryea, S., Leiringer, R. and Hughes, W. (Eds) *Procs West Africa Built Environment Research (WABER) Conference,* 19-21 July 2011, Accra, Ghana, 761-769.

accurate as possible since business and individual survival depends on this accuracy. Carr (1989), as cited in Akintoye and Fitzgerald (2000), identified a serious lack of generally accepted estimating guidelines, despite the availability of literature on the format, procedures and principles involved in cost estimating. This we believe is due to a lot of factors like complexity of the project, size of the project, unknown soil conditions, time allowed to prepare the cost estimate, unknown utility location, location of the project, experience of the estimator and other unknowns that are beyond the control of the estimator (at a particular time). These factors and unknowns are notorious to projects and can cause project cost overruns if not detected early and handled well. A cost estimate is made up of many elements that may not be completely defined at the time it is prepared. It assists in the making of financial decisions on a proposed project at a given time or period. In other words, an estimate is key or central to establishing the basis for key project decisions, for establishing the benchmark on which project success will be measured and for communicating financial status of a project at any point in time. Hence it must be prepared using the best information at the appropriate time and accurately.

The bill of quantities is the document that lists items of a proposed project in trade or work order with the quantities of each of the items shown (Smith, 1996). According to Geddes (1996) and Smith (1996), the bill of quantities with other tender documents is given to each tenderer of a proposed project to serve as a basis of fair competition. It is the summation of all priced items in the bills of quantities and other un-quantified items in the other attached tender documents that determine estimated costs of proposed projects as offered by each tenderer.

PREVIOUS STUDIES ON PRE-TENDER COST ESTIMATES

Review of the practice of cost estimates

There appears to be scarce literature relating to the practice of cost estimating (Akintoye and Fitzgerald, 2000). One of the shortcomings of cost estimating currently being practiced is the evidence shown by estimators in avoiding the real problems of their trades (uncertainty of estimates) by presenting socially acceptable forecasts (Skitmore and Wilcox, 1994) as cited by Akintoye (2000). This infers that cost estimating, an important element in tendering, has not been given much attention by estimators. The question of accuracy of the rates build up for past and proposed projects by the estimators with this mind set is raised. It is important to note that cost estimating is a fundamental part of the construction industry of any nation. The success or failure of a project is in great part dependent on the accuracy of the cost estimate prepared by the client’s consultant, the contractor or liaison of the client’s consultant and the contractor’s representative. It is in no doubt that accurate cost estimates optimize good contracting. Therefore, inaccurate cost estimating is a serious construction industry problem. According to Adrian (1982), estimating is the nuts and bolts of the construction industry.

Adrian (1982) clarifies that it is not realistic to expect a construction estimate to be one hundred percent accurate because of, in part, the uncertainties of future events. He further asserts that no procedure, or mathematical technique, or policy employed by the estimator is without its flaws or is able to guarantee perfect estimates. Skitmore (1990) while commenting on research in the UK opine that despite a substantial research, very little progress has been made to establish a suitably reliable mechanism for generating item rates. According to Geddes (1996) a work on estimating must be sound and at the same time comprehensive, so that both the experienced and inexperienced estimator may not only also have every confidence in the matter it contains, but also have available data from which to estimate the cost of all those items of work most likely to be met with. Most times estimators do not have at their disposals appropriate drawings to work with in the preparation of their cost estimates. Estimators must have clear and complete drawings based on clear clients' briefs in addition to having current information of even the minutest details that will assist them in preparing detailed cost estimates at the onset.

Studies on accuracy levels of pre-tender cost estimates

Odusanmi and Onukwube (2008) emphasized that the accuracy of quantity surveyors pre-tender cost estimates vary from country to country at different levels. Findings of researchers (Morrison, 1984; McCaffer, 1976; Jupp and McMillan, 1981; Ashworth and Skitmore, 1982; Cheong, 1991; Gunner and Skitmore, 1999) as cited in Odusanmi and Onukwube (2008) show that pre-tender estimates are observed to be either underestimated or overestimated as low as 5% and as high as 33.9% respectively in different countries where their researches were carried out. Laryea (2010) in a research conducted in Ghana concluded that clients in that country should add an allowance of 40% of the cost estimates prepared by consultant quantity surveyors as a contingency for errors and inaccuracies in their preparations. In the same research, it was found that contractors' calculated estimates were more reliable and accurate than consultants' calculated estimates. This therefore suggests that consultants should prepare estimates as if they are quoting for a job so that they can prepare and calculate detailed estimates with whatever data is available. Beeston (1983) also agrees that consultants should move towards contractors' methods of estimating as a way of improving clients' estimators' performance.

Factors that affect the accuracy of pre-tender cost estimates

Akintoye (2000) identified the main factors influencing cost estimating practice as the complexity of the project, scale and scope of construction, site constraints, client's financial position, buildability and location of the project. Consultant quantity surveyors must visit and assess the site for the proposed project in order to have on record the features on site to assist them in determining a lot of cost-related issues with regards to the project. Skitmore (1990) cited the work of Skitmore and Tan (1988) in which they introduced five types of factors namely (1) the type of project, (2) the information used, (3) the technique used, (4) the estimator himself, and (5) the feedback system that affect the quality of estimates generally. There are assertions by Adrian (1982) that the degree of accuracy varies with the amount of effort and time taken to prepare a cost estimate and the degree of details in contract document preparation.

Dysert (2006) also identified factors influencing accuracy of cost estimates as quality of reference cost estimating data, the quality of assumptions used in preparing the estimate, the state of new technology in the project, the experience and skill level of the estimator, the specific estimating techniques employed the desired use of the estimate, as well as extraneous market conditions. In addition, other factors that affect estimate accuracy are the project team's capability to adjust the estimate for changes in scope as the project develops. From review of some past contributions of researchers globally in general and in Nigeria in particular, it is pertinent that there is little literature on factors affecting accuracy of pre-tender cost estimates in and no any detailed explanation on record for the inaccurate cost estimate as well Nigeria, hence the need for this study.

RESEARCH METHOD

The data for the study were obtained through bills of quantities collected from seven selected consultant quantity surveying firms in the Federal Capital Territory (Abuja), Kaduna metropolis and Zaria town of Kaduna State. A total of seventeen bills of quantities were used for the study. We had difficulties in getting documents for some of the completed projects released to us for this study.

A document analysis approach was employed to analyze the bills of quantities. There are various methods open for research surveys as opined by Fellow and Liu (1997), but we chose the document analysis approach to find out if the pricing of the items in the bills of quantities (BOQs) conform to the provisions made in the 6th edition of the Standard Method of Measurement (1979), used in preparing the BOQs. Another reason for using the document analysis approach is that this study is a preliminary one that will be broadened in the very near future.

CASE STUDIES

Seventeen projects in Nigeria between 2005 and 2010 were examined and analyzed (see Tables 1 to 6). In the first group of nine projects in Tables 1 to 3 (Csd 01-Csd 09), the clients engaged designers and consultant quantity surveyors who prepared and priced the bills of quantities. It should be noted that the group comprises multi-storey buildings and none is more than three-storey high. The projects in this group were initiated by stakeholders from the public sector with varying types of jobs in terms of usage.

In the second group of eight projects in Tables 4 to 6 (Csd 10-Csd 17), the clients too engaged designers and consultant quantity surveyors who prepared and priced the bills of quantities. Buildings in this group are also multi-storey and none is more than three-storey high. Projects in this group were initiated by the private sector.

All the bills of quantities prepared were format of the 6th edition of the Standard Method of Measurement (1979) popularly known and called the SMM 6.

Analysis of the priced bills of quantities

Tables 1 to 3 examine and analyze consultant-priced projects for the public sector between Year 2005 and 2010. The pricing patterns of some elements of the projects under consideration were shown.

Csd 01-Csd03: the jobs were yet to start but are about to be awarded. For Csd04-Csd09, some of the jobs are ongoing with about 95% completion while some have been completed. These jobs were awarded on a Fixed Contract basis with varying completion periods. As a result of the problems we had with getting most of the documents, we resorted to analyzing some vital elements of each job namely (1) excavation and earthwork, (2) concrete work (in substructure and superstructure), and (3) concrete work (with formwork section) as shown. Excavation in trench not exceeding 2m deep. (B.) Excavation in trench exceeding 2m deep. (C.) Excavation in pit not exceeding 2m deep. (D.) Excavation in pit exceeding 2m deep.

The rates used in Table 1 by the consultant-priced projects for the public sector projects clearly show that the rates were not built or used in accordance with the provisions in the SMM 6 (1979). This is evident when the Legend for Table 1 is considered. A check indicates that excavation works for different items and at different depths was indicated. But, the rates used did not take into consideration the positions and the depths specified in the BOQs. This is equally true for rates used for items in Table 2 and Table 3. This inappropriate pricing of items, it is believed, affects the accuracy of the cost estimates for the items concerned.

Table 1: Case studies of consultants-priced projects in the public sector in Nigeria

		Element - Excavation and Earthwork			
Case Study	Type of job	A	B	C	D
Csd 01	Hostel blk	350.00	400.00	450.00	NA
Csd 02	Lecture hall	1,200.00	1,200.00	1,200.00	NA
Csd 03	Hostel blk	100.00	250.00	310.00	NA
Csd 04	Hostel blk	450.00	550.00	600.00	NA
Csd 05	Hostel blk	450.00	550.00	600.00	NA
Csd 06	Offices educ	350.00	NA	420.00	NA
Csd 07	Exhibtn hall	500.00	422.50	900.00	NA
Csd 08	Hostel blk	650.00	NA	700.00	NA
Csd 09	Res qtrs	NA	NA	1,000.00	NA

Notes: Rates are in Nigerian Naira per m3. NA= Not applicable. See Legend below for other information on alphabetical letters in table

Legend: For Table 1.

(A.) Excavation in trench not exceeding 2m deep. (B.) Excavation in trench exceeding 2m deep. (C.) Excavation in pit not exceeding 2m deep. (D.) Excavation in pit exceeding 2m deep.

Table 2: Case studies of consultants-priced projects in the public sector in Nigeria

		Element - Concrete Work (substructure and superstructure)						
Case Study	Type of job	E	F	G	H	J	K	L
Csd 01	Hostel blk	14,000.00	15,000.00	15,000.00	15,000.00	15,000.00	15,000.00	15,000.00
Csd 02	Lecture hall	22,500.00	24,500.00	24,500.00	24,500.00	24,500.00	24,500.00	24,500.00
Csd 03	Hostel blk	15,600.00	18,700.00	18,700.00	18,700.00	18,700.00	18,700.00	18,700.00
Csd 04	Hostel blk	10,500.00	14,500.00	14,500.00	14,500.00	14,500.00	14,500.00	14,500.00
Csd 05	Hostel blk	15,600.00	18,700.00	18,700.00	18,700.00	18,700.00	18,700.00	18,700.00
Csd 06	Offices educ	18,500.00	22,500.00	22,500.00	22,500.00	22,500.00	22,500.00	22,500.00
Csd 07	Exhibtn Hall	18,500.00	20,000.00	20,000.00	20,000.00	20,000.00	20,000.00	20,000.00
Csd 08	Hostel blk	26,000.00	28,850.00	28,850.00	28,850.00	28,850.00	28,850.00	28,850.00
Csd 09	Res qtrs	36,000.00	36,000.00	36,000.00	36,000.00	36,000.00	36,000.00	36,000.00

Notes: Rates are in Nigerian Naira per m^3. NA= Not applicable. See Legend below for other information on alphabetical letters in table

Legend: For Table 2.

(E.) Plain in-situ concrete in foundation. (F.) Reinforced in-situ concrete in column bases. (G.) Reinforced in-situ concrete in columns in foundation. (H.) Reinforced in-situ concrete in beams. (J.) Reinforced in-situ concrete in suspended floor slab. (K.) Reinforced in-situ concrete in landing at staircases. (L.) Reinforced in-situ concrete in waist at staircases.

Table 3: Case studies of consultants-priced projects in the public sector in Nigeria

		Element - Concrete Work (Formwork)						
Case Study	Type of job	M	N	P	Q	R	S	T
Csd 01	Hostel blk	900.00	1,000.00	1,000.00	1,000.00	1,000.00	1,000.00	1,000.00
Csd 02	Lecture hall	1,850.00	1,850.00	1,850.00	1,850.00	1,850.00	1,850.00	1,850.00
Csd 03	Hostel blk	960.00	960.00	960.00	960.00	960.00	960.00	960.00
Csd 04	Hostel blk	650.00	850.00	850.00	850.00	850.00	850.00	850.00
Csd 05	Hostel blk	960.00	960.00	960.00	960.00	960.00	960.00	960.00
Csd 06	Offices educ	1,500.00	1,500.00	1,500.00	1,500.00	1,500.00	1,500.00	1,500.00
Csd 07	Exhibtn Hall	1,000.00	1,250.00	1,250.00	1,250.00	1,250.00	1,250.00	1,250.00
Csd 08	Hostel blk	1,650.00	1,910.00	1,910.00	1,910.00	1,910.00	1,910.00	1,910.00
Csd 09	Res qtrs	1,400.00	1,400.00	1,400.00	1,400.00	1,400.00	1,400.00	1,400.00

Notes: Rates are in Nigerian Naira per m^2. NA= Not applicable. See Legend below for other information on alphabetical letters in table

Legend: For Table 3.

(M.) Sawn formwork to sides of columns in foundation. (N.) Sawn formwork to sides of column bases. (P.) Sawn formwork to soffit of suspended floor. (Q.) Sawn formwork to sides of beams. (R.) Sawn formwork to soffit of landing. (S.) Sawn formwork to soffit of waist. (T.) Sawn formwork to sides of columns (in frames).

Tables 4 to 6 examine and analyze consultant-priced projects for the private sector between the Year 2005 and 2010. The pricing patterns of some elements of the projects under consideration were shown.

Table 4: Case studies of consultants-priced projects in the private sector in Nigeria

		Element - Excavation and Earthwork			
Case Study	Type of job	A	B	C	D
Csd 10	Res block	457.00	NA	498.00	NA
Csd 11	Exec Villa	620.00	NA	620.00	NA
Csd 12	Hotel ghse	400.00	400.00	400.00	400.00
Csd 13	Terrace flats	450.00	NA	450.00	NA
Csd 14	Recretion bld	450.00	NA	450.00	NA
Csd 15	Hotel bldg	1,450.00	NA	1,500.00	NA
Csd 16	Resid devpt	500.00	NA	500.00	NA
Csd 17	Priv residnce	450.00	NA	450.00	NA

Notes: Rates are in Nigerian Naira per m^3. NA= Not applicable. See Legend below for other information on alphabetical letters in table

Legend: For Table 4.

(A.) Excavation in trench not exceeding 2m deep. (B.) Excavation in trench exceeding 2m deep. (C.) Excavation in pit not exceeding 2m deep. (D.) Excavation in pit exceeding 2m deep.

Csd 10-Csd17: the jobs have been completed but we could not have access to the project files to carry out in-depth analyses on the management of the jobs. Hence, we examined the jobs in the same way we did Csd01-Csd09. From the rates used in Table 4 by the consultant-priced projects for the private sector projects it is also clear that the rates were not built or used in accordance with the provisions in the SMM 6 used by the consultant quantity surveyors in preparing the BOQs. This is also true for Table 5 and Table 6. There are therefore doubts that the rates used in the BOQs were built or developed as accurately as possible; the cost estimates arrived at may not represent fair and reasonable costs to the clients.

Table 5: Case studies of consultants-priced projects in the private sector in Nigeria

		Element - Concrete Work (substructure and superstructure)						
Case Study	Type of job	E	F	G	H	J	K	L
Csd 10	Res block	14,750.00	15,970.00	15,970.00	15,970.00	15,970.00	15,970.00	15,970.00
Csd 11	Exec Villa	19,500.00	19,500.00	19,500.00	19,500.00	19,500.00	19,500.00	19,500.00
Csd 12	Hotel ghse	20,500.00	20,500.00	20,500.00	20,500.00	20,500.00	20,500.00	20,500.00
Csd 13	Terrace flats	25,900.00	25,900.00	25,900.00	25,900.00	25,900.00	25,900.00	25,900.00
Csd 14	Recretion bld	25,900.00	25,900.00	25,900.00	25,900.00	25,900.00	25,900.00	25,900.00
Csd 15	Hotel bldg	23,000.00	24,500.00	24,500.00	24,500.00	24,500.00	24,500.00	24,500.00
Csd 16	Resid devpt	17,000.00	17,000.00	17,000.00	17,000.00	17,000.00	17,000.00	17,000.00
Csd 17	Priv residnce	15,000.00	25,900.00	25,900.00	25,900.00	25,900.00	25,900.00	25,900.00

Notes: Rates are in Nigerian Naira per m^3. NA= Not applicable. See Legend below for other information on alphabetical letters in table

<u>Legend: For Table 5.</u>

(E.) Plain in-situ concrete in foundation. (F.) Reinforced in-situ concrete in column bases. (G.) Reinforced in-situ concrete in columns in foundation. (H.) Reinforced in-situ concrete in beams. (J.) Reinforced in-situ concrete in suspended floor slab. (K.) Reinforced in-situ concrete in landing at staircases. (L.) Reinforced in-situ concrete in waist at staircases.

Table 6: Case studies of consultants-priced projects in the private sector in Nigeria

		Element - Concrete Work (Formwork)						
Case Study	Type of job	M	N	P	Q	R	S	T
Csd 10	Res block	480.00	480.00	480.00	480.00	480.00	480.00	480.00
Csd 11	Exec Villa	1,800.00	1,800.00	1,800.00	1,800.00	1,800.00	1,800.00	1,800.00
Csd 12	Hotel ghse	950.00	950.00	950.00	950.00	950.00	950.00	950.00
Csd 13	Terrace flats	1,210.00	1,210.00	1,210.00	1,210.00	1,210.00	1,210.00	1,210.00
Csd 14	Recretion bld	1,210.00	1,210.00	1,210.00	1,210.00	1,210.00	1,210.00	1,210.00
Csd 15	Hotel bldg	2,500.00	2,500.00	2,500.00	2,500.00	2,500.00	2,500.00	2,500.00
Csd 16	Resid devpt	750.00	750.00	750.00	750.00	750.00	750.00	750.00
Csd 17	Priv residnce	1,210.00	1,210.00	1,210.00	1,210.00	1,210.00	1,210.00	0.00

Notes: Rates are in Nigerian Naira per m^2. NA= Not applicable. See Legend below for other information on alphabetical letters in table

<u>Legend: For Table 6.</u>

(M.) Sawn formwork to sides of columns in foundation. (N.) Sawn formwork to sides of column bases. (P.) Sawn formwork to soffit of suspended floor. (Q.) Sawn formwork to sides of beams. (R.) Sawn formwork to soffit of landing. (S.) Sawn formwork to soffit of waist. (T.) Sawn formwork to sides of columns (in frames).

DISCUSSION

The main point of the analyses here is to present a preliminary impression of how projects estimated by consultants turn out in terms of cost estimated. From the analyses in Tables 1-6, the rates in the bills of quantities for the same items at different locations and levels are priced the same. This is not in conformity with some provisions of the SMM 6 format of which the bills of quantities considered for this study were based on (refer to sections D.11, F.3, F.4, F.9, F.13, F.15 and T.). This therefore, raises questions on the accuracy of the cost estimates arrived at by the consultant quantity surveyors for the projects considered.

There is no comparison of analyses and results from the estimated total cost of the proposed projects and the final contract sums of the projects studied. This was partly due to the fact that access to some documents of the completed projects was not gained. The non-adherence to the provisions of the SMM 6 in building or developing prices used in the BOQs prepared by the consulting quantity surveyors is a serious issue. Cost estimates for the various projects handled or being handled by the consultant quantity surveyors do not represent fair and reasonable cost to the various clients they rendered services to.

CONCLUSION

The situations which require the adoption of techniques to prepare accurate cost estimates in the Nigerian construction industry were identified, this is as a result of one of the findings that survival of business and individuals in the industry are hinged on accurate cost estimates of projects. There is the need for the consultant quantity surveyors to obtain sufficient quality and timely cost information to enable them build up their rates for future projects. In addition, all costs which prudent and experienced contractors will expect to incur should be captured in their cost estimates.

RECOMMENDATIONS

Consulting quantity surveyors are advised to explore and use various estimating techniques at their disposal for better service delivery.

Consulting quantity surveyors are advised to explore and use computers to assist them in using various statistical tools in preparing their cost estimates for all projects. The computers will also assist them in building and organizing data bank for their use on projects at different stages.

There should be adherence to provisions made in the Standard Methods of Measurement of the existing editions in use by consulting quantity surveyors in the preparation of BOQs.

Prospective project owners should insist on assessing the quality of output of consultants on projects they intend to engage in handling their projects.

REFERENCES

Adrian, J.J. (1981) CM: The Construction Management Process. Rexton Publishing Co. Inc. Virginia.

Adrian, J.J. (1982) Construction Estimating: an accounting and productivity approach. Rexton Publishing Co. Inc. Virginia.

Akintoye, A. (2000) “Analysis of factors influencing project cost estimating practice”, Construction Management and Economics, 18:2:, 77-89.

Akintoye, A. and Fitzgerald, E. (2000) “A survey of current cost estimating practices”, Construction Management and Economics, 18:2:, 161-172.

Beeston, D.T. (1983) Statistical methods for building price data. E. and F.N Spon, London.

CIOB (1997) Code of estimating practice, 6ed. The Chartered Institute of Building, London Press.

Dysert, L.R. (2006) “Is accuracy an oxymoron?". AACE International Transaction 2006. EST01: 1-01.5.

Fellows, R.F. and Liu, A. (1997) Research Methods for Construction. Blackwell Science Ltd, Oxford.

Geddes, S. (1996) Estimating for building and civil engineering works, 9ed. Butterworth, London.

Holroyd, T.M. (2000) Principles of estimating. Thomas Telford Ltd, London.

Laryea, S. (2000) "Contractor project estimates vs. consultant project estimates in Ghana. In: The Construction, Building and Real Estate Research Conference of the Royal Institution of Chartered Surveyors, 2-3 September 2010, Dauphine Université, Paris. Available at http://centaur.reading.ac.uk/16290/

Odunsami, K.T. and Onukwube, H.N. (2008) "Factors affecting the accuracy of pre-tender cost estimate in Nigeria. In: The Construction, Building and Real Estate Research Conference of the Royal Institution of Chartered Surveyors. Held at Dubling Institute of Technology, 4-5 September 2008.

RICS, and NFBTE. (1979) Standard Method of Measurement of Building Works, 6ed. The Royal Institution of Chartered Surveyors, London.

Skitmore, M. (1990) “Which estimating technique?”. In Procs 11th International Cost Engineering Congress and 6th Association Francais des Ingenieurs et Techniciens, D’estimation de Planification de Projects Annual meeting, pp B.1.1-B.1.7. Paris, France.

Smith, R. C (1986) Estimating and tendering for building work, Longman: London.

PARTNERING: AN ALTERNATIVE CONTRACTUAL ARRANGEMENT FOR CONSTRUCTION PROJECT DELIVERY IN GHANA

Samuel K. Ansah[1]
Department of Building Technology, Cape Coast Polytechnic, Cape Coast, Ghana

Understandably, clients in both the public and the private sectors in Ghanaian construction industry have become increasingly dissatisfied. What they see is unpredictability and under-performance. What they receive is too often of poor quality, late and over priced. More often contractors enter the construction project focusing on achieving their objectives and maximising their profit margins, with no regard for the impacts on others. This mindset leads to conflict, litigation and often a disastrous project. In the pursuit of performance excellence, there is a need for partnering. This paper therefore, attempting to explain the need for partnering as an alternative approach to construction project delivery. The paper presents a review of partnering projects in general. Through a postal and e-mailed questionnaire survey, opinions of various parties in Ghanaian construction industry – clients, sub-contractor and contactors were sought regarding construction project delivery and level of use of partnering. This paper also explains the importance and benefits arising from partnering implementation as reviewed by the other researchers and concluded that, partnering is one of the most innovative developments in delivering a project efficiently and reducing disputes. It provides a sound basis for a 'win – win' climate and synergistic teamwork. By changing to a 'win – win' style the parties can reap benefits of cost saving, profit sharing, quality enhancement and time management.

Keywords: client, under-performance, partnering, win-win.

INTRODUCTION

Historically, the construction industry has used procurement methods and contractual arrangements (traditional approach) that have beset the industry with several problems, such as lack of co-operation, limited trust, ineffective communications (Chan et al. 2004). These procurement methods and contractual arrangements have encouraged clients and contractors to see themselves as adversaries and that have reinforced any differences in values, goals and orientations that exist within the construction project team (Latham, 1994). In fact, the traditional construction relationship among the parties in Ghanaian construction industry has lacked any degree of objective alignment, and provides for no improvement in work processes. Parties enter the project focused on achieving their objective and maximises their profit margins, with no regard for the impacts on others. This mindset leads to conflict, litigation, difficult in resolving claims, project delay, and cost overruns and often a disastrous project. The characteristics of such a competitive environment includes objectives which lack commonality, success coming at the expense of others (a win or lose mentality), and a short-term focus.

[1] Skansah@hotmail.co.uk

Ansah, S.K. (2011) Partnering: an alternative contractual arrangement for construction project delivery in Ghana *In:* Laryea, S., Leiringer, R. and Hughes, W. (Eds) *Procs West Africa Built Environment Research (WABER) Conference*, 19-21 July 2011, Accra, Ghana, 771-781.

Understandably, clients in construction industry have become increasingly dissatisfied. What they see is unpredictability and under-performance. What they receive is too often of poor quality, late and overpriced. In Ghana, both public and private sector clients of the construction industry continue to complain about the industry's performance and its seeming inability to deliver projects on time, within budget and to expected quality standards. Major clients are dissatisfied with consultants' performance in co-ordinating teams, in design and innovation, in providing a speedy and reliable service and providing value for money. Nicco-Annan (2006) carried out a limited survey of the construction of a few office buildings in Accra which have been commissioned by a well-known non-bank financial institution and found that:

- Costs of executed projects far exceeded the original costs, not taking inflation into account.
- Completion dates of executed projects also far exceeded the original completion dates.

The question is, "why is the construction industry under-performing?" The Egan's UK Report (Rethinking Construction) saw construction as: "a series of sequential and largely separate operations undertaken by individual designers, contractors and suppliers who have no stake in the long term success of the product and no commitment to it."
In the pursuit of performance excellence in the Ghanaian construction industries, there is a need for an effective management technique. Many new procurement and management techniques have gained popularity to help solve these problems (Sanders, 1994). Partnering is one of such technique that tries to create an effective project management process between two or more organisations (Sanders and Moore, 1992). It aims to generate an organisational environment of trust, open communication, and employee involvement. According to Thompson and Sanders (1998), partnering helps to advance the collaboration and enhance the competence of construction parties. It is an innovative concept to the construction organisations, which traditionally rely heavily on contracting to bind the parties together.

Partnering as an approach to manage construction projects is regarded as an important management tool to improve quality and programme, to reduce confrontations between parties, thus enabling an open and non-adversarial contracting environment. This research therefore, attempting to explain the need for partnering as an alternative approach to effective construction project delivery. The paper also assesses the performance of construction projects and level of use of partnering in Ghanaian construction industry. The paper further discusses the importance and benefits arising from partnering implementation.

LITERATURE REVIEW

What Is Partnering

Numerous definitions of partnering have been derived from past studies. Among them, the definition developed by the Construction Industry Institute (CII) in the United States is the most widely cited. The CII defined partnering as "a long-term commitment between two or more organizations for the purpose of achieving specific business objectives by maximizing the effectiveness of each participant resources. This requires changing traditional relationships to a shared culture without regard to organizational boundaries. The relationship is based on trust, dedication to common goals and an understanding of each other's individual expectations and values (CII, 1991).

The above definition depict partnering as a generic term and emphasis that the relationship will cause all to seek win-win solutions, place value in long-term and emphasis that the relationships and encourage trust and openness to be the norms and that an environment for profit exists. It is also a view that neither partner should benefit from exploitation of the others needs, concerns and objectives and is interested in helping its partner achieve them. It creates a team environment to accomplish a set of goals in much the same way that a sports team works together to achieve its goals. But perhaps the definition that provides explicit meaning, which is adopted for this paper, is that by the Reading Construction Forum, in trusting the team (Bennett and Jayes, 1995); Partnering is a managerial approach used by two or more organisations to achieve specific business objectives by maximising the effectiveness of each participant's resources. The approach is based on mutual objectives, an agreed method of problem resolution, and an active search for continuous measurable improvements. This definition focus on the key elements that feature prominently in partnering, irrespective of the form it takes.

Objectives of Partnering

In construction, the concept of partnering is described as a generic term of management approach to align project goals (Bayliss, 2002). The goal for partnering is to improve relationships among contracting parties, either in single project partnership or in long-term strategic alliances. Partnering provides benefits to the contract-parties, including cost effectiveness, work efficiency, opportunities for innovation, equitable risk sharing, and less confrontation (Black C, et al. 1999). Partnering is not a contract but an attempt to establish non-adversarial working relationships among project participants through mutual commitment and open communication. It is also serves to create an environment that fosters cooperation and team work (Stevens, 1993).

Genesis of Partnering In Construction Industry

Partnering has been widely advocated for the Construction industry to rectify the adversarial contractual relationships that have jeopardised the success of many projects. Features of partnering relationships have been seen in various industries for many years. The partnering style of relationships with contractors was a feature of some construction projects in Britain early in the Industrial Revolution (Barnes, 2000). As applied today, it originates in the philosophies of the Japanese influenced automobile industry. The defence, aerospace and construction industries have followed. Its essence is alignment of values and working practices by all members of the supply chain in order to meet the customer's real needs and objectives (Green, 1999). Continuous improvement has been an important objective, with emphasis not only on cost but also on quality, lead time, customer service, and health and safety at work. Contrary to current perceptions, construction partnering, although not necessarily in its present form or using that particular name, has existed within the UK construction industry since at least the early 1990's, when Marks and Spencer and Bovis began a long-standing relationship which has lasted to the present time and is based upon mutual trust and respect as well as the resulting commercial benefits enjoyed by both parties (Masterman, 2004).

In the USA, it was in the late 1980's that growth of claims and litigation on construction contracts led public agencies to begin to use the technique that led to a promising increase in the controlling of cost and time growth on numerous major projects (Bennett and Jayes, 1998). Many States and central governmental organisations are now committed to the use of partnering, and it is understood that the growth of the use of the method in the private sector has increased significantly in the recent past and continues to expand. In Australia, formalised partnering emerged at the beginning of the 1990's, partially, it is believed (Uher,2000) as a result of central and state governmental initiatives which put forward a new strategy to improve production in the construction industry, which included a commitment to partnering.

The Process of Partnering

The key to partnering is that it starts at the outset of a project. The process is formally established in 'workshop (or 'kick-off') sessions between the partnering members so that everyone has a clear understanding of what the process is and agrees to use it. As in any collaborative venture, all parties have to get together pre-construction and invest time into agreeing and understanding the objectives, form and operation of a partnering agreement (Wearne and Wright, 1998). The essential stages of the project partnering process are:

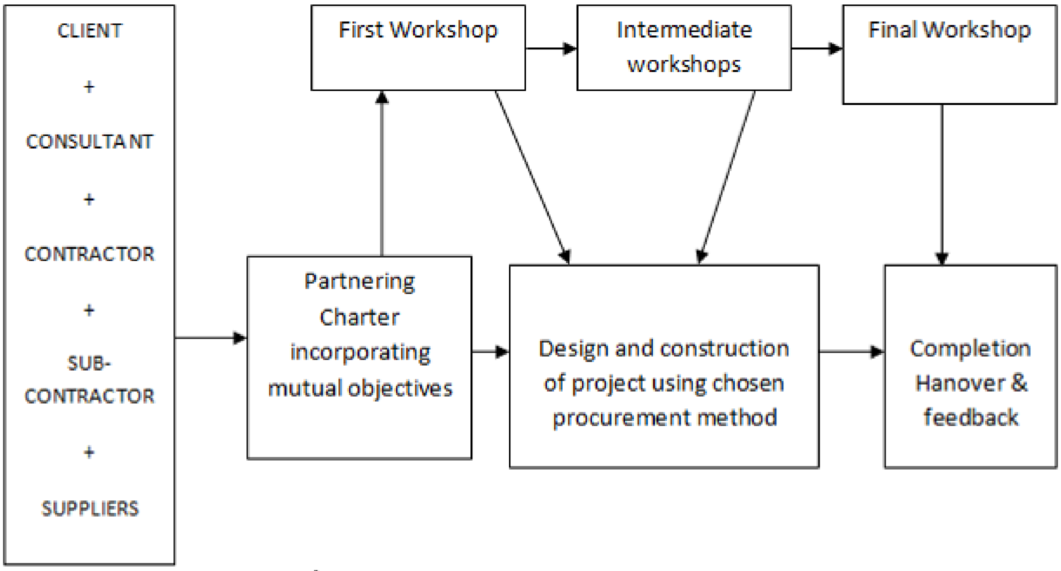
- Decision stage: the desire of all of the main members of the project team to become involved in the partnering process is essential; this desire will often stem from relationships that have been formed during past associations when organisational cultures have been found to be compatible. If this has not been the case, and examination of each of the main participants' organisations and personnel to establish compatibility, or the lack of it, is essential before any commitment is entered into. Once all of the parties are convinced that they wish to participate in the partnering process, a decision to use partnering on the project under consideration can be made and the next stage of the process can be commenced.
- Establishment of working practices – during this stage, a series of mutual objectives for the project are identified and agreed and the way in which problems are to be solved during the duration of the project is established. These activities are carried out by means of a workshop, which needs to be held immediately the decision has been taken to use the partnering process and should be attended by all of the main parties involved in the project. This event is critical to the sources of the project as it will determine how the project team will implement the project together and engender mutual understanding among the participants. This initial workshop is likely to be of 1 or 2 day's duration as it will be dealing with a considerable amount of detail in order to reach agreement on a list of mutual objectives, identify improvement targets, design the problem resolution process and deal with any matters specific to the project. The final major task of the workshop is to formulate a partnering charter, a document with no legal standing, which incorporates in simple language the agreed mutual objectives, a summary of the problem resolution process and the basic philosophy and aims of the partnership. Once this document had been signed off by all of the parties, it is exhibited in the offices of all the participating organisations and in all site offices, canteens, notice boards etc. At the end of the workshop, arrangements are made for future follow-up and induction workshops.
- Implementing partnering practices – the execution of the practices agreed during the second stage of the partnering process is carried out in parallel with,

but physically separate from, the everyday management of the project by means of the follow-up workshops.

These workshops will take place at intervals and will be of a duration determined by the project team; they will also deal with any problems that have arisen during the implementation of the project, review progress that has been made in achieving the agreed mutual objectives and take whatever action is necessary to ensure that the previously agreed continuous improvements are being made. Sub workshops, sometimes referred to as action teams, and are used to deal with matters which are not capable of being dealt with during the comparatively short duration of the normal workshops.

On the appointment of new key members of the project team, whether they are consultants, subcontractors or suppliers, induction workshops are held in order to familiarise the new corner with project partnering and to obtain their agreement to partnering charter. Over the often lengthy implementation period of many major projects, these workshops should enable project teams to establish the trust and understanding which is so necessary to improving working relationships and enhancing performance to the benefit of all of the participants. Figure 1 illustrates the project partnering process.

Figure 1: The project partnering process



Source: Masterman, 2004

Performance of Partnering Projects in Terms of Cost, Time and Quality Cost Reduction

According to Uher (2000), a research carried out by the New South Wales Department of public works and services, which compared costs on the individually partnered projects with non-partnered public projects, reported a possible 2-3 percent reduction in cost when using project partnering. A research reported by Westminster University also suggested savings of 60 percent when practising strategic partnering. This research was based upon the case study of the McDonalds construction programme for their standard, fast food restaurants and reflects not only the use of strategic partnering but also the use of modular buildings and the repetitions nature of the projects and should therefore be viewed in this context (Barlow et.al. 1997). Other case studies of partnering in Australia, although not providing specific examples of cost savings, confirm that the use of the method results in a lower risk of cost overruns.

In the USA, a quantitative study of 400 public projects half of which were performed using project partnering, carried out by the Texas Department of Transportation found that whereas the partnered projects incurred more change orders (variations) than non-partnered projects, the average cost was approximately one-half of that expended on non-partnered projects. The partnered projects had slightly less cost growth than non-partnered projects, and for the majority of the partnered projects no costs were incurred from claims or disputes. Because of the nature of the research, no attempt was made to identify any cost savings that may have resulted from these benefits (Grasberg, et al. 1999).

The University of Reading's Report on partnering maintained that cost savings of 2-10 percent were achieved on the project partnering schemes that were examined and that savings of up to 30 percent could realistically be achieved when strategic partnering is used (Reading Construction Forum. 1995). Bennett and Jayes, report on second-generation partnering, i.e. long-term/strategic partnering, maintained that where cost reduction was the focus of the exercise savings of up to 40 percent were obtained (Bennett and Jayes, 1998).

Time Saving

The 1995 Reading Construction Forum report on partnering maintained that the benefits derived from partnering included reduced design times, quicker commencement on site and shorter construction periods. A 27 percent reduction in construction times achieved on five projects carried out by the Arizona Department of Transport is given as an example. As overview of the performance of partnering in the Australian construction industry (Uher, 2000) is more circumspect in its findings, which in essence, simply confirmed that there was a lower risk of time overruns on partnered projects. An analysis of partnered project performance carried out on 400 projects in the State of Texas in the USA was more positive, establishing that time growth was negative on all of the 200 partnered projects, which resulted in them being completed, on average, some 4-7 percent earlier than originally planned. Bennett and Jayes (1998) maintained that when using second-generation/strategic partnering and provided that the firms involved carry out the correct management actions, savings in time of more than 50 per cent are achievable.

Quality Improvement

According to the Reading Construction Forum's (1995) report on partnering, much of the literature examined for the report suggested that the primary focus of partnering should be quality. Some of the case studies investigated showed a reduction in the number of defects identified, together with a related decline in the amount of remedial work needed. Three of the five clients studied in the Westminster University report (Barlow et. al, 1997), claimed to have achieved improvements in construction quality. The Australian experience (Uher, 2000), although lacking in definitive data with regard to quality, confirmed in general terms that the use of project partnering resulted in an improvement in quality standards.

RESEARCH METHOD

Most of the content of this research is based on a review of relevant materials from textbooks, professional journals, conference papers, refereed publication and research reports to explain the objectives of partnering, genesis of partnering and its implementation process in the construction industry. Opinions of various parties in Ghanaian construction industry – clients, sub-contractors and contactors were sought regarding construction project delivery, performance and level of use of partnering in Ghanaian construction industry. The paper also sought the importance and benefits of partnering implementation from previous researchers.

Questionnaires were distributed to a random sample of one hundred and eighty (180) contractors, sub-contractors and clients in Accra and Cape Coast all in Ghana. The questionnaires were posted with self addressed envelop and the same time e-mailed to the respondents. This was to ensure that the targeted persons received the questionnaire. These methods of communication have led to the return of one hundred and sixty-four (164) completed questionnaires. Table1shows the breakdown of sent and returned questionnaire and the respondents types as well .Data collected was analysed using descriptive statistics, thus frequencies and percentages.

Table 1: Sent/Returned Questionnaire

Respondent type	Number of questionnaire sent	Percentage sent (%)	Number of questionnaire return	Percentage return (%)	Number of questionnaire not return	Percentage of questionnaire not return
Main Contractors	95	52.78	87	48.33	8	4.44
Sub-Contractors	65	36.11	62	34.44	3	1.67
Client Consultants	20	11.11	15	8.33	5	2.78
Total	180	100	164	91.11	16	8.89

RESULTS AND DISCUSSION

Table 2 shows a summary of finding of research conducted by the researcher on some of the Partnered and Non-partnered projects carried out in Ghana, specifically Accra and Cape Coast between 2009 and 2010. Findings of the survey were analysed by using descriptive statistics to provide a better understanding of the issues of project delivery and partnering in the Ghanaian construction industry. The results of this study were generated from all the responses received. In totality 164 out of 180 questionnaires were received. The 164 returned questionnaires consisted of eighty-seven (87) respondents from main contractors, sixty-two (62) from sub-contractors and fifteen (15) from clients.

The survey indicated that 8% of the projects undertaken by the participants' organisations were Partnered projects and 92% of the projects Non-partnered. The participants' firms were small to large (D4 through D1) size companies which meant that the survey was cut-across all organisations irrespective of the size. With regard to the level of use of the partnering in Ghanaian construction industry, the result indicates that only 8% of the participants' organizations implemented partnering for their projects. When compared cost on partnered projects with non-partnered project, it was realized that partnered projects incurred lower cost risks between 2-5%. Partnered projects also recorded no risk of time overruns. On the other hand all the non-partnered projects under studied suffered major deficiencies such as cost and time overruns. Table 2 gives more details and other related issues concerning partnering and non-partnering projects performance.

It was also realized that 92% of the projects which formed the non-partnered projects have been delivered based on the traditional procurement system with open competitive tendering where clients appointed consultants to act on their behalf in order to produce designs and supervise site works. The adversarial relationship between clients and construction constructors inherited in this procurement system is one of the major barriers to the success of the construction industry. One thing we should note is that in a traditional procurement system, particularly with open competitive tendering, cut-throat tendering is actively encouraged, mainly by the client and usually upon advice from the client’s consultant. Contractors would be forced to bid at low margins, hoping to make up for loses through client changes. The system is adversarial, based on a closed book approach in which client, consultant and contractor often play a game of hide and seek with one another, hoping to “catch each other out”. This is the main reason for the atrocious prevalence of claims within the industry and situations when the out-turn or final cost of projects far exceed the tender price, leaving extremely bitter clients who feel ripped off by unscrupulous contractors. In contrast to the traditional procurement approach in which the parties appear pitched against each other, partnering seeks a team approach in which the parties work together to improve performance through agreeing mutual objective, devising a way for resolving any disputes and committing themselves to continuous improvement, measuring progress and sharing gains. Sir John Egan’s report, “Rethinking construction,” recommended that “the industry must replace competitive tendering with long-term relationships based on clear measurement of performance and sustained improvements in quality and efficiency.”

Table 2: Summary of findings of performance of Non-partnered and Partnered project carried out at Accra and Cape Coast between 2009/2010

Cost overruns	For non-partnered projects, cost of construction projects under studied overruns of between 25%-43%, not taking inflation into account. For partnered projects, cost overruns between 2 – 5 %.
Time overruns	For non-partnered projects, time overruns of between 9-21 months. For partnered projects, no time overruns recorded.
Project delivery satisfaction	96% of the respondents’ claim clients were not satisfied with the projects delivered by their contractors in terms of cost, time and quality for non-partnered project. For partnered projects, all the clients were satisfied with project delivered.
Claims Issues	For non-partnered projects, 73% of the projects under studied had claims issues. For partnered projects, no claims issues were recorded.
Disputes Issues	For non-partnered projects, 54% of the projects under studied had disputes cases. For partnered projects, no disputes cases were recorded.
Working Relationships	For non-partnered projects, 73% of the respondents claim project participants were unhappy with the working relationship with the other parties. For partnered projects, all the respondents claim project participants were happy with the working relationship with the other parties.
Project delivered with inclusion of partnering	8% of the participant organisations included partnering in their project.
Project delivered on traditional procurement system	92% of the completed project under studied, have been delivered based on the traditional procurement system with open competitive tendering where clients appointed consultants to act on their behalf.

Previous studies (Cowan et al. 1992; Moore et al. 1992) also suggested that project partnering could well be applied to construction projects and can provide improved time and cost benefits to both clients and contractors. It can therefore be concluded that the process of partnering is, therefore, a clear attempt to overcome some of the actual and perceived shortfalls in traditional methods of procurement.

Benefits arising From Partnering Implementation

Partnering relationships offer advantages and opportunities specific to the individual members of the project team. The benefits of partnering include:

- **Benefits for client:** Effective utilisation of personnel resources may be the most important benefit to the owner, in terms of both staffing requirements and available expertise. The client may also benefit from increased flexibility and responsiveness in terms of added skills and resources available from other parties, from the presence of a diversity of talent not usually found in a single company, which will improve on delivery, and from reduced costs associated with contractor or consultant selection, contract administration, mobilisation, and the learning curve associated with beginning a project with a new contractor or consultant. Other benefits to the client will be the reduced dependence on legal counsel, the development of a team for future projects and more control over possible cost overruns.
- **Benefits for design team:** Partnering provides the design team with the opportunity to refine and develop new skills in a controlled and low risk way. This occurs because new methods or approaches may be required to meet owner project requirements. Through partnering, the design team will benefit from the involvement of contractors during budgeting, development of the team for future projects and optimal use of the design team's time.
- **Benefit for contractor:** The contractor may benefit from increased opportunity for value-engineering involvement to provide value for money, faster decision-making processes, and more effective time and cost control. Other benefits to the contractor will include formation of teams for future projects, increased opportunity for financially successful projects, reduced dependence on legal counsel and the possibility of faster payments.

- **Benefits for the manufacturers and suppliers:** As with the other team members, the benefits that manufacturers and supplier stand to gain through partnering include approval of their products recommendation, a voice in the design intent, involvement in the coordination with other project trades and the possibility of repeat business. Other benefits are a better chance for quality in product installation and increased opportunity for financially successful projects.

CONCLUSION

This paper attempted to explain partnering as an alternative contractual arrangement for successful project delivery in the Ghanaian construction industry. With the identification of the specific issues and problems, such as cost overruns, time overruns, fragmented nature and adversarial relations, in the Ghanaian construction industry, a partnering is highly recommended. Partnering arrangement can replace the potentially adversarial atmosphere and foster a team approach to achieve common goals. Industry world-wide studies have suggested the use of partnering as a way to promote co-operative contracting. Construction companies and clients in Ghana can use partnering to improve their competitiveness, to improve product quality and to keep pace with changing customer requirements. Partnering is one of the most innovative developments in delivering a project efficiently and reducing disputes. It provides a sound basis for a 'win – win' climate and synergistic teamwork. By changing to a 'win – win' style the parties can reap benefits of cost saving, profit sharing, quality enhancement and time management.

REFERENCES

Barlow, J., Cohen, M., Jashapara, A and Simpson, Y. (1997), Towards Positive Partnering, the Policy Press, Bristol

Barnes, N. M. L. (2000), Civil Engineering Management in the Industrial Revolution. Proceedings of the Institution of Civil Engineers 138, 135 – 144.

Bayliss, R. F. (2002). Partnering on MTR Corporation Ltd's Tseung Kwan O Extension. Hong Kong Inst. Eng. Trans; 9 (1), 1 – 6

Bennett, J. and Jayes, S. (1995). Trusting the Team: The Best Practice Guide to Partnering in Construction. Centre for Strategic Studies in Construction, University of Reading, Reading.

Bennett J, and Jayes, S. (1998). The Seven Pillars of Partnering: A guide to Second Generation Partnering, Centre for Strategic Studies in Construction, University of Reading, Reading.

Black, C; Akintoye, A; and Fitzgerald E. (2000). An Analysis of Success Factor and Benefits of Partnering in Construction. International Journal of Project Management, 18 (6): 423 – 434.

Chan, A. P. C; Chan, D. W. M; Chiag, Y. H.; Tang, B. S.; Chan, E. H. W. and Ho, K. S. K. (2004). Exploring Critical Success Factors for partnering in Construction Projects. Journal of Construction Engineering and Management 130 (2) 188 – 198.

Construction Industry Institute (1991). In Search of Partnering Excellence, CII Special Publication, Construction Institute, Austin, Tx.

Cowan, C., Gray, C., and Larson, E. (1992), "Project Partnering". Project Management Journal, 22(4), 5-12.

Grasberg, D. D.; Dillon, W. D.; Reynolds, L. and Boyd, J. (1999) Qualitative Analysis of Partnered Project Performance; ASCE Journal of Construction Engineering and Management 125 (5), 161 – 166).

Green, S. D. (1999). Partnering: The Propaganda of Corporatism. In: Ogunlana S. O (Ed), Profitable Partnering in Construction Procurement, Proceedings of CIB Symposium, pp. 3 – 14. E and FN Spon, London.

Latham, M. (1994). Constructing the Team, H M S O, London.

Masterman, J. W. E. (2004). Introduction to Building Procurement systems. Second Edition. Spon. Press.

Moore, C., Mosley, D., and Slagle, M. (1992). Partnering Guidelines for win-win project management. Project Management Journal, 22(1), 18-21.

Nicco – Annan, J. (2006) Partnering in Construction. The Quantity Surveyor. Official Magazine of Quantity Surveying Division of the Ghana Institute of Surveyors. Issue I., pp 14 – 19.

Reading Construction forum (1995). Trusting the Team. The Best Practice Guide to Partnering in Construction, Reading: Centre for Strategic Studies in Construction.

Sanders, S. R. (1994). Partnering on the Wangaratta Bypass. Australian project Management Journal, 12, 21 – 25.

Sanders, S. R., and Moore, M. M. (1992). Perceptions on Partnering in the Public Sector. Australian Project Management Journal, 22 (4), 13 – 19.

Stevens, D. (1993). Partnering and Value Management. The Building Economist, the Australian Institute of Quantity Surveyors.

Thompson, P. J. and Sanders S. R. (1998). Partnering Continuum, Journal of Management in Engineering, 14(15), 73 – 78.

Uher, T. E. (2000). Partnering Performance in Australia, Journal of Construction Procurement 5 (2), 163 – 176.

Wearne, S. H. and Wright, D. (1998). Organizational Risks of Joint Ventures, Consortia and Alliance Partnerships. International Journal of Project and Business Risk Management, 2 (1), 45 -57.

PERFORMANCE OF BUILDING PROJECTS FUNDED BY PUBLIC ORGANIZATIONS: POTENTIALLY INFLUENCING MANAGEMENT PRACTICES

Sarfo Mensah[1], **Ayirebi Dansoh**[2] **and Peter Amoah**[3]
[1]*Department of Building Technology, Kumasi Polytechnic, Kumasi, Ghana*
[2,3]*Department of Building Technology, KNUST, Kumasi, Ghana*

There is a strong association between project performance and project management practices. Satisfactory performance is a reflection of optimal practices. Management practices may however differ from organization to organization. The aim of this research is to determine whether there are differences in the performance of building projects funded by selected public organizations. The study was pursued in two stages: (1) determination of the performance of projects managed by the organizations and (2) identifying potential project management practices that could explain differences in the performance of the projects. Building projects of three funding organizations were selected for the Study. A structured questionnaire was used to collect information for measuring the performance of projects executed from year 2005 to 2009. Pair-wise analysis was used to test for differences between the performances of projects using independent t-test. Significant differences were observed in the time and cost performances of projects managed by the different organizations. Semi-structured interviews were conducted for identification of practices used in the management of the building projects. The time and quality performances of one organization was better than the other two organizations. This organization's practice of establishing a budget for particular project and making payments from that budget at defined stages could explain the differences in the performances.

Keywords: Ghana, project finance, project management practice, project performance, public organization.

INTRODUCTION

Project performance is influenced by several factors (Blismas *et al.*, 2004). In Ghana, projects funded by public organizations have had reported performance problems related to: irregular release of funds for construction projects by the Client (Baiden-Amissah, 1999); delayed payment by client and inadequate contract information and performance appraisal (Amoah-Mensah, 2005). Generally, construction projects are completed in longer times and at higher-than-budgeted costs due to: poor planning at the pre-design phase of the building procurement process (Best and Valence, 1999); and improper appraisal of contractor's past performance information (Kashiwagi and Parmar, 2004; Xiao and Proverbs, 2003)

[1] sarfmen@yahoo.com
[2] adansoh@consultant.com.
[3] amoahp@yahoo.com

Mensah, S., Dansoh, A. and Amoah, P. (2011) Performance of building projects funded by public organizations: Potentially influencing management practices *In:* Laryea, S., Leiringer, R. and Hughes, W. (Eds) *Procs West Africa Built Environment Research (WABER) Conference,* 19-21 July 2011, Accra, Ghana, 783-793.

However, most of these influencing factors seem to emanate from practices engaged in by project managers and other project-related bodies. Therefore, the relationship between project performance and project management practices is of great significance. Sharma and Gadenne, (2002) asserts that there is strong association between practices and performance. (Loader, 2002) also confirms performance of projects funded by government organizations suffer from the practices of: Frequent lateness on approvals of application for funding; infrastructure cost not fully estimated and so underfunded; and giving tight time scales for preparation of bids.

The relative effect on performance is what makes a practice optimal (Ramabadron *et al*., 1997). Thus quality of manner in which individual project management activities are carried out would determine the eventual performance of a project. Identifying the influencing tendencies of the daily practices would therefore help managers to pursue actions to optimize the performances of projects.

It has been argued that since professional practice within the construction industry is required to follow laid down guidelines and ethics, management practices may not necessarily vary from organization to organization and that the purpose of adopting a particular practice may therefore be due to peculiar environmental and social demands of the project at hand. However, practices could vary from organization to organization since, in striving for the best results, practices may progressively be refined till their effect on the performance becomes optimal.

This study was undertaken to determine the performance of projects managed by the organizations. This was meant to be a measure of the effectiveness of their project management practices. It further attempts to identify management practices that could explain the differences in performance. Three public organizations in Ghana whose key activities involve the funding and management of construction projects were selected for the study. The organizations differ from each other in funding sources, scope of operations and peculiar organizational goals. However, the mission of executing building projects is common to them. The organizations are designated as PMO1, PMO2 and PMO3 in the Study. The main objectives and project management activities of the organizations are given in Table 1.

Table 1 Objectives and Project Activities of PMOs

	Organization	Objective	Common observed Project management -related activities
1	PMO1	Supplement the provision of educational facilities at all levels	Scheduling release of project funds Advancing of Mobilization fund
2	PMO2	Develop housing schemes, improve educational and primary health care facilities, and manage environmental sanitation.	Interim valuation of works by consultant Honouring of Payment Certificates
3	PMO3	Reduce rural and urban poverty.	

The day-to-day ways of carrying out the project management related activities for the purpose of achieving set project targets (Das *et al.*, 2000) are referred to as project management practices in this study. The organizations manage building projects through their project management departments which engage the services of consultants. Data on building projects funded by the organizations were used for the study.

LITERATURE REVIEW

Project Performance Measurement

Project performance has been considered to be tied to project success and this is also tied to project objectives (Chan and Chan, 2004). Sadeh *et al.* (2000) measured project success based on dimensions including Meeting Design Goals, Benefit to End Users, Benefit to the developing organization, etc. These project success criteria do not consider time, cost and quality, the most common of building project objectives. Shenhar *et al.* (1997) proposed that project success is divided into dimensions including Project Efficiency, Impact on Customer, Business success, etc. The measurement of these dimensions appears to be on subjective basis. Chan and Chan (2004) developed a consolidated framework encompassing broad range of values for measuring project success. The framework includes Cost, Environmental performance, Quality, etc. The frame work is too broad and may not make the performance measurement handy for everyday use. Three basic objectives of Construction projects -time, cost and quality- are adopted as dimensions for measurement of project performance in this study. Measuring success on these objectives is expected to yield more effective results since project participants are more familiar with these basic widely known and widely understood project objectives (Phua and Rowlinson, 2004.) The overall project performance is determined from performance metrics based on the outcome of basic project objectives: Time, Cost and Quality performance. The choice of KPI's is based on guidelines advocated by Collin (2002);

- Only a limited, manageable number of KPI's is maintainable for regular use. Having too many (and too complex) KPIs can be time and resource-consuming.
- Data Collection must be made as simple as possible.
- For performance measurement to be effective, the measurement or indicators must be accepted, understood and owned across the organization.

Metrics adopted for measurement of project performance include: Time variation (for measurement of time performance) and Percent Net Variation (for measurement of cost performance) as employed by Chan and Chan (2004) (originally used by Naoum ,1994). The Time Variation indicator has the ability to take care of percentage increase or decrease in the estimated project days/weeks whiles discounting the effect of extension of time. The Percent Net Variation indicator also has the ability to give indication of cost overrun or under-run. Moreover, the benefit of using these Key Performance Indicators (KPIs) is the facilitation of the measurement of project and organizational performance throughout the construction industry. In contrast to the objective ways of measuring cost and time, quality performance measurement has mostly been subjective. This study employs consultant and clients' satisfaction for quality performance measurement.

General factors influencing project performance

There are several factors that can affect thesuccess of a project. The nature and source of funds and payments scheduling engaged by a given organization could determine performance level (Loader, 2002). Bryde (2003) in his investigation into the formalization of project management activities cited the structuring of the project among four broad areas that define the success of projects. The experience of the client with project management process has a lot to do with the kind of decisions that are taken during the lifetime of the project. Some of the decisions made by the project client include insisting on design changes irrespective of the stage of a project. A lack of adequate experience on the part of the client is likely to lead to ignoring the cost implications of such decisions, especially at the latter stages of the project. It is not only the client's decisions that are relevant to project success; the decisions of other parties too are important. The designer's experience is among the major factors that affect cost and time overruns (Naoum, 1994).

The effectiveness of client's representative team, effectiveness of construction management team, and the scope of works are broad factors that affect construction time performance (Walker, 1995). Cost performance may also be affected by variations and modifications during the construction period (Chan and Chan, 2004). The extent to which projects are monitored, the experience of project consultants, quality and past performance record of contractors (Kashiwagi and Parmar, 2004) and the number of variation orders issued affect quality. The competent coordination of all these factors is relevant to achieving satisfactory quality performance.

MANAGEMEN PRACTICES THAT INFLUENCE PROJECT PERFORMANCE

Project management practices are very important to performance level that could be attained in project management. (Gowan and Mathieu, 2005; El-Mashaleh, and Minchin Jr, 2006). Since "it is the performance that makes a practice optimum", an accurate measurement of project performance is required for a determination of optimum practices (Bryde's, 2003). Loader (2002) observed that the presence of tight timescales for preparation of bids is usually an attribute within certain client organizations that have bodies entrusted with coordination of project funding. This situation usually occurs when funds need to be tapped from their sources within a time limit. Pressure therefore mounts on project consultants to subsequently prepare bids for quick submission. Such schedules place limitations on the preparation of bids resulting in a reduction in the quality of documents. The consequent result is of unforeseen variations retarding the project's progress. The industry is characterized by repeated delays, cost overruns and collapse of buildings. In the light of these, Kashiwagi and Parmar (2004) suggested that past performance information should stand as a key indicator for predicting future performance in the construction industry. The problem of poor project performance is attributed to a number of factors (Mansfield *et al.*, 1994). Best and Valence (1999) contend that the problem of construction projects frequently taking longer and costing more than originally anticipated is often due to poor planning at the pre-design phase of the building procurement process. Xiao and Proverbs (2003) observed that contractor performance is critical to the success of any construction project as it is contractors who convert designs into practical reality. Project managers have been called upon to be critical about the contractor selection process since it is important to project success. The selection of project consultants is of equal importance.

The ability of managers to have managerial control may be a key element in achieving project success. A high level of administrative ability in the project team could lead to reduced time overruns, which in turn leads to increased satisfaction of client. Also project organizational structure may have some influence on the project performance from inception to completion. Weaknesses in management structure lead to poor project performance regardless of organizational facilitators such as senior management commitment and leadership style (Cooper, 1998). Jawaharnesan and

Price (1997) studied project management best practices in the UK construction industry and found that "preparing and organizing" and "developing project definition" were among the highest ranked tasks

Best Practices in Project Management

As practices vary from organization to organization or from project team to project team the question of best practice subsequently arises. Ramabadron *et al*. (1997) describes best practices in project management as optimum ways of performing works to achieve higher performance. In determining whether certain practices are best or not, their effect on project outcome should be evaluated. There is a strong association between quality management practices and performance (Sharma and Gadenne, 2002). Quality management practices differed from industry to industry and from organization to organization. These practices are carried out for the purpose of successfully managing projects. In a research conducted into the organizational learning practices in project management environment, it was concluded that project organizations should focus on building knowledge because increased knowledge is associated with increased project performance (Kotnour, 2000). Thus, taking feedbacks from projects and learning from experiences have a significant influence on project performance (Loo, 2003). The identification and pursuit of best practices within a particular project management organization enhances successful project management.

RESEARCH METHOD

First, the performances of substantially completed similar projects executed by the organizations were measured with data on projects that fall within predefined criteria. The conditions were set to minimize the impact on performance that could emanate from the following extraneous as indicated in Table 2. Purposive sampling was therefore required to obtain the projects. Thus, from each organization, Thirty-three (33) projects, which could meet the predefined conditions, were randomly sampled for the performance measurement .Respondents were also notified of the conditions in order to guide them the selection of projects for which data were to be provided.

Table 2 – Conditions used project sampling and

Conditions providing basis for project selection	Extraneous influence expected to be minimized
Project's original contract sum should not be less than USD 10,000.00	Effect of project financial size
Projects completed from year 2005 to year 2009	Effect of price fluctuations associated with different economic seasons
Project executed under the traditional procurement method	Effect of type of procurement method
Project type should be entirely new works.	Effect of nature of works being undertaken in project
Project should be education-related were required from respondents.	Effect of building end-use

Data on 24, 22 and 20 of PMO1, PMO2 and PMO3 projects falling within the predefined conditions were obtained. Three criteria - time, cost and quality objectives - were adopted for measuring the project performance and performance indices were computed for them. Indices for time and cost performances were developed as (tables 2(a) and 2(b)) using data of planned and actual time and cost values. Quality performance was measured subjectively by ranking satisfaction with quality of completed projects as shown in table 2(c).

Table 2 (a) Time Performance (Y_1) Index

Project Completion Status Achieved	Completed behind schedule					Completed on schedule	Completed ahead of schedule				
Index	0.5 and below	0.6	0.7	0.8	0.9	1.0	1.1	1.2	1.3	1.4	1.5 and above
Time performance index = $\frac{\text{Planned Contract Period}}{\text{Actual Construction Period}}$											

Table 2 (b) Cost Performance (Y_2) Index

Project Cost Status Achieved	Completed above initial estimated cost					Completed As estimated	Completed below initial estimated cost				
Index	0.5 and below	0.6	0.7	0.8	0.9	1.0	1.1	1.2	1.3	1.4	1.5 and above
Cost Performance Index = $\frac{\text{Initial Project Cost}}{\text{Final Project Cost}}$											

Table 2 (c) Quality Performance (Y_3) Index

Project Quality Status Achieved	Below expectation by about:					As expected	Above expectation by about:				
Margin	50% and below	40%	30%	20%	10%		10 %	20 %	30 %	40 %	50% and above
Index	0.5 and below	0.6	0.7	0.8	0.9	1.0	1.1	1.2	1.3	1.4	1.5 and above

A computed index of less than 1.0 indicates underperformance or below trend whilst 1.0 or above is according to the expected performance or above expected performance respectively. The results of the performance measurement are as given in Tables 3(i) – (iii)

To test the significance of differences in the measured performances three null hypotheses were formulated. These are:

Hypothesis #1

Performance of the building projects funded by 'PMO1' organization does not differ significantly from performance of the projects funded by the 'PMO2" organization. (i. e. H_o ; $\mu_1 - \mu_2 = 0$)

Hypothesis #2

Performance of the building projects funded by 'PMO1' organization does not differ significantly from performance of the projects funded by the 'PMO3" organization. (i. e. H_o ; $\mu_1 - \mu_3 = 0$)

Hypothesis #3

Performance of the building projects funded by 'PMO2' organization does not differ significantly from performance of the projects funded by the 'PMO3" organization. (i. e. H_o; $\mu_2 - \mu_3 = 0$)

Independent *t*-test statistical method was adopted for the test. The *t*- tests were conducted 2-tailed at α-significance level of 0.05. Comparison of the performances was done by Pair-wise analysis. Tables 4 to 6 give results of the test.

The practices engaged in by the organizations to carry out selected project management activities were also identified through the administration of semi-structured questionnaire and interviews as well as documentary analysis. This was to enable us observe the existence of differences in practices from organization to organization and to be able to explain any performance differences.

DISCUSSION

Measured Project Performance

Tables 3(i) – 3(iii) show the results of the measured performance of the building projects obtained under each organization.

Table 3 (i) Measured time performances of projects

Time Performance Index	No. of Projects obtained under:				Percent (%)	Classification
	PMO1	PMO2	PMO 3	Total		
0.5	13	3		16	24.2	Completed behind schedule
0.6	7	12		19	28.8	
0.7		4	8	12	18.2	
0.8	2		7	9	13.6	
0.9		2		2	3.0	
1.0	2	1	5	8	12.1	Completed on schedule
Total	24	22	20	66	100.0	
Mean Index	0.60	0.65	0.81			

Table 3 (ii) Measured cost performance of projects

Cost Performance Index	No. of Projects obtained under:				Percent (%)	Classification
	PMO1	PMO2	PMO3	Total		
0.6	5			5	7.6	Completed above initial budget
0.7	14			14	21.2	
0.8	2			2	3.0	
0.9		12	6	18	27.3	
1.0	3	10	9	22	33.3	Completed as budgeted
1.1			5	5	7.6	Completed below initial budget
Total	24	22	20	66	100.0	
Mean Index	0.73	0.95	1.00			

Table 3 (iii) Measured quality performances of projects

Quality Performance Index	No. of Projects obtained under:				Percent (%)	Classification
	PMO1	PMO2	PMO3	Total		
0.9			10	10	15.2	Below expectation
1.0	10	17	2	29	43.9	As expected
1.1	4	5	5	14	21.2	Above expectation
1.2	10			10	15.2	
1.5			3	3	4.5	
Total	24	22	20	66	100.0	
Mean Index	1.10	1.02	1.05			

The mean indices indicate of the level of the measured performances of projects within each organization. From tables 3(i) and 3(ii) the time and cost performances of PMO3 projects are better than the other two organizations. Also the time and cost performances of PMO2 projects are better than that of PMO1 projects. Table 3(iii) however shows that the quality performance of projects funded by PMO1 is better than that of projects funded by the other two organizations whilst the quality performance of PMO3 projects is better than that of PMO2 projects. The significance or otherwise of theses performance differences are have been determined in Tables 4 - 6

Table 4 Independent Samples T-Test with Time performance as Test Variable

Grouping Variable	t-test for Equality of Means				Conclusion	Decision
	$t_{\alpha/2,m+n-2}$	T	Df	Sig. (2-tailed)		
'PMO1' and 'PMO2' Organizations	2.021	-1.294	44	0.202322	Fail to Reject Null Hypothesis	Time Performance difference NOT SIGNIFICANT
'PMO1' and 'PMO3' Organizations	2.021	-5.101	42	0.000008	Reject Null Hypothesis	Time Performance difference SIGNIFICANT
'PMO2' and 'PMO3' Organizations	2.021	-4.117	40	0.000187	Reject Null Hypothesis	Time Performance difference SIGNIFICANT

The test results in table 4 imply that, following from table 3(i), the time performances of the PMO3 projects are significantly better the other two organizations.

Table 5 Independent Samples t-test with Cost performance as Test Variable

Grouping Variable	t-test for Equality of Means				Conclusion	Decision
	$t_{\alpha/2,m+n-2}$	T	Df	Sig. (2-tailed)		
PMO1 and PMO2 Organizations	2.021	-8.04176808	44	3.5138E-10	Reject Null Hypothesis	Cost Performance difference SIGNIFICANT
PMO1 and PMO3 Organizations	2.021	-8.76774276	42	4.8821E-11	Reject Null Hypothesis	Cost Performance difference SIGNIFICANT
PMO2 and PMO3 Organizations	2.021	-2.504	40	0.016455	Reject Null Hypothesis	Cost Performance difference SIGNIFICANT

In Table 5, differences in cost performance of all organizations are significant. Thus the cost performance of PMO3 projects is significantly better than the other two and that of PMO2 significantly better than that of PMO1. The only significant difference in quality performance occurs between PMO1 and PMO2 projects. Following from table 3(iii) the quality performance of PMO1 projects are significantly better than PMO2 projects but not significantly better than PMO3 projects.

Table 6 Independent Samples t-test with Quality performance as Test Variable

Grouping Variable	t-test for Equality of Means				Conclusion	Decision
	$t_{\alpha/2,m+n-2}$	T	Df	Sig. (2-tailed)		
‘PMO1’ and ‘PMO2 ‘Organizations	2.021	3.555	44	0.001	Reject Null Hypothesis	Quality Performance difference SIGNIFICANT
‘PMO1’ and ‘PMO3’ Organizations	2.021	1.044	42	0.302	Fail to Reject Null Hypothesis	Quality Performance difference NOT SIGNIFICANT
‘PMO2’ and ‘PMO3’ Organizations	2.021	-0.592	40	0.557	Fail to Reject Null Hypothesis	Quality Performance difference NOT SIGNIFICANT

Potential Practices that could explain Performance Differences

Management practices vary from organization to organization and the performance of the outcomes is what makes a practice optimum (Bryde, 2003). The cause of variation in the PM practices may not be due only to the kind of organization but also the type and purpose of project and most importantly the level of performance desired. (Sharma and Gadenne, 2002). Project performance could differ from organization to organization since different practices could yield different success levels. For instance, PMO3 normally establishes a budget for a particular project from which all payments on the project are made whilst PMO2 make payments on more than one project from a quarterly budget, which is not also usually released on time. According to Choudhurry and Phatak (2004), delayed progress payment is a major cause of construction time overrun. Thus, the nature and source of funds and payments scheduling engaged by a given organization could determine performance level. PMO3 engages in the practice of establishing a budget for a particular project from which payments to builders are made as and when funds are required for the project. On the other hand the other two organizations make payments as and when periodic funds, which are not determined for a given project, are released. With regards to advancing mobilization fund all PMOs do this in different ways PMO1 client rarely advances mobilization fund to contractors. It is a usual practice for PMO2 client to advance mobilization fund to contractors. On the other hand PMO3 client adopts these two practices and implements one or the other based on certain determined circumstances surrounding a given project. Concerning how valuation of works is carried out, contractors on PMO1 projects usually initiate valuation of works for subsequent vetting and approval of consultant. However, within the PMO2 most consultants carry out an entire interim valuation for a contractor after mere request is made irrespective of pre-defined work stage. Most consultants within the PMO3 practice same but not until the work reaches a pre-defined stage. In the process of honouring payment certificates, the client’s organization appoints a team, which cross-checks and endorses claims before contractor receives payment. In the PMO1 and PMO3 these teams are integrated into the organization. Contractors report that this process does not cause delays hence, payment is prompt and they are usually motivated to execute satisfactory work.

CONCLUSION

The measured time performances indicate that averagely, the projects studied were completed behind schedule. Also the determined cost performances indicate that PMO1 and PMO2 projects were completed above initial budget with PMO3 projects being completed as initially budgeted. However, the measured quality performances indicate that averagely, quality levels achieved for the projects studied were not below expectation. The time and cost performances of PMO3 projects are significantly better than the other two organizations. Also the time and cost performances of PMO2 projects are better than that of PMO1 projects. All the organizations show significant difference in cost performance levels of their projects. The only significant difference in quality performance determined occurred between PMO1 and PMO2. These indicate that different practices could have great impact on project performance. The organizations have different ways of carrying out the project management related activities of: Scheduling release of funds for payments; Advancing mobilization fund; Valuation of work done for payments; and Honouring of payment certificates, hence practices generally differed from organization to organization. Due to the strong association between performance and practices, (Sharma and Gadenne, 2002), the difference in the management practices could account for the differences in performances of the projects.

REFERENCES

Amoa-Mensah, K. (2005) Government Development and Poverty Reduction Challenges to the Quantity Surveyor as a Built Environment Professional: An Overview *The Quantity Surveyor*, Issue 3

Baiden-Amissah, P. D. (1999), An Evaluation of the Delivery Performance of ConstructionProjects Funded by the District Assemblies' Common Fund (A case Study of 4 Districtsin Ashanti Region), *Unpublished M Sc. Thesis submitted to the Department of Building Technology*, KNUST

Best, R. and Valence, G. (1999) "Building in Value – pre-design issues", Arnold: London.

Blismas, N G, Sher, W D, Thorpe, A and Baldwin, A N (2004) Factors influencing project delivery within construction client's multi-project environments. *Engineering, Construction and Architectural Management*, **11** (2), 113 -125.

Bryde, D. J. (2003) Project Management Concepts, Methods and Application. *International Journal of operations and Production Management*, 23 (7), 775-793

Bubashit A. A. and Almohawis, S. A. (1994) Evaluating the general conditions of a construction contract. *International Journal of Project Management*, 12 (3), 133-5

Chan, A. P. C. and Chan, A. P. L. (2004) Key Performance Indicators for measuring construction success. *Benchmarking: An International Journal*, 11(2), 203-221

Choudhury, I. and Phatak, O. (2003) Correlates of Time overrun in Commercial Construction. *ASCE Proceedings of the 40th Annual Conference*: Texas A&M University

Collin, J. (2002), "Measuring the Success of Building Projects – improved project delivery initiatives", July 2002.

Cooper, R. (1998), "Benchmarking new product performance: results of the best practices study", European Management Journal, Vol. 16, pp. 1-17

Das, A, Handfield, R B, Calantone, R J and Ghosh, S (2000) A contingent view of qualitymanagement – the impact of international competition. *Decision Sciences*, **13** (3), 649-90

El-Mashaleh, M, O'Brien, W J, and Minchin Jr., R E (2006) Firm performance and information technology utilization in the construction industry. *Journal of Construction Engineering and Management*, 132 (5), 499 – 507.

Gowan Jr, J A, and Mathieu, R G, (2005) The importance of management practices in IS project performance. *The Journal of Enterprise Information Management Systems*, 18(3), 235 – 255

Jawaharnesan, L. and Price, A.D.F. (1997) Assessment of the role of the client's representative for quality improvement. *Total Quality Management*, Vol. 8, pp. 375-89.

Kashiwagi, T. and Parmar, D. (2004) Past Performance Information in the Construction Industry. *ASC Proceedings of the 40th Annual Conference,* Brigham Young University - Provo, Utah April 8 -10, 2004.

Kotnour, T. (2000) Organizational Learning practices in the project management environment. *International Journal of Quality and Reliability Management*, 17 (4/5), 393-406

Loader, K. (2002) What price competition? The management of competitive funding in UK Local Government", *The International Journal of Public Sector Management*, 15 (7), 565-577

Loo R. (2003) A multi-level causal model for best practices in project management. *Benchmarking: An International Journal* 10 (1), 29-36

Mansfield, N.R., Ugwu, O.O. and Doran, T. (1994) Causes of delay and cost overruns in Nigerian construction projects. *International Journal of Project Management*, 12(4) 254 – 260.

Naoum, S. G. (1994) Critical Analysis of time and cost of management and traditional contracts. *Journal of Construction Engineering and Management*, 120(3), 687 – 705.

Parfitt, M. K. and Sanvido, V. E. (1993) Checklist of Critical Success factors for Building Projects. *Journal of Management in Engineering*, 9(3), 243-249

Phua, F. T. T. and Rowlinson, S. (2004) How important is cooperation to construction project success? A grounded empirical quantification. *Engineering, Construction and Architectural Management*, 11(1), 45–54.

Ramabadron, R., Dean, J.W. Jr. and Evans, J.R. (1997) Benchmarking and project management: a review and organizational model. *Benchmarking for Quality Management and Technology*, 4, 47-58.

Sadeh, A, Dvir, D, and Shenhar, A (2000) The role of contract type in the success of R and D defence projects under increasing uncertainty. *Project Management Journal*, 31 (3), 14-21.

Serpell, A. and Alarcon, L.F. (1998) Construction process improvement methodology for construction projects. *International Journal of Project Management*, 16(4), 215-221.

Sharma, B and Gadenne, D (2002) "An inter-industry comparison of quality managementpractices and performance", Managing Service Quality, Vol. 12 Iss: 6, pp.394 – 404

Shenhar, A J, Levy, O, and Dvir, D (1997) Mapping the dimension of project success. *Project Management Journal*, 28 (2), 5-13.

Walker, D. H. T. (1995) An investigation into construction time performance. *Construction Management and Economics*, 13, 263 – 274.

Xiao, H and Proverbs, D (2003) Factors influencing contractor performance: an international investigation. *Engineering, Construction and Architectural Management*, 10 (5), 322 – 332.

POST OCCUPANCY EVALUATION OF PUBLIC OFFICE BUILDINGS IN MINNA URBAN: A CASE STUDY OF SOME SELECTED GOVERNMENT PROPRIETIES

Ayoola A. Babatunde[1], Ayo Adeniran[2] and Kemiki Olurotimi[3]

[1,3]*Department of Estate Management, Federal University of Technology, Minna, Nigeria*

[2] *Department of Estate Management Federal Polytechnic, Ado Ekiti, Nigeria*

Since humans spend more than 90% of their lives inside constructed environments and reasonable percentage of their active time in productive activities in such environments like offices, it is fundamental to know how office environments support workers productivity and how best they are satisfied with these environments. Post Occupancy Evaluation therefore has long been recognised as a method of measuring the performance of a building in use as well as provide information for upgrading or improving existing facilities. It is against this backgound that the research examines post occupancy evaluation of public buildings in Minna, Nigeria. The primary method of data collection was an extensive questionnaire combined with physical observation of office environments. The research reveals that there is no significant relationship between quality of office environment and workers productivity. Notwithstanding, there is need for the involvement of workers at design decisions that affect their offices for there to be an enabling environment and perfect job satisfaction by workers.

Keywords: office environment, post occupancy evaluation, workers' productivity.

INTRODUCTION

A building has a significant role in the life of man as it is one of man's basic necessities of life after food in the ranking of his greatest wants. Buildings are notable for the extent to which they are really open to the outside air, a system that could be described to as natural ventilation, but with technological developments, buildings are often sealed tightly with people spending most of their time indoors with some estimates being that humans spend more than 90% of their lives inside constructed environments.(Iyagba, 2005). It follows that if humans spend most of their lives inside buildings, then it is fundermental to note how well buildings match users' needs, and identify ways to improve building design, performance and fitness for purpose.

Post Occupancy Evaluation(POE) is importantly to ensure that buildings are responsive to the changing needs of the occupiers. In a business environment with constant change and routine evaluation in most areas of activity, Post Occupancy Evaluation highlights the importance of design to organisations' marketing, operations and other interests. Evolving laws, market trends and information technology changes the activities of people and therefore the requirements of designs. Evolution of

[1] ayosoye@yahoo.com

[2] ayoadeniran@yahoo.com

[3] kemiki123@yahoo.com

Babatunde, A.A., Adeniran, A. and Olurotimi, K. (2011) Post occupancy evaluation of public office buildings in Minna urban: A case study of some selected government proprieties *In:* Laryea, S., Leiringer, R. and Hughes, W. (Eds) *Procs West Africa Built Environment Research (WABER) Conference*, 19-21 July 2011, Accra, Ghana, 795-803.

environmental ideals for changing ways of life and values is dependent on design practices clearly identifying these changes. Post Occupancy Evaluation provides the dialogue with building users about their ways of life, their values and their environmental ideals.(Watson, 1996).

Formal Post Occupancy Evaluation has its origin in the UK.(Preiser et al, 1988). POE in the 1960s and 1970s involved in individual case studies of public and student housing sector (Vischer,2002; Zimring, Rashid & Kampschroer,2000) in Britain, France, Canada and United States. It then extended to other facilities such as army barracks, hospitals, prisons, courthouses and hospital. By seeing the logical step and beneficiary results from POE, it was later applied to commercial real estate and office buildings by the mid of 1980s. Information from POE has been used by the public agencies in support of the design criteria.(Khalil and Husin, 2009). Its development however in most developing countries is yet to be pronounced. But its potentials in countries like Nigeria, South Africa and Ghana to name a few with large population and urban settlements that require facilities to satisfy their commercial, residential, industrial and recreation needs should be canvassed.

Ironically, POE has suffered almost 40 years of continued neglect in Uk where it originated from.(Carthey, 2006 citing Cooper, 2001). However, in the last decade, there has been renewed interest in POE fuelled by the emergence of facilities management as a major discipline in the procurement and management of buildings (Carthey, 2006 in Preiser, 1995; Baird, 1996; Cooper, 2001; Stanley, 2001). This research work therefore sets out to investigate the effect of some selected public building office environment on the workers satisfaction and suggest essential feedback to inform existing or future actions in building designs.

PROBLEM STATEMENT

Without Post Occupancy Evaluation, the sustainability of buildings in occupation may only be assumed rather than measured. With increased emphasis on sustainable design technologies; comfort and functionality may be compromised which in turn may hinder steps toward sustainability.(Ayoola and Davies, 2006).

Khalil and Husin (2009) were also of the opinion that in our persent-day, peoples' concern is about sustainable environment wherein building occupants seek to obtain comfort and efficiency in their office. They emphasized that occupants' demand is to have priority in terms of comfortability to use and utilize the facilities and services as it must be fit for purpose of user.

Therefore, in measuring building performance, there are three main elements that should concern the evaluator as identified by Wolfgang et al (1988) in Zubairu (2010). Technical elements which is concern with health, safety, stability and security aspects of building performance; Functional elements which has to do with occupants' ability to operate efficiently and effectively; as well as Behavioural elements which bothers on psychological and social aspects of user satisfaction and general well-being.

Workers ability to operate efficiently and effectively forms the major research problem to which this work tends to provide solution.

In an attempt to analyse the main problems of job satisfaction by workers in Minna from the purview of office environment; the pertinent issues are- are the existing facilities? What is the adequacy of space? What is the situation of supporting Infrastructure in public buildings? These are the research problems to which this work tends to provide solutions.

RESEARCH HYPOTHESIS

The hypothesis for this research is a Non-directional two tail hypothesis as stated below;
Ho – There is no significant relationship between the level of workers satisfaction and their working environment
H_1 - There is significant relationship between the level of workers satisfaction and their working environment

THEORETICAL FRAMEWORK

Post Occupancy Evaluation Defined and Similar Studies

There are a number of meanings of Post Occupancy Evaluation(POE), all generally in agreement with, and built around the key subject of the simple statement (Preiser *et al*., 1988) that "post-occupancy evaluation (POE) is the process of evaluating buildings in a systematic and rigorous manner after they have been built and occupied for some time". (Carthey, 2006). Vischer (2001) in Carthey (2006) also defines POE as any and all pursuits that stem from a concern in learning how a building functions once it is built, including if and how well it has met expectations.

POE has been defined by Zimring and Reizenstein (1980) in Khalil and Husin (2009) as examination of the effectiveness for human users of occupied design environment. Khalil and Husin (2009) added that Post Occupancy Evaluation (POE) is one of strategic implementation of analysis on building sustainability after occupancy.

Post Occupancy Evaluation(POE) from the purview of this research work is the systematic evaluation of public buildings or facilities' assumed to occur some time after their occupation.

Khalil and Husin (2009) were of the opinion that POE are typically performed within 4 to 24 months following occupancy of a new or renovated facility and are performed only once for an individual building. However, Watson (2003) in his opinion states that POE can be conducted at any time in the life of a building and it is not necessary to say that it should be conducted in between any time frame.

A POE study conducted by Ayoola and Davies in 2006. Findings revealed that there is statistically significant difference in the area of space required and the area of space available to staff in the Minna NTA complex. The study suggested amongst others that allocation of workplace to the staff should primarily follow the nature of their jobs and assignment and not to be based on positions and ranks. This work though is empirical has only taken into consideration space requirement as a variable of work environments for workers.

Another study conducted by Khalil and Husin (2009) at the golden triangle area in Kuala Lumpur is purposely to determine occupants' satisfaction and perception level in their office building in terms of indoor environment using level of cleanliness, visual comfort, thermal comfort, air movement and noise pollution. The study has shown that majority (much decreased - 40%; decreased – 47%) of the respondents indicated that their work productivity is affected due to poor indoor environments. Improved cooling system, better visual comfort(day lightings) and indoor air movement and ventilation were suggested as ways to mitigate the problems associated with indoor environment in office buildings. This work, however has not been able to show statistically the relationship between work productivity and indoor environment of the occupants.

Types Of Post Occupancy Evaluation(POE)

Van Wagenberg (1989) in Zubairu (2010), identifies four (4) types of POE to include:

(a) Historical Evaluation: This is the most common type of POE. Here the aim is to evaluate the building in retrospect by asking such questions as does the building serve its users effectively? The evaluator has to reconstruct the objectives of the original designers and then determine whether the building actually fulfills these objectives.
(b) Comparative Evaluation: Here two buildings are compared, one changed by some specific action and the other unchanged. Several measures after the change are taken simultaneously in the two buildings which were similar before the change. The differences in the effects are postulated to result from the change.
(c) Longitudinal Evaluation: This is comparative in time. In this type of evaluation, the expected consequences on the building are clearly stated before a change is made and they are used as a yardstick to take baseline measures. After baseline measurement, an action is taken and the effects measured again. Then the outcomes of before and after the action are compared.
(d) Quasi-experimental Evaluation: Measures in a control situation as well as in the experimental situation are taken before and after the intervention by the evaluator. True effects show up in differences of outcome before and after the action as well as in the difference in outcome of the experimental situation and the control situation after the action.

Levels of post occupancy evaluation

The types of POE that Preiser (1989) discusses in much of his work as emphasized by Carthey (2006) in Zubairu (2010) and Office Accomodation Management Framework (2009) have been developed to useful in a range of applications ranging from the investigation of a specific building, through to use for evaluation of an overall program. The types of POE outlined may be summarised as three main approaches:

• Indicative (wide ranging application) – This provides an indication of major failures and successes of a building’s performance. This type of POE is usually covered within a short time varying from several hours to one or two days.

• Investigative (more detailed approach) – Often an investigative POE is conducted when an indicative POE has identified issues that require further investigation. An investigative POE is more time-consuming, more complicated and requires more resources than an indicative POE. The major steps in conducting an investigative POE are identical to those in an indicative POE, however the level of effort is higher. Much more time is spent on the site and more sophisticated data collection techniques are used.

• Diagnostic (extremely detailed and focussed study) – This is a comprehensive and in-depth investigation conducted with a very high level of effort. It generally employs a multi-method strategy including questionnaires, surveys, observations, interviews and physical measurements. The diagnostic POE may take from several months to one year or longer to complete. Its results and recommendations are long-term oriented aiming to improve not only a particular facility, but also the state of the art in a given building type.

Functions of post occupancy evaluation

Zimring et al (2010) citing DGS (2003) stated that the goals of the Post Occupancy Evaluation include;

- To better understand the impact of early design delivery decisions on long-term efficiency and effectiveness of buildings, and
- To better understand the impact of building delivery processes and decisions on customer response both initially and over the life cycle of the building.

Baird et al (1996) in Carthey (2006), notes the benefits of evaluation, which suggest a range of purposes for carrying out a POE which include;

- Better matching of demand and supply
- Improved productivity within the workplace
- Minimization of occupancy costs
- Increased user satisfaction
- Certainty of management and design decision making
- Higher returns on investment in buildings and people.

Carthey (2006) emphasized that most critics appear to be in general accord that Post Occupancy Evaluation is an integral component of the building procurement process, (Marans, 1984; RIBA, 1991; Shepley, 1997; Duffy, 1998; 2001; MARU, 2001; Zimmerman and Martin, 2001; Preiser, 2002) and that evaluation of buildings in-use must provide essential feedback to inform future actions.

Carthey (2006) citing Vischer (2001, p.23) notes that POE may be conducted for a range of purposes and reasons. She considers the main reasons for conducting them that include initiation as "research (Marans and Sprecklemayer, 1981), as case studies of specific situations, (Brill *et al*., 1985) and to meet an institutional need for useful feedback on building and building-related activities (Farbstein and Kantrowitz, 1989). For some public agencies ... POE is a mechanism for linking feedback on newly built buildings with pre-design decision-making; the goal is to make improvements in public building design, construction, and delivery."

RESEARCH METHOD AND DATA COLLECTION

Majority of the public (government) buildings in Minna are situated within Chanchaga local government area. Five (5) federal government buildings, Seven (7) state government buildings and Two (2) local government, giving a total of 14 out of 24 public buildings have been selected for this research work via simple random sampling technique. This work examines the functional elements of building performance which is concerned with occupants' ability to operate efficiently and effectively within their office workplace.

The data for this research is mainly primary in nature. A total of 400 questionnaires were retrieved from the 510 administered questionnaires on the workers across the 14 public buildings. Data as diverse as the level of workers satisfaction, state/condition of working facilities, availability of clinic, sources of electricity and the allocation of work place were extracted from this four hundred (400) workers in the fourteen (14) government owned parastatals and agencies in Minna, Niger State. A descriptive statistics of the variables for this research is as shown in Table 1.

Table 1: Summary of Descriptive Statistics of the Variables

Public Buildings	Level of satisfaction	Space Allocation	State of working facilities	Source of water Supply	Source of electricity	Availability of Clinics
Niger State Water Board	4.50	0.00	3.60	1	1	1
National Library of Nigeria, Minna	4.50	6.00	3.60	0	1	0
Niger state judiciary	7.75	10.00	5.80	1	1	1
Niger state development company	3.75	4.00	2.40	1	1	0
Federal road safety, Minna	7.50	0.00	6.00	1	1	0
Niger state Housing corporation	3.75	0.00	3.00	0	1	1
Magistrate Court, Minna	9.00	0.00	7.20	1	1	1
National Drug Law Enforcement Agency, Minna	3.75	0.00	3.00	1	1	0
Niger State Transport Authority	7.75	10.67	6.20	1	1	1
Chanchaga Local Government Secetariat	12.00	16.00	9.60	0	1	1
Niger State Library, Minna	3.25	4.00	2.60	0	1	1
Federal government secretariat	20.00	0.00	5.40	1	1	0
Nigerian Postal Services, Minna	8.00	7.00	6.60	0	1	1
Zonal Directorate for Education	4.50	6.00	3.60	0	1	0

*Source of electricity equals to 1 if from PHCN,otherwise 0
Source of water supply equals to 1 if from Niger state water board, otherwise 0
Availability of clinics equals 1 if nearby, otherwise 0

Variables such as the level of satisfaction, space allocation and state of working facilities were derived from workers perception and composite ranking of the variables to arrive at their mean values. Conversely, variables such as source of electricity, water supply and availability of clinics take a dichotomous form. In this research, simple backward multiple regression model is employed to determine the relationship between the level of workers satisfaction and working environment using space allocation, state of working facilities, source of water supply and availability of clinics as proxies.The results of the research is presented in the subsequent section.

FINDINGS/ANALYSIS

Working Facilities

Computer, Intercom and Internet constitute the major working facilities available across the sampled public buildings. 55.75% of the respondents rated availability of computer high, and on the other hand internet facility earned a low score of 19.75%. From the responses also, it is clear that the score for the adequacy of working facilities across the sampled public buildings by workers were dwindling with 9.5% as excellent, 24.75% very good, 32% good, 21.25% fair and 12.25% poor. As to how best the working facilities enhance performance of workers, 37.25% of the workers said their productivity had improved by the use of working facilities, 48% indicated that their productivity is fairly enhanced and 14.75% perceived a no effect of the working facilities.

Source of Water Supply

The need for water in office buildings is very fundamental. 58.25% of the workers said water board is the source of their water supply, 27.5% for water Vendor (Mai-ruwa), while both private borehole and well as sources of water accounted for 14.25%. This shows an average effort of government agency responsible for water supply in areas where the selected public buildings are situated.Rather disheartening to find out that reasonable percentage of the workers still depend on water vendors, private bore hole and well for sources of water instead of public mains

Source of Electricity

Power Holding Company of Nigeria(PHCN) and genators are the main sources of electricity across the 14 public buildings sampled. 89.75% of the workers said that PHCN is their source of power, while 10.25% indicated that it was generator. 64.5% of the workers rated electricity from PHCN to be highly frequent as they have electricity everyday. 28.75% rated the frequency to be several days a week, 5.5% rated the frequency to be once a week while 1.25% were highly dissatisfied with the level of electricity supply by PHCN as this percentage hardly have electricity. It has been observed that the state of electricity in the country as a whole is receiving attention.

Availability of Social Infrastructure

The availability of clinics around the sampled public buildings is our pre-occupation here. 43.25% of the workers said clinics are available in close proximity while 56.75% said clinics are not available nearby. In essence, workers that fall in the latter category in cases of feverish systoms will have to leave their offices and in most cases go afar to take care of themselves.

Space allocation

Space management ensures that the quantity and quality of space in a building or buildings meet up to an established standard, so that it is supportive to the changing demands of the organisation through time in a cost effective way. The main issue that often arise with space allocation are the needs of flexibility and adaptability for different users. In this research, 41.25% of the workers rated space allocation to be adequate, 34% said it is inadequate and 24.75% were indecisive.

Level of satisfaction with office environment

19% of workers are highly satisfied with the office environment and 18.75% of workers dissatisfied. 28.75% of the workers sampled are satisfied with their office environment while 33.5% are fairly satisfied.

Relationship between level of workers satisfaction and their work environment

Tables 2 and 3 give the summary of the regression model and ANOVA indicate that P – value of 0.240 is greater than 0.05 level of significance, thus we reject the null hypothesis and accept the alternative hypothesis which states that there is no significant relationship between the level of workers satisfaction and their working environment. Although, the four variables as seen in model 1 of regression model summary table account for 42.6% of the level of satisfaction among workers in the public buildings, these four variables are not significant predictors since P-value of 0.240 as shown in both the regression model summary table and ANOVA table is greater than 0.05 level significance. The unexplained factors can be attributed to other factors.

DISCUSSION

Effective facilities management at work place, specifically public buildings in Minna has been established as non significant in workers' satisfaction. This is contrary to the work of Khalil and Husin (2009) at the golden triangle area in Kuala Lumpur, where majority of the respondents indicated that their work productivity is affected due to poor indoor environments. Similar to general theory of better working facilities leading to high productivity, source of water supply and space allocation in this research contributed 38.5% of the variation in the level of workers satisfaction. This is to say that even though there is no significant relationship between the level of workers satisfaction and their working environment, certain working facilities are still relevant in determining level of workers satisfaction.

Table 2: Summary of the Regression Model

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.653(a)	.426	.171	2.47610	.426	1.671	4	9	.240
2	.634(b)	.402	.223	2.39781	-.024	.378	1	9	.554
3	.620(c)	.385	.273	2.31855	-.017	.285	1	10	.605
4	.509(d)	.260	.198	2.43581	-.125	2.244	1	11	.162

a Predictors: (Constant), Availability of Clinics, Source of water supply, State of working faciilities, Space Allocation
b Predictors: (Constant), Availability of Clinics, Source of water supply, Space Allocation
c Predictors: (Constant), Source of water supply, Space Allocation
d Predictors: (Constant), Source of water supply
e Dependent Variable: Level of Satisfaction

Table 3: ANOVA(e)

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	40.974	4	10.243	1.671	.240(a)
	Residual	55.180	9	6.131		
	Total	96.154	13			
2	Regression	38.659	3	12.886	2.241	.146(b)
	Residual	57.495	10	5.749		
	Total	96.154	13			
3	Regression	37.021	2	18.511	3.443	.069(c)
	Residual	59.133	11	5.376		
	Total	96.154	13			
4	Regression	24.956	1	24.956	4.206	.063(d)
	Residual	71.198	12	5.933		
	Total	96.154	13			

a Predictors: (Constant), Availability of Clinics, Source of water supply, State of working faciilities, Space Allocation
b Predictors: (Constant), Availability of Clinics, Source of water supply, Space Allocation
c Predictors: (Constant), Source of water supply, Space Allocation
d Predictors: (Constant), Source of water supply
e Dependent Variable: Level of Satisfaction

CONCLUSION/RECOMMENDATIONS

The results of this study have confirmed the relationship between the level of workers satisfaction and working environment. It has also highlighted the interdependence of working facilities such as space allocation, state of working facilities, source of water supply, source of electricity supply and availability of clinics. The feedback from workers would indicate that emphasis should also be placed on provision of unexplained factors such as wages/salaries and better social programmes as well as the involvement of workers at design decisions that affect their offices for there to be an enabling environment and perfect job satisfaction by workers.

If source of water supply and space allocation which contributed 38.5% of the variation in the level of workers satisfaction coupled with other factors such as wages/salaries as well as better social programmes are adequately addressed, it is likely that the level of workers satisfaction would increase. Building owners (local, state and federal governments) as a result of the findings of this research should know that attention needs to be directed at future upgrade of internet and water supply so as to ensure that these facilities are adequate and the reasonable expectations of workers are met. The attention the power sector is receiving in the country at the moment is a right step in the right direction. However, efforts should be intensified by the federal government so that adequate power supply in all the states of the federation will be a dream come through. Managers of government public buildings are encouraged to discuss office etiquette on a frequent basis at team meetings. As building designers have building users opinion in an appropriate format, they can reduce guesses about what is important to occupants and the building owners will be able to adjust their practices to suit new buildings.

REFERENCES

Ayoola, A.B and Davies, O.T (2006). Post Occupancy Evaluation of the Nigerian Television Authority, Minna, Niger State. Unpublished Thesis submitted to the Department of Esta Management, Federal University of Technology, Minna.

Carthey, J (2006). Post Occupancy Evaluation: Development of a standardised Methodology for Australian Health Projects, *The International Journal of Construction Management* Department of General Services (2003). Facility Performance Evaluation, State of California.

Khalil, N and Husin, H.N (2009). Post Occupancy Evaluation Towards Indoor EnvironmentImprovement in Malaysia's Office Buildings. Journal of Sustainable Development, Vol.2, No.1

Office Accomodation Management Framework (2009). Undertaking a Post Occupancy Review of Office Accomodation Projects.

Preiser W.F.E., Rabinowitz H.R. and White E.T.(1988). *Post Occupation Evaluation,*Van Nostrand Reinhold Company, New York.

Prieser, W.F.E (1999). *Post Occupancy Evaluation – Conceptual Basics, Benefits and Uses*. Van Nostrand Reinhold Press, New York.

Watson, C.G (1996). *Evolving Environmental Ideas; Changing Ways of Life, Values and Design Practices*. A Paper for IAPS 14 Conference in Stockholm on July, 30.

Zimring, C; Rashid, M & Kampschroer, K (2010). Facility Performance Evaluation. *http://www.wbdg.org/ccb/ ; http://www.wbdg.org/index.php*

Zubairu, (2010). Introduction to Facilities Management, Lecture notes for M.Tech Students, Federal University of Technology, Minna, Niger State, Nigeria.

PUBLIC PRIVATE PARTNERSHIP (PPP) IN HOUSING DELIVERY IN NIGER STATE: CASE FOR LOW AND MEDIUM INCOME EARNERS

Suleiman Bolaji[1]

Quantity Surveying Department, Federal University of Technology, Minna, Nigeria

The problem of providing adequate and qualitative housing for Nigerians, especially the low and medium income groups has been the concern of both the government [public housing developers] and many individuals [private developers] since independence. However, not until recent times, when the world attention is drawn to the practicability of a symbiotic relationship between government policies, plans and programmes and private pragmatic project implementation approach that the PPP became a topical issue. Government of Niger State through its agencies, Niger State Housing Corporation, Niger State Ministry of Housing and Environment etc. has in the past provided houses for the civil servants and general public, but not in sufficient quantities. The paper examines how the low and middle income civil servants fare in the provision of PPP housing in Minna, Niger state capital. A total of three hundred (300) questionnaires were administered to workers of different grade levels in the Federal, State, Local government ministries and parastatals, including police and para-military agencies in Minna. Data obtained were analysed using relative frequency distributions. The result reveals that PPP could be a viable method of mass housing delivery, with modification for peculiarities of the low and middle income earners and that primary mortgage institutions are yet to perform their expected role of providing housing loans to the majority of the civil servants in the state.

Keywords: developer, housing, mortgage, Public Private Partnership, Nigeria.

[1] suleiman264@yahoo.com

Bolaji, S. (2011) Public private partnership (PPP) in housing delivery in Niger State: Case for low and medium income earners *In:* Laryea, S., Leiringer, R. and Hughes, W. (Eds) *Procs West Africa Built Environment Research (WABER) Conference,* 19-21 July 2011, Accra, Ghana, 805-805.

PUBLIC-PRIVATE PARTICIPATION IN HOUSING IN NIGERIA AND THE CASE FOR COMMUNITY PARTICIPATION

Abraham A. Taiwo[1] and Olumuyiwa B. Adegun[2]

Department of Architecture, Federal University of Technology, PMB 704 Akure, Nigeria

Collaboration between the public and private sector towards mass delivery of low-income housing is a relatively new policy initiative in Nigeria. This initiative of partnership has been widely embraced and employed in a number of housing schemes across the country in the recent past. Three of such schemes which represented partnership between state government and private developer and the federal government and private developer were chosen as case studies. They are, Sunshine Gardens and HOB Estate, both in Akure and the Doma road Estate in Lafia. The absence of community/beneficiaries' participation in the schemes was discovered from the study. This absence impinged on the overall performance of these shelter projects. A case was therefore made for community/beneficiaries' participation throughout the stages of the public-private partnership for low-income housing. The advantages of this third partner should be exploited to improve success on the present and future housing schemes.

Keywords: community participation, housing, public-private partnership.

INTRODUCTION

Nigeria is experiencing a high rate of urbanisation. The swelling populace in the rapidly extending cities do not have adequate supply to basic infrastructural facilities especially decent housing. To tackle this deficit, successive governments have evolved various policy approaches to deliver mass and affordable housing for the different class of citizens especially the low-income group. A notable feature in the recent past in terms of delivery mechanism is Public-Private Partnership (PPP). PPP originally entails the provision of public assets and services through collaboration between the government and private sector. Grimsey and Lewis (2005) opined that PPP generally fill the space between traditionally procured government projects and full privatisation. The application of PPP in various sectors of the economy is becoming increasingly popular in Nigeria as well as other developing economies. For housing, PPP has been embraced widely and employed in a number of low-income housing schemes across Nigeria.

Granted that this paradigm of partnership is on course and growing, what kind of arrangement is obtainable on these projects? How do these arrangements include the participation of all necessary stakeholders so as to achieve the goal of delivering adequate, appropriate and affordable houses? This paper delves into the place of

[1] abraham_taiwo@yahoo.com
[2] muyiwaadegun@yahoo.co.uk

Taiwo, A.A. and Adegun, O.B. (2011) Public-private participation in housing in Nigeria and the case for community participation *In:* Laryea, S., Leiringer, R. and Hughes, W. (Eds) *Procs West Africa Built Environment Research (WABER) Conference,* 19-21 July 2011, Accra, Ghana, 807-815.

community/beneficiaries' participation in PPP arrangement for low-income housing in Nigeria.

PRIVATE SECTOR PARTICIPATION IN HOUSING IN NIGERIA

The private sector's participation in housing in Nigeria comprises both the formal and informal segments. Small-scale private landlords in rental housing dominate the informal sector supply of urban housing as noted by Ikejiofor (1997). The greater part of houses produced by this sector are non-conventional, they do not comply with established procedures and are frequently contravening existing legislation, (Olotuah 2005). The formal segment of the private sector constitutes corporate institutions who are involved in direct large scale production and delivery of housing units. The collaborative effort between this sector and the government is generally believed to be beneficial as Li and Akintoye (2003), Austin (2008) among others noted that it enhances government capacity to develop integrated solutions, facilitates creative and innovative approaches thus reducing cost and time spent to implement project, transfers certain risk to the private project partner, attracts larger productivity and more sophisticated bidders to projects while providing avenue to access better skills, expertise and technology.

As a Policy Initiative

Private sector participation has been a highlight in Nigeria's housing policy documents. A shift in policy initiative came in response to propositions by various scholars and stakeholders. Government's earlier direct provider approach have been criticised in terms of meeting the need of target groups, transparency in project implementation, scale of production achieved (Keivani and Werna, 2001), financial constraints, affordability and cost recovery. A new housing policy evolved in 2002 from the document produced by a Presidential Committee on Housing and Urban Development. The extant policy had the primary goal of ensuring that all Nigerians own or have access to decent, safe and affordable housing accommodation. The features of the policy influenced the establishment of certain institutional apparatus such as the Federal Ministry of Housing and Urban Development (FMHUD), restructuring of the Federal Mortgage Bank of Nigeria (FMBN), review of critical laws relevant to housing and so on.

A novel policy feature which is in the direction of serious private sector involvement was the formation of Business Development Department in the Federal Ministry of Housing and the establishment of the Real Estate Development Association of Nigeria (REDAN). The former is the division that deals with partnership issues while the latter is umbrella body of the various individual players(developers) in private sector housing development. State governments across the country also evolved institutional frameworks to facilitate partnership with the private sector.

Public-Private Partnership Model

The model of PPP in housing in Nigeria is largely similar to what obtains in Malaysia, (Abdul-Aziz and Kassim, 2011), Australia (Thomas, 2009) South Korea (Choe, 2002) and India (Awil and Abdul-Aziz, 2006, Segpunta, 2005). Its emergence can be traced to the broader Nigeria National Privatisation Policy and shift towards structural adjustment in the national economy.

Asegiemhe (2007) identified the following operational modes and development process of PPP in housing through his study of Lagos State Property Development Company (LSDPC): a) conception or demand for the project b) site identification c) preliminary development appraisal- feasibility and liability analysis d) development programme e) appointment of professional team f) contract award g) actual construction h) completion and disposal of the project and i) profit sharing.

The private developer is expected to perform all development task- design, finance and construct the housing units. The public sector, that is, government agency would normally contribute the land, provide counterpart funding, and determine the housing type and selling price. Abdul-Aziz and Kassim (2011) outlined the role of public agencies in this form of partnership. They include that of ‘regulator’ (Leung and Hiu, 2005), ‘enabler’ by providing enabling environment for the private developer (Segpunta, 2005), ‘moderator’ by balancing market incentives with community interests, ‘facilitator’ by assisting in project completion and reducing developers risk (Lynch, Brown and Baker, 1999). These are unlike the erstwhile previous ‘provider’ role whereby the government involves itself in direct construction and production of houses (Ogu and Ogbuozobe, 2001). The variety of the roles identified in the former is a function of the level of involvement of the government and other stakeholders especially the beneficiaries. The touted value of community participation makes any arrangement that involves the community of beneficiaries in part or entire project process noteworthy.

COMMUNITY PARTICIPATION IN HOUSING

The idea of community participation has been so widely expressed (Davidson et al 2007) that it may not seem to mean anything clearly distinct anymore. The term ‘Community’ has been used to refer to a neighbourhood, a slum, a group of local NGOs, a group of militant leaders, the residents of a small town, a workers’ union, a group of women, etc. It however depicts a group of people that can benefit from any development project and in this context the terms beneficiaries’ participation and community participation are used to mean the same thing.

A ‘ladder of community participation’ defines a continuum of approaches for how organisations seek community involvement in housing projects. This ladder was originally proposed by Arnstein (1969) and was later modified to fit the context in developing countries by Choguill (1996). (Davidson et al 2007) adapted it from these two authors as shown in Figure 1 below. The ladder depicts that approaches at the top of the ladder empower people in important decision-making roles or offer collaboration with communities, thus promoting community control over the project. On the bottom end of the ladder, beneficiaries may be consulted about their needs and wants (with no assurance that these will be taken into account), merely informed about the shape the housing project will take or even manipulated into taking part in the project. As Choguill (1996) and Arnstein (1969) argue, these cannot really be classified as ‘participation’ because the users will have little or no control over decision-making (Davidson et al 2007).

It is largely accepted that stakeholder participation brings important benefits for construction projects (Chinyio and Olomolaiye, 2010; Friedman and Miles, 2006; Walker et al., 2008). As observed in some African cities (Uduku, 1994), the support of the urban populace is necessary for the development and provision of many aspects or infrastructure services. One possible way of achieving this is through some form of stakeholder partnership, Ogu (2000); and one major stakeholder in a housing project are the beneficiaries.

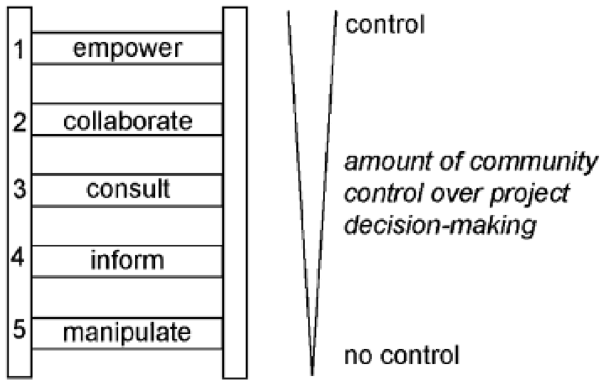


Figure 1. Ladder of Community Participation adapted from Arnstein (1969) and Choguill (1996) by Davidson *et al*., (2007).

RESEARCH METHOD

The method adopted follows the case study methodology. This approach involves careful and complete observation of the concerning unit in minute details and then from the case data generalisations and inference are drawn (Kothari, 2004). Three case studies which represented partnership between state government and private developer and the federal government and private developer were chosen. They are Sunshine Gardens and HOB Estate, both in Akure, Ondo State. The third one is Doma road Estate in Lafia, Nassarawa State. The research involved a longitudinal collection of data from March 2006 to February 2011. The non-chronological sequences of activities involved are:

Visits to low-cost housing projects delivered through PPP. Study and collection of drawings indicating building design and site layout, project report, notes and picture. Non-participant observation also took place which allowed the researchers learn directly from their own experience of the setting.

Visits to offices (out of site) of the project partners. The offices included that of the Federal Ministry of Housing and Urban Development (FMHUD), Ondo State Development and property Company (OSDPC) and other representative of the public and private sector. Collection of data through interview and taking of notes.

Unstructured interviews and informal meetings were held with personnel involved in the project. This cut across public servants who are representing government interest, officers/representative of private developers, contractors and professionals involved in the scheme.

Search for all publications (advertorial, articles, website, and press releases) that relate to any one of the projects studied.

Interactions with some individuals who fall within the beneficiaries/target group of the housing units developed. This yielded information that helped to ascertain the needs, expectation and involvement during the different phases of the projects

Condensation of research results and analytical generalisations as opined by Yin (2003).

Following the case study research method proposed by Proverbs and Gemeson (2008), triangulation method was used to ascertain the integrity of the information collected. Information on the project discussed in case study 3 was derived from Ahmed et al (2010) having utilised similar methods to the ones stated above.

Case Study 1- HOB Housing Estate, Akure, Ondo State

Sometime in August 2005, the Federal government of Nigeria signed MOU with private developers for the construction of housing units across the country. Development of the above estate was undertaken by the real estate arm of HOB Nigeria Ltd in partnership wit Federal Ministry of Housing and Urban Development under the Partnership and Business development programme. HOB is a private company involved in human and infrastructural development, educational advancement, telecommunication, automobiles and housing development. It is a registered member of the Real estate developers association of Nigeria REDAN. The official handing over of the project site by the honourable minister took place on 15 December, 2005 at Igbatoro road Akure. Funding for the scheme it is learnt was from institution lenders with particular reference to the Federal Mortgage bank of Nigeria.

The housing scheme was targeted at the low-income group especially the public servants in the Akure Metropolis. The estate is located directly behind the Federal Secretariat Complex and adjacent to the Nigeria Police State headquarters as well; thus making that area to hold the largest concentration of offices of federal public servants in the state. There are three mode of acquiring any of the dwelling unit. The first is outright payment, then instalment payment within one year and payment through Mortgage finance. Contributors to the National Housing Fund through accredited Primary Mortgage Institution PMI can make installmental payment that span twenty-five years.

New Dimension Consultants, an architectural firm undertook the design for the estate in 2005. The 29.9 hectares of land was designed in 110 blocks and 314 units of 2-bedroom semidetached, 3-bedroom detached and 3-bedroom semi-detached dwelling. Other supporting facilities include school, religious centre, petrol station, administrative building, recreation spaces etc. A scheme is only on its first phase which has seen the construction and delivery of only 3-bedroom detached units. Different building contractors were engaged by the developer to handle construction of the units in this phase. Taiwo and Adegun (2010) reported that less than seventy units of this have actually been delivered in the scheme while others are under construction though no construction work was seen to going on as at the time of their study. Some of those delivered have already been sold, allocated and occupied.

Case Study 2- Sunshine Gardens, Oba Ile, Akure, Ondo State

The Ondo Sate Government through the Ministry of Lands and Housing entered into a strategic partnership wit Locke Homes Ltd, a Lagos-based real estate company in 2009 to develop low-cost housing scheme for the Akure urban populace. The housing estate is located on a land earlier earmarked for housing development which is also beside the existing Oba-ile housing estate. PMG Nig. Ltd undertook architectural design and site layout for the estate in three typologies to a total of 405 dwelling units. Other facilities proposed are sport centre, police post, shopping mall and other communal facilities.

This phase of the scheme was developed in the three typologies - namely Liberty, Diamond, and Starlet. Liberty is 3-bedroom detached dwelling unit with all the rooms en-suite. Diamond is also a three bedroom detached dwelling unit wit only the Master Bedroom en-suite. Starlet is a two bedroom semi detached dwelling unit. There are three mode of payment for any of the unit. The first is outright payment, then instalment payment within one year (10% initial payment, 30% for provisional allocation, and the rest 60%). Payment is also possible through Mortgage finance; that is the National Housing Fund. Other payments include a 5% of the selling price as agency fee and 5% also as VAT.

Case Study 3- 500 Unit Estate, Lafia, Nasarawa State

On inception in October, 2007 the Administration of Governor Aliyu Akwe Doma signed a Memorandum of Understanding (MoU) with CHIPA Nig. Ltd. for the construction of 500 housing units in Lafia, the Nasarawa State Capital through PPP. Chipa Nig. Ltd. was selected out of the numerous bidders due to their track record in similar projects and a strong company profile. The housing scheme was developed in 200 blocks of 3-bedroom detached bungalow and 150 blocks of 2-bedrrom semidetached units. This makes a total of 500 dwelling units. The scheme was targeted at civil servants in the State capital.

The agreement provides that Government will shoulder the following as its contribution to the joint venture: (i) Land with secured tenure, (ii) Access road, Water Supply, Electricity Supply (off and on the site). The State Government secured a 58–hectare piece of land along Doma road, in Lafia for the development. Having paid compensations to the land owners, the land was cleared and handed over to the developer for the commencement of construction. The Certificate of Occupancy (C of O) was also issued the developer to facilitate mortgage transactions. The C of O is under lease tenure of 99 years to be sub-divided among beneficiaries on completion of the housing estate. The remuneration to Government and other parties in the joint venture shall be based on pro-rata of contribution to the total project cost. The State Government signed a contract with a construction company to provide the earlier mentioned infrastructural services for the estate.

The mortgage arrangement will involve the sourcing of NHF loan from the federal Mortgage Bank of Nigeria (FMBN) through a PMI at an interest rate of 6% on behalf of interested civil Servants. The loan would be utilized by the allottee to purchase the houses from the developers. The developer is to secure the facility for the Civil Servants in consultation with the office of the Head of Service and an accredited Primary Mortgage Institution to ensure effective mortgage transaction. The developer's designs and specifications were harmonized with similar designs earlier prepared by Ministry of Works, Housing and Transport to arrive at costs for the 3-Bedroom and 2-Bedroom semi-detached houses.

Absence of Beneficiaries' Input

The study indicated that the organizational structure in the projects excludes the participation of the beneficiary group at the various stages: management, financing, design, construction and assembly of components. It was only an affair between the government ministry/parastatal in charge of housing and the private organization (developer). The Nigeria Labour Congress (NLC) was to stand in for civil servants in the MOU signed for case 3. This community of government workers was however denied participation in the scheme intended for them.

The architectural design and layout of the units did not take adequate cognizance to the 'incremental'[3] characteristic of low-cost housing; a factor which can be addressed with timely and appropriate beneficiaries' participation. There is no permission for external alteration on any of the buildings after they are purchased. Provision for

[3] The incremental factor refers to the evolutionary process (horizontal and vertical expansion of the units) in response to the problem of inadequate space, household dynamics and growth, exploration of economic possibilities.

physical development to accommodate household growth and dynamics is limited to the erection of another structure behind the existing building in the little setback provided at the rear of each building. This is averse to the nature of low-cost housing in a developing economy, it impedes the achievement of self-help initiative and citizen empowerment and does not adduce towards sustainable development.

The entire housing schemes studied are relatively new and the housing units delivered have been barely occupied, the place of community participation at the post-occupancy stages was therefore not looked into. These housing schemes delivered through PPP are devoid of meaningful participation from the beneficiary groups. The same situation applies to majority of the housing scheme delivered through PPP across the states in the country; though the cases discussed above have not been proved to be truly representational. The finding corroborates Taiwo and Adegun (2010) position that although progressive strides are discernable in terms of addition to the existing housing stock, the present arrangement of PPP needs to be fine-tuned to improve affordability, project execution among other issues.

Case for Community Participation

On PPP in housing Segpunta (2005) opined that the government will have to pave the way for a constructive expansion of partnership to include community participation without stifling producer productivity and competitiveness. This will, however require the balancing of market incentives with community interests. Alongside policies, capacity building efforts will be needed to increase awareness and change attitudes to the formation of what Jain (2003) called Public–Private–Peoples Partnerships. The fact is that low-income housing development will require a careful "articulation of multiple participants" (after Lizarralde, 2011) – private, public and communal.

A South African example was noted by Lizarralde (2011) where in order to respond to the difficulties of integrating beneficiaries in the development of subsidized housing, the program adopted a participatory approach called People Housing Process (PHP). Contrary to developer-driven approaches, in PHP housing projects, community based organizations which might take the form of Community Development Co-operatives (McEwan, 2003), lead the process of housing procurement with the support of Community Support Organizations (CSO), which are often NGOs involved in development and community empowerment.

CONCLUSION

PPP has been embraced and employed as a means of delivering housing to the low-income group in Nigeria. The discussions made and cases studied have shown this. Through this arrangement additions have been made to the existing housing stock across the nation's urban centres. The arrangement has however excluded any meaningful participation of the beneficiaries in the implementation of these shelter projects.

It has also become clear that there is need to restructure these partnerships to incorporate beneficiaries input as exemplified in community participation. Community participation in PPP however would not be an end in itself but a means to an end, which is, providing mass, decent and affordable houses. There is no single model for participation that would fit into the different kind of schemes taking place in the country; since there are varying participants and contexts. Further study would then be helpful to determine what kind of participation, at what stage, what kind of input among other variables would help to achieve better housing projects for the low-income group.

ACKNOWLEDGEMENT

The authors are grateful to Dr. Gonzalo Lizarralde of IF Research group, University of Montreal, QC, Canada for making available useful materials for this research.

REFERENCES

Abdul-Aziz, A. R. and John Kassim, P. S. (2011). Objectives, success and failure factors of housing public–private partnerships in Malaysia. *Habitat International.* 35(1) pp 150-157.

Ahmed, M. B., Moohammad, Y. A., and Abubakar, S. U. (2010). Assessing housing delivery in Nasarawa State through the Public–Private Partnership: Focus on 500 housing units in Lafia, Nasarawa State. Paper presented at 1st International Conference, Schl. Of Environmental Tech. Federal University of Technology. Akure. Nigeria. Oct. 23-26.

Arnstein, S. R. (1969). A ladder of citizen participation. *Journal of American institute of Planners,* 35(4).

Asegiemhe, I. A. (2007). A study of Public-private partnership in housing delivery in Lagos State. Unpublished B. Tech. Project. Department of Estate Management. Federal University of Technology. Akure.

Austin P. M. (2008). Public-private partnership for funding affordable housing development in New Zealand. Waitakere City Council Report p 5

Awil, A.-U., and Abdul-Aziz, A. R. (2006). Internationalization of Malaysian housing developers: Case studies from India, South Africa, Cambodia and Australia. Paper presented at the international real estate research symposium (IRERS), Kuala Lumpur, 11–13 April.

Chinyio, E., and Olomolaiye, P. (2010). Introducing Stakeholder Management. *Construction Stakeholder Management*, 1.

Choe, S.C. (2002). The promise and pitfalls of public–private partnerships in Korea, *International Social Science Journal* 54 (172), pp. 253–260.

Choguill, M. B. G. (1996). A ladder of community participation for underdeveloped countries. *Habitat International*, 20(3), 431-444.

Davidson, C. H., Johnson, C., Lizarralde, G., Dikmen, N. and Sliwinski, A. (2007). Truths and Myths about community participation in post-disaster housing projects. *Habitat International.* 31. 100-115.

Friedman, A. and Miles, S. (2006). *Stakeholders: Theory and Practice*. Oxford University Press.

Grimsey, D. and Lewis, M. K. (2005). Are Public Private Partnerships value for money? Evaluating alternative approaches and comparing academic and practitioner views. *Accounting Forum* 25, 345-378.

Ikejiofor U. (1997). The private sector and urban housing production in Nigeria: A study of small-scale landlords in Abuja. *Habitat International.* 21 (4) 409-425.

Jain, A. K. (2003). Actioning new partnerships for Indian Cities. *Cities* 20(5), 353-359.

Keivani, R., and Werna, E. (2001). Refocusing the housing debate in developing countries from a pluralistic perspective. *Habitat International*, 25(2), 191–208.

Kothari, C. R. (2004). *Research Methodology.* New Age Intl. Publishers. p. 7

Leung, B.Y.P. and Hui, E.C.M.(2005). Evaluation approach on public–private partnership (PPP) urban redevelopments, *Intl. Journal of Strategic Property Management* 9(1), 1–16.

Li B. and Akintoye A. (2003). An Overview of Public Private Partnership. Akintola Akintoye, Mathias Beck and Cliff Hardcastle (eds) *Public Private Partnership: Managing Risk and Opportunities*. ISBN 0-632-06465-X), 1-30.

Lizarralde, G. (2011). Stakeholder Participation and incremental housing in subsidised housing projects in Colombia and South Africa. *Habitat International,* 35(2). 175-187.

Lynch, J., Brown, M. and Baker, L. (1999). Public–private partnerships in transitional land and housing markets: case studies from Bulgaria and Russia. In: G. Payne, Editor, *Making common ground: Public–private partnerships in land for housing*, Intermediate Technology Publications, London, pp. 168–192.

McEwan, C. (2003). Bringing government to the people: women, local governance and community participation in South Africa. *Geoforum,* 34, 469-481

Ogu, V. I. (2000). Stakeholders' partnership approach to infrastructure provision and management in developing world cities: lessons from the Sustainable Ibadan project. *Habitat International*, 24, 517-533.

Ogu, V. I. and Ogbuozobe, J. E. (2001). Housing Policy in Nigeria: Towards enablement of private housing development. *Habitat International* 25, 473–492.

Olotuah O.A. (2005). Sustainable Urban Housing Provision In Nigeria: A Critical Assessment of Development Options. Proceedings of the Africa Union of Architects Congress, 23-28 May, Abuja, Nigeria, pp. 64-74.

Proverbs, D. and Gameson, R. (2008). Case Study Research. In A. Kinght and L. Ruddock (Eds.) *Advanced Research Methods in the built environment* pp. 99-121.

Sengupta, U. (2005). Government intervention and public-private partnerships in housing delivery in Kolkata, *Habitat International* 30 (3), pp. 448–461.

Taiwo, A. A. and Adegun, O. B. (2010). Contribution and Challenges of private Sector's involvement in housing in Nigeria: Case study of Akure. *Journal of Housing and Built Environment.* (in the press).

Thomas, H. (2009). The local press and urban renewal: a South Wales case study, *International Journal of Urban and Regional Research* 18(2) pp. 315–333.

Uduku, O. (1994). Promoting community based appropriate approaches to social infrastructure provision in urban areas in Nigeria. *Environment and Urbanisation*, 16(2), 57-78.

Walker, D., Bourne, L., and Rowlinson, S. (2008). Stakeholders and the supply chain. In: *Procurement systems'cross industry project management perspective* (pp. 70-100).

Yin, R. K. (2003). *Case Study: Design and Methods*. Sage.

REGENERATION OF BIOPHILIC ARCHITECTURAL CONCEPTS AND PSYCHOSOCIAL VALUES IN BUILDING DESIGN

Rita Obiozo[1]

Department of Architecture, Enugu State University of Science and Technology, Enugu, Enugu State Nigeria

On reflecting on the various settings and experiences of our lives today, we should be able to find some fairly close matches between characteristics we like that would have improved our chances of survival. In our course we perceive that the natural contiguous keeps us healthy and in turn probably promotes physical performance as well. Occupants of built environment do not want to work, play, eat or sleep in a functional building. They want to be inspired, invigorated, comforted and reassured by their surroundings. We want spaces that will make them more appropriate and comfortable. In sum buildings that celebrate the local microclimate, topology, vegetation, hydrology and material resource. Biophilic Architecture offers an exciting opportunity to achieve environmental, moral and economic benefits. It is an investigation into nature based designs that merge the interior with the exterior; a natural blend between landscape architecture and interior design. Green architecture - an ecostyle that identifies with the characteristic manner of nature referred to as biophilia. It is an investigation into the psycho-evolutionary framework of the origin of shelter. Why is it that some environments heal us while others do not? Conclusively, it will involve breaking up the nature of architectural design of the workspace involving identification of key elements that increase optimal productivity of the occupants of our buildings. The ultimately resulting is a more effective built environment that has both physiological and psychological impact, determining that the design of human communities affect human health and productivity.

Keywords: biophilia, green architecture, therapeutic garden, living building, psychosocial.

[1] ritax2k@gmail.com

Obiozo, R. (2011) Regeneration of biophilic architectural concepts and psychosocial values in building design *In:* Laryea, S., Leiringer, R. and Hughes, W. (Eds) *Procs West Africa Built Environment Research (WABER) Conference*, 19-21 July 2011, Accra, Ghana, 817-817.

REINVENTING PROTOTYPE BUILDINGS: THE SIGNIFICANCE OF PREFABRICATION IN MASS HOUSING CONSTRUCTION

Lateef A.T. Lawal[1]
Department of Architecture, Federal University of Technology PMB 65 Minna, Nigeria

Increasingly, high quality housing remains a problem of the housing industry. Compared to the feat recorded by electronic and automotive industries, most prototype mass housing generally reveal a great deal of variability in the end products. which differs greatly from the original model. The variability is manifested in building components such as walls, floors and finishes, which compromise both quality and uniformity. Prefabrication is considered as a better approach to the production of mass housing. .A number of visits was made to mass housing construction sites in Minna, capital of Niger State, Nigeria to assess discrepancies of work in the prototype buildings. A model prefab system was highlighted and other applications of innovative methods and techniques especially at the Massachusset Institute of Technology (MIT) House_n Research Consortium on open source buildings were discussed. The approach can engender high quality construction, increase standardisation of repetive work and reduce time spent on construction.

Keywords: mass housing, prefabrication, prototype, quality.

INTRODUCTION

In an age where increasingly, it is difficult to have high-quality houses, a need thus arise to explore innovative and unconventional method of housing construction (Singh et al, 1999). There is immense housing shortage that is yet to be constructed globally. Yet, many existing mass housing stocks generally fall short of quality in their erection. According to Singh et al (1999), the world is in short supply of about 200 million dwellings. In Nigeria, the housing stock to be constructed is estimated to be about 16 million (Federal Housing Authority, 2011). Peterside (2005) notes that an average of 1 million housing units will need to be constructed annually to replenish decaying housing stock and to meet rising demand. In effect, this constitutes a gigantic task to be accomplished considering that only about 10,000 housing units are constructed on an annual basis (Adejumo, 2008). The seeming failure of delivering adequate quality housing coupled with the housing shortages requires that new housing construction for the future needs to adopt innovative method and enlightened production management that will detach from the conventional method of production of mass housing.

It is frequently observed that mass housing construction predominantly has a deluge of prototype buildings. Their designs are tailored in manners that reflect simplicity and flexibility. This is important for the simple reason of mass-producing for different owners.

[1] latiadelawal@yahoo.com

Lawal, L.A.T. (2011) Reinventing prototype buildings: The significance of prefabrication in mass housing construction *In:* Laryea, S., Leiringer, R. and Hughes, W. (Eds) *Procs West Africa Built Environment Research (WABER) Conference,* 19-21 July 2011, Accra, Ghana, 819-825.

Fig 1: Prototype buildings in Minna showing variations of building components.
Source: Author Field work, 2011

The aim thus, is to have economies of scale for mass production and save time in construction. Ironically, this is often not the case since a great deal of prototype buildings shows marked variability among the building components such as walls, columns, roofs and finishes: these do not only affect quality but also compromise uniformity among individual building prototype. (For instance, see Figure 1).

This is primarily due to lack of standardisation in the production method as compared to feat recorded in electronic and automotive industries. Incidentally, mass housing construction is still fragmented, resistant to change, labour intensive, inefficient, unresponsive, and slow to embrace new technologies of construction. According to MIT white paper on Open Source Building Alliance (OSBA), the industry is way behind other industries in the adoption of new process and technology innovations. It is thus imperative to examine how prefabrication can help to bring about efficient erection method that promotes high quality production of mass housing in Nigeria's construction industry.

OBJECTIVES

The objectives of this paper are to bring to fore the concept of prefabrication technology that is fast and cost-effective for the production of mass housing in Nigeria. This could further reduce wastages, guarantees accuracy, standardisation, and robust production.

RESEARCH METHOD

The research reported in this paper involves series of visits to mass housing construction sites in Minna, capital of Niger State, Nigeria. Primarily, on the spot physical observations were made involving random survey of the housing units. This paper focused on the elements of physical variability recorded in the housing units such as walls, floors, columns and beams variability. The paper also relies on a literature research covering the Open Building Approach at *Massachusset Institute of Technology (MIT) House_n Research Consortium* for mass housing.

THE CONCEPT OF PREFABRICATION FOR MASS HOUSING

Prefabrication is a method employed for the manufacture of components such as panels or in modules that can be disassembled and transported to site for purposes of construction. Prefabrication's root lies in ancient Egypt as an ingenious method by which boat makers of that era attempted to standardise their craft (McQuaid, 2003). Nevertheless, experimentation by architects and engineers in prefabricated housing systems only began in the late nineteen century and gained momentum after Henry Ford's mass production of the Model T in the early twentieth century (McQuaid, 2003; Batchelor, 1994). McQuaid (2003) describe prefabrication as the manufacturing and assembly of standardised parts prior to construction; these parts are later transported and assembled at a specific site. Thus, a prefabricated construction is "a quick and clean method of construction in which components or groups of components are made under workshop conditions and transported to site for installation. (Jokiniemi and Davies, 2008).

As pointed out by Phillipson (2001), prefabrication, whether full volumetric application or based at component level, need only affect the construction process and not the end-product. The use of prefabrication offers an alternative way to procuring a building, which comes with opportunities and benefits due to change in the construction process. The benefits of using prefabrication include may thus be summarized as follows:

1. Higher quality products for clients;
2. Improved productivity and profitability for contractors;
3. Environmental benefits associated with its use.

However, the quality of construction works by the builders perhaps has not yielded much in terms of expected quality output. This explains a need for prefabrication in which standardisation plays a significant role in mass housing construction. The experience from automotive and electronics industries could be apposite because buildings are also products that people (customers) would buy, rent and expect optimum users' satisfaction

OVERVIEW OF PREFABRICATION IN MASS HOUSING IN NIGERIA

There have been a limited number of mass housing construction sites involving the application of prefabrication. Among the few ones, is the Dolphin Estate in Lagos where precast panels were employed for the construction of the dwelling units (Alade, 2010). Similarly, Olusanya (2003) proposed the first documented prefabricated housing impliedly in the form of interlocking masonry, comprising of 60-unit housing experimented in 1991 at the University of Lagos. The system features a prototype design that represents a "marriage of architecture design, materials and technology" where the product and the process was made as an integral whole.. This effort, although very minimal has developed into an urban housing prototype with public patronage in an industrial scale where a 60-unit housing estate for Home Ownership Scheme of Lagos State Government Staff Housing Board, in Alausa was constructed (Olusanya, 2003). Thus, it offers a strategic approach to housing delivery in Nigeria (Adedeji and Ajayi, 2008). Recently too, a move has been initiated by a firm known as Structuracasa International LLC.construction firm into the Nigerian housing industry with a new building technology aimed to mass-produce housing at reduced cost and increased speed. The technology known as modular system rested on the use of prefabricated aluminum frames for mass housing. (http://www.structuracasa.com) Already, this effort has culminated in the signing of memoranda between the firm and some state governments in Nigeria.. Notably, this system of mass housing has been successfully applied in Mexico, Brazil and elsewhere.The acceptability of this innovation is gaining momentum in India and presents a different approach to modern construction especially for mass housing in Nigeria. Above all, the implementation of prefabrication in Nigeria's construction industry has been very minimal with generally few construction industries showing interest in the use of prefabrication and standardisation techniques aim at improving productivity. There is therefore a need to move towards leaner construction.

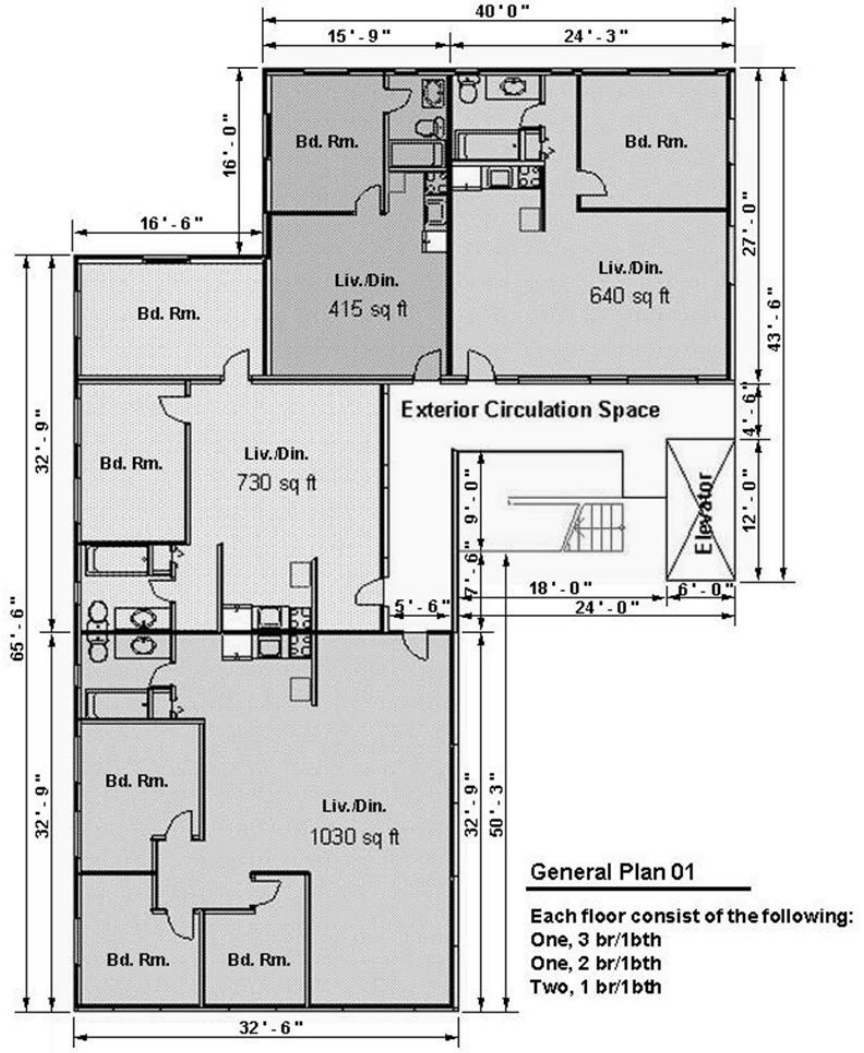
A MODEL PREFAB SYSTEM APPLIED TO CONSTRUCTION

Since the system is firstly developed to tackle much-accustomed problems of quality and standardisation in mass housing construction, therefore it should present a unique set of approaches that aim at providing lasting solution. Singh et al (1999), argued that for a mass housing to be attractive, three parameters have to be present; first is the architectural flexibility; second manufacturing flexibility and third is the erection flexibility. These are vital for an agile production. Further, architectural flexibility is essential so that each dwelling unit can be of different design to address monotony typical of mass housing.

Singh et al (1999) detailed a prefabricated modular housing, which has a fully embedded cam-nut/cam-screw for the joining of concrete components. The approach allows for easy repetition of work tasks for shell erection that can be undertaken using a single crew. The prefabricated system in question has the architectural characteristics of one and two bedroom units or modules arranged on seven storeys. The layout can be used to develop larger units as there is in-built architectural flexibility. The modules can be placed in different locations to cater for various needs. The modules are also standardized to allow for efficient manufacture (Figure 2).

Further in the model, provision of the mechanical joint such as cam-nut/cam-screw for the assembly of walls, floors and columns helps to increase the speed and quality of construction as compared to day-to-day conventional methods. This proves advantageous because there is ease of assembly of component parts that also minimises labour use. The cam-nut/cam-screw was adopted mainly because of its better performance and faster assembly benefit over other methods (Singh, 1998).

The structural characteristics of the system are an all panel system comprising of wall and floor panels, or slabs. The panel consists of 6"thick structural section, a 1.5" thick insulation section and a 2.5"thick facade section. The panels are joined with mechanical joints along the panel's vertical and horizontal edges. The mechanical joints clamp the panels together with sufficient force to allow them to work together as a monolithic element. A gasket is placed between each panel and between the panels and the floor slabs to ensure a weather tight seal.



General Plan Layout After Singh, et al, (1999)

The floor system consists of solid precast floor slabs, designed as one-way slabs. These slabs lie on top of the wall panels and are held in place by passing the cam-screw of the lower wall panel through the floor slab and into the upper wall panel.

CURRENT PREFABRICATION APLLICATIONS IN MASS HOUSING

Recent development in the housing industry suggests new future for the production of mass housing. The applications of prefabrication technology are generally yielding results, notably in the UK and in the United States of America where innovative way of delivering high quality houses has begun. Currently in the UK construction industry, prefabrication is being applied to a wide variety of forms and applications ranging from the simple prefabricated site hut, which has been a long established application, up to volumetric units that can be delivered to site to integrate into the structure of the building (Phillipson,2003). Considerably, the types of prefabrication approaches that can be used include: Volumetric systems; Partial modularization of components; and Prefabrication of elements of the construction. Modularisation or modular design has been described as vital to prefabrication. Modular design refers to construction using standardised units or standardised dimensions. Again, modular buildings do not have to be built using prefabrication techniques, but they are usually involved (Phillipson, ibid)

Further, work by the *Massachusset Institute of Technology* MIT House_n Research Consortium known as *the open prototype initiative* that developed series of four prototypical homes also lends weight to the argument for agile production method in mass housing construction. In the work, they aim to test 'a new model for the design, fabrication, and assembly of highly responsive places of living'. The first prototype referred as 'open 1' has been completed since 2006 at the Crotched Mountain Brain Rehabilitation Center. The project successfully implemented the following:

a. Design and construction employed a library of virtual components that could be combined to form unique structures, with data flowing directly to automated prefabrication processes.
b. The floor, wall and roof systems - complete with power, data, piping, ductwork, and finishes - were prebuilt in a factory.
c. The building consisted of distinct, disentangled and accessible layers that allowed for both efficient assembly and for change over time.

The finished shell, interior fit-out, and mechanical, electrical, and plumbing systems were completed in approximately 30 days.

Dey (2006) opines that open building could be a revolutionary approach to mass housing with the house separated into layers; and each layer has its own life span that determines its need for alteration or maintenance. Importantly, houses need to be viewed as parts that come together during construction and it is only logical to have such parts changed or replaced with much ease if they required so at any stage or life of the building. Thus, this is only possible having a method that integrates enlightened production techniques that combines a tripartite of architectural flexibility, manufacturing flexibility and erection flexibility (Sngh et al, 2003). This is very key to prefabrication.

CONCLUSIONS

In an ever-changing world where everything is all about improvements over what had been done in the past, the housing industry is resistance and unresponsive to change. The introduction of prefabrication for the production of mass housing in Nigeria is however, important in bringing about high quality housing units. It would also engender standardisation and uniformity, which generally is lacking in the conventional approach. Essentially, too, there is a need for the prototype design of mass housing to incorporate architectural flexibility, which assures product variety. The concept of prototype ignores variability to a large extent and should be so for prototype construction. Above all, the Nigeria's housing industry needs to embrace prefabrication for better production agility, reduction of wastage and time saving during construction.

REFERENCES

Adedeji, Y.M.D. & Ajayi, B. (2008) "Cost-effective Composite Building Panel for Walls and Ceilings in Nigerian" 11th International In-organic Bonded Fiber Composites IIBCC Proceeding, November, 5-7 2008 Madrid- Spain. Pp 151-159

Adejumo, A.A (2008) "Some Thoughts on Affordable and Social Housing in Nigeria"

Alade, B. (2010) Paper presentation on "Affordable Mass Housing Delivery: Possibilities within Nigerian Context" 5th Nigerian Real Estate Fair; Eko Hotel Conference Hall, Victoria Island Lagos, 12th October 2010

Batchelor, R. (1994). *Henry Ford: Mass Production, Modernism and Design*

Dey, A (2006) 'Reinventing the House' *Fine HomeBuilding Houses* October/November pp 5863

Jokiniemi and Davies (2008) *Dictionary of Architecture and Building Construction*, Architectural Press, UK pp 292

McQuaid, M (2003) Shigeru *Ban* Phaidon Press Limited, London. pp 152-181

Peterside, C S, 2005. "Ameliorating Housing Deficit in Nigeria ...The Role of Primary and Secondary Mortgage Institutions and the Capital Market". Available online at www.nigeriaworld.com 20 July 2005.

Phillipson, M. (2003) "Defining the Sustainability of Prefabrication and Modular Process in Construction" *Current Practice and Potential Uses of Prefabrication* BRE Environment Division Bucknalls Lane; Garston ,Watford ,WD25 9XX http://projects.bre.co.uk/prefabrication/prefabrication.pdf

Singh, A., Barnes, R, and Yousefpour, A. "High-Turnaround and Flexibility in Design and Construction of Mass Housing" Proceeding IGLC-7 University of California, Berkeley, CA, USA. 26-28 July 1999, Pp 181-194.

REMITTANCES TO GHANA: BENEFITS TO THE HOUSING SECTOR AND IMPACT OF FINANCIAL CRISIS

Noah Kofi Karley[1]
School of the Built Environment, Heriot Watt University, Edinburgh, EH14 4AS, UK

The role of inflow of overseas remittances towards the development of housing sector in Ghana, and the impact of recent financial crisis on the development process is investigated. This is achieved through a review and analysis of information gathered through national and international statistical sources and targeted household and institutional interviews. As a prelude to the analysis the study assessed the importance of remittance as large and growing part of the economic underpinning of developing countries. It then assesses whether remittances have a particular relationship with housing. The research provided an estimate of the nature, level and uses of remittances and the different cyclical characters of other flows. It reveals that the successful real estate market development across Ghana during the past decade benefited from a buoyant national economy, improved financial systems and family remittances. However, the picture changed especially during 2008 attributed mainly to the global financial crisis and economic downturn. The reverberating problems of unemployment and high levels of bankruptcies in the advanced countries were felt but not as pronounced as they were in the major industrialised economies. The discussions concluded by posing a much broader question in relation to other developing countries about how remittances could be mobilised towards the development of the housing sector.

Key words: financial crisis, Ghana, housing sector, migrant remittance.

INTRODUCTION

The Ghanaian economy, like other developing countries depends highly on external financial support. In particular, family remittances play a big part in the economy. The World Bank estimates that total recorded flows of remittances to developing countries reached US$167 billion in 2005 (World Bank 2006). Officially recorded remittance flows to developing countries reached US$316 billion in 2009 down 6 per cent from US$336 billion in 2008. With improved prospects for the global economy, remittance flows to developing countries were expected to increase by 6.2 per cent in 2010 and 7.1 per cent in 2011 (World Bank 2010). These are staggering sums that dwarfs other financial sources, such as official development assistance, bank lending and private investment into developing countries, suggesting that remittances make a powerful contribution to reducing vulnerability at least at the household and local community levels. However, the reverberating problems of unemployment and high levels of bankruptcies in the advanced countries owing to the global financial crisis cannot be overemphasised. One area that could suffer the direct consequences of high levels of

[1] n.k.karley@hw.ac.uk

Karley, N.K. (2011) Remittances to Ghana: Benefits to the housing sector and impact of financial crisis *In:* Laryea, S., Leiringer, R. and Hughes, W. (Eds) *Procs West Africa Built Environment Research (WABER) Conference*, 19-21 July 2011, Accra, Ghana, 827-840.

unemployment, mortgage foreclosure and banking crisis is inward remittances into these countries.

Despite the importance of remittances as outlined above, and their likely impact on welfare (including housing), this relationship has not been sufficiently investigated in Ghana. Thus, the primary aim of this study is to try to fill the knowledge gap by specifically examining how remittance flows can help to improve the housing and home ownership aspiration of households in Ghana. To fulfil this aim the primary objective is to understand the nature, motivation and level of migrant remittances to Ghana and how these are remitted. The secondary objective is to ascertain whether the recent financial crisis had any impact on remittances and thus the housing industry in Ghana. The argument for the secondary objective is that households that receive remittances are able to withstand economic shocks since these inflows serve as a form of "insurance" against income shortfalls.

As a prelude to the analysis, a systematic literature review is carried out comprising an update of academic literature on understanding, motivation as well as impact of remittances. This is followed by analysis of official statistics on remittances flows and channels by which they are remitted. Analysis of household data and institutional interviews is then undertaken. Finally, the impact of recent financial crisis on remittances is assessed and conclusions drawn.

STUDY APPROACH

In order to understand the contributions of remittances to the housing sector in Ghana this research investigates several questions: What are remittances? How are remittances distributed? What channels are used to remit these funds? How are remittances spent? Finally, what are the policy implications on housing sector development of how the money is remitted and used, and effects of the recent financial crisis? In the process of answering these questions this study employed a variety of methods, predominantly desk-based. First, a systematic literature review is carried out comprising an update of academic literature and official statistics on remittances flows. A review and analysis of official statistical information about remittances to Ghana is undertaken. An important source is statistics held by the Bank of Ghana on inward remittances.

For diversity, it is deemed valuable to undertake a number of interviews with residents in the UK to ascertain motivation, use and impact of migrant remittances. The interviews explored experiences with remittances and impact of the recent global financial crisis on remittance flow and thus contribution to the housing industry. Discussions with stakeholder institutions such as developer companies, banks were also undertaken.

STUDY CONTEXT: A LITERATURE REVIEW

There has been much successful real estate market development across Ghana during the past decade as many urban areas benefited from buoyant national economy, improved financial systems, high level of Foreign Direct Investment (FDI) and family remittances from Ghanaians living and working abroad (BoG 2008). Analysts and observers (Asare and Whitehead, 2006; Karley, 2009) agree that the real estate industry has experienced tremendous growth over the past decade. Figures for the past five years and particularly 2007 showed impressive residential property development and activities (Karley 2008), benefiting from, among others migrant remittances from abroad. Karley (2008) estimated that 65 per cent of the clients of private residential property developers in Ghana are Ghanaians living and working abroad.

But the picture has been changing especially after the last quarter of 2007 attributable to the global credit crunch and economic downturn. For example, evidence shows that the construction orders of NTHC Properties, one of the main private residential property developers in Ghana declined by about 15 per cent in 2008 after a constant growth for 5 years (NTHC Properties 2009) although this has started to show signs of growth again from 2010. The Ghana Real Estate Developers Association (GREDA 2009) also indicated that 2009 and beyond have been tough for its members as they experienced unfulfilled stage payments for houses completed.

Understanding remittances and motivation for them

The term 'remittances' can be seen from different perspectives. In simple terms it refers to the money that migrant workers send back to their communities or home countries of origin. Addison (2005) views remittances as financial flows into households that do not require a *quid pro quo* in economic value. Although they can also be sent in kind, the term 'remittances' is usually limited and referred to monetary and other cash transfers transmitted by migrant workers to their families and communities back home. While the motive behind remittances may not be for a direct compensation in return, literature on remittances confirms elements of quid pro quo behind transfers although these may not be immediate or binding. The literature on remittances give several and diverse explanations to motivation for it. These motivations are summarised by Solimano (2003) as (1) altruism motive, (2) self-interest motive, (3) implicit family contract I: Loan repayment and (4) Implicit family contract II: Co-insurance.

The altruistic and self-interest models explained the remittances process from the individual perspective. *The altruism motive* also referred to as livelihoods school of thought considers remitting as an obligation to the household. It argues that remittances are sent out of affection and responsibility towards the family and sending remittances yields a satisfaction to the migrant out of a concern for the welfare of family (Stark 1991). *The Self-Interest Motive* assumes that the migrant is mainly motivated by an economic and financial self-interest. The argument is that the aim of a successful migrant is to save as much money as possible while they are in a foreign country in order to be able to invest back in their home country by buying property, land, financial asserts, and so on.

The literature has also considered the discussion on the remittance process from the family perspective rather than the individual. According to the *implicit family contract I* (Loan repayment) model. The family invests in sponsoring a family member to travel abroad for study or directly for greener pastures with the hope that when they have settled well and start earning the migrant will be able to pay back to the family by remitting. *The implicit family contract II* (Co-insurance) theory argues that remittances occur largely because migration forms part of a strategy for 'livelihood diversification'. The migrant can help to support his family in bad time at home and they in turn can help the migrant in bad times in the foreign country. Migration becomes a co-insurance strategy with remittances playing the role of an insurance claim.

Impact of remittance flow

There has been a growing literature examining how migrant workers' remittances can affect households. Among these studies, some have documented how migrants have contributed to economic and social development in their country of origin. Evidence suggests that remittances from abroad are crucial to the survival of communities in many developing countries. Russell et al. (1990) concluded that after satisfying subsistence needs, migrant remittances are used for investment purposes such as education, livestock, farming, and small scale enterprise. Taylor (1996) has also argued that remittances have multiplier effects that work to increase national income. In a study on Senegal, Diatta and Mbow (1999) found that remittances were a substantial source of revenue for families with migrant members and were also used to promote development in migrants' home communities.

Study by Koc and Onan (2001) examined the impact of remittances on the standard of living of families of emigrants in Turkey and found that remittances have a positive effect on household welfare. Migrant remittances also serve as a source of income for savings and investment, as confirmed by Taylor (1996), and thereby lead to growth and development of an economy. This is corroborated in a study on Mali by Findley and Sow (1998), who report that remittances not only covered basic food and cash needs but also allowed people to pay for irrigation in agriculture. Analysis of household surveys shows that remittances have been associated with significant declines in poverty (headcounts) in several low income countries, including Uganda (11 per cent), Bangladesh (6 per cent) and Ghana (5 per cent). Unlike development assistance transfers which mostly pay for the expensive lifestyles of NGO executives, migrant remittances go directly to family members. They tend to increase at difficult times – during an economic downturn when other private capital flows tend to decrease.

With respect to Ghana, dated back to the late 1960s, Caldwell (1969) investigated the uses of remittances from internal migration in Ghana and found that migrants spent remittances to pay for schooling and wages of farm labourers, and to develop small businesses. Also, a survey conducted by the Sussex Centre for Migration Research in Ghana, particularly in the Ashanti Region in March 2003, identifies three main uses of the remittances. First, remittances are used to satisfy individual needs such as smoothing consumption needs, organizing funerals and meeting other pressing social needs. The second motive is to support social projects in migrants' originating communities. The third motive, less common but perhaps the most important for the promotion of economic development, is for productive investments. Under this third category, the most common objective is for migrants to invest in businesses of their relatives in their home country. A recent study on remittances of Ghanaian emigrants in Sydney, Australia (Obeng-Odoom 2010) also shows that by saving about a third of their incomes, emigrants are able to build houses in their home country Ghana within 3-6 years.

The Bank of Ghana (BoG) also highlighted the significant contributions to national development by remittances from the over one million Ghanaians living and working abroad. In the early 1980s during the period of economic downturn in Ghana, remittances helped the Ghanaian economy greatly, influencing economic policies positively and straightening the economic fundamentals in the economic structural adjustment programme (Acquah 2007). In conclusion, the empirical literature suggests that remittances make a powerful contribution to reducing vulnerability at least at the household and local community levels.

DISTRIBUTION OF REMITTANCES

Remittances by migrants have become an important source of income and foreign exchange for many developing countries. Remittance flow globally currently exceeds US$300 billion, which is greater than the value of official development assistance (ODA). Remittances to developing countries amount to some US$335 billion (Sub Sahara Africa, US$21.6 billion) in 2010 (World Bank 2010). Outlook for remittances flows for 2009-11 indicates a similar trend but quite a big jump in the amounts involved as shown in Table 1.

Table 1: Outlook for remittances flows for 2008-11

US$ billion	2008	2009	2010f	2011*
Developing countries	335.8	315.7	335.4	359.1
East Asia and Pacific	86.1	85.7	94.1	102.7
Europe and Central Asia	57.5	45.6	48.1	51.7
Latin America and Caribbean	64.4	56.5	559.8	64.5
Middle-East and North Africa	34.8	32	33.1	34.5
South Asia	71.7	75.2	78.7	82.8
Sub-Saharan Africa	21.3	20.7	21.6	22.9
Growth rate (%)				
Developing countries	15.90%	-6.20%	6.20%	7.10%
East Asia and Pacific	*20.70%*	*-0.40%*	9.80%	9.20%
Europe and Central Asia	*13.30%*	*-20.70%*	5.40%	7.60%
Latin America and Caribbean	*2.10%*	*-12.30%*	5.70%	7.90%
Middle-East and North Africa	*9.80%*	*-8.10%*	3.60%	4.00%
South Asia	*32.60%*	*4.90%*	4.70%	5.20%
Sub-Saharan Africa	*14.10%*	*-2.70%*	4.40%	5.80%

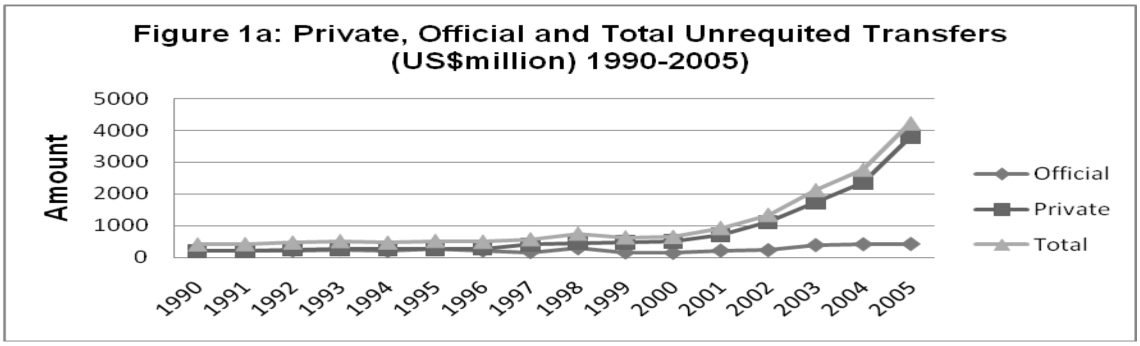
Source: World Bank Migration and Remittances team and Global Development Finance database (2010), *Estimated.

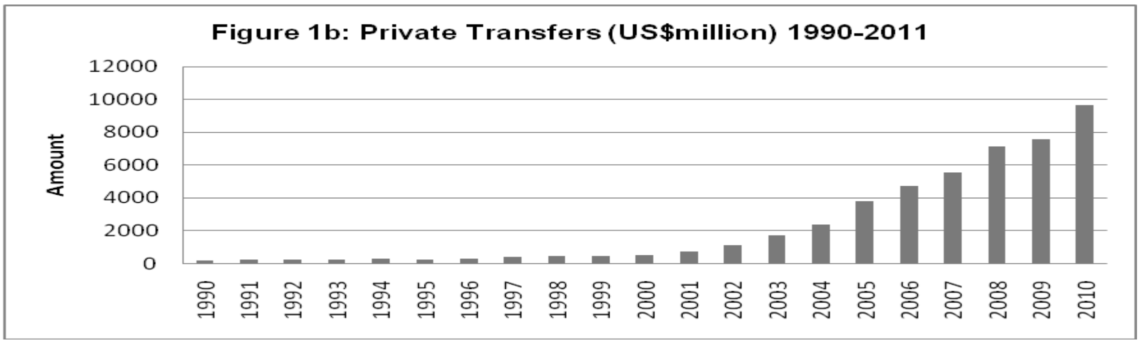
The distribution of remittances to the top recipient developing countries in terms of the share of remittances in GDP in 2008 (Figure 1, expressed in 2008 terms) shows that in these economies remittances exceeded a quarter of the GDP. Data on remittance flows to Sub-Sahara Africa are sparse, but these flows appear to have declined only modestly in 2009. Arguable this provides a lifeline to the poor in developing countries.

Volume of remittances to Ghana

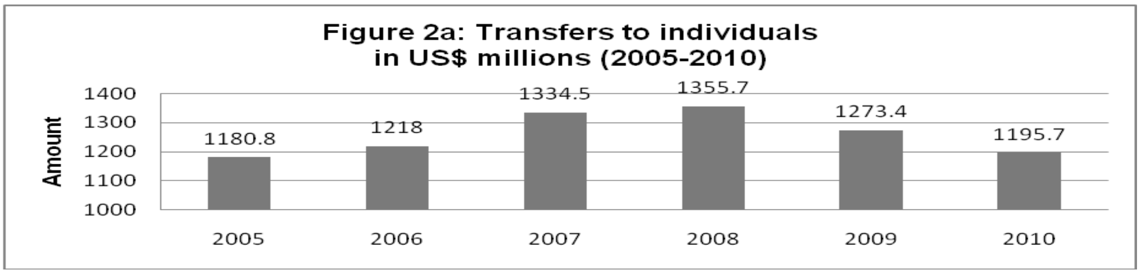
The importance of remittances as a source of foreign exchange is widely acknowledged in Ghana but there is less agreement on the volume of remittance flows coming into the country. According to the BOPs data portrayed in Figure 2a, total transfers to the Ghanaian economy ranged between US$400 million in 1990 and US$935 million in 2001. Of the total transfers, private unrequited transfers increased from US$201.9 million to almost US$718 million in 2001. Over the years private unrequited transfer has gained significant importance in total unrequited transfers. In Figure 1a, while private unrequited transfer jumped up strongly between 2002 and 2005 (from US$1.1 billion to US$3.8 billion), official transfer rather followed a relatively sluggish upward trend during the same period. Recent estimates in Figure 1b show a strong increase in private transfer in 2006 from US$4.7 billion to US$9.68 billion in 2010, which represents 27.8 per cent increase over those for the corresponding period in 2009.

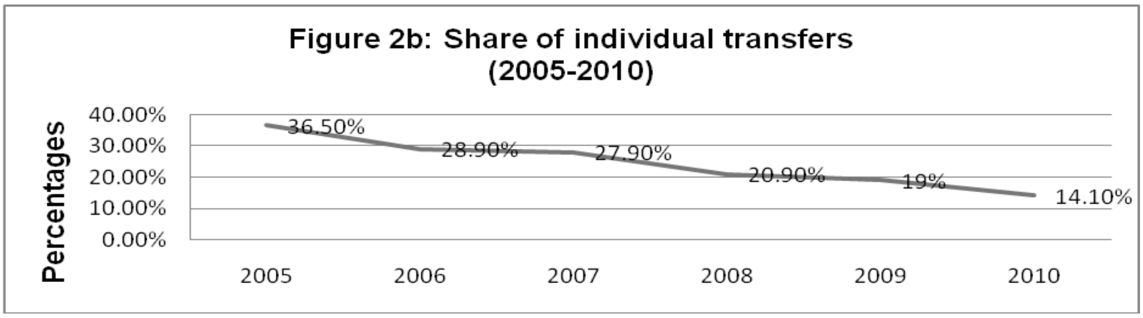
Whiles total private transfers have been increasing, transfers to individuals peaked in 2008 at US$13.6 billion and have since been descending as shown in Figure 2a. The corresponding decrease in share of individual transfers as percentage of private transfers portrayed in Figure 2b continued to decline and down from 36.5 per cent in 2005 to 14.1 per cent in 2010. This could largely be attributed to the recent financial crisis started around end of 2007.





Sources (Figure 1a and b): Data for 1990 to 2001 derived from Bank of Ghana BOP office and 2002 to 2010 from BOG Monetary Policy Report Vol. 4 No.5 (2010)





Sources (Figure 2a-b): Data derived from Bank of Ghana Monetary Policy Report Vol. 4 No.5 (2010)

Channels and uses of remittances

In principle, remittances inflow can be measured in one of three ways. The first approach is the balance of payments estimates, second is micro or household surveys of recipients of such flows, and the third method is through banks or financial institutions in origin countries. Recorded Transfers to Ghana were shown earlier. However, none of these data sets take into account informal remittance flows, which are likely to be substantial. The fact that remittances are transmitted through different channels makes it difficult to capture the full amount in the balance of payment statistics of the recipient country, which tends to underestimate the actual flow of remittances. This problem makes it difficult to come up with strong conclusions on the role remittances play in the economy.

It has not been possible to obtain official data on amount of informal remittances and their uses. So in order to establish how these funds are transmitted and used, data based on interviews, personal observation and other records are explored. In all, 200 Ghanaian migrants based in different regions in the UK were identified through Ghana High Commission and local church sources. They were asked to complete questionnaire and followed with telephone interviews with 10 selected from the sample. Eighty responses or 40 per cent of questionnaire were returned completed, among which 5 respondents indicated they never remitted funds back home since arriving in the UK. The respondents were grouped into two main job categories. Those employed in jobs perceived as skilled are referred to ‘professionals’ in this study; and those unskilled referred to ‘others’. The discussions are based on analysis of findings from the 75 responses received. The questionnaire also sought estimates of income levels, proportions remitted regularly, purpose of remitting, and overall remittance experiences.

Methods of migrant remittances

Migrants remit funds formally through bank transfers and formal money operators such as Western Union and Moneygram. Informal remittances tend to be most significant in countries with relatively undeveloped banking sectors and where trade and exchange-rate restrictions encourage parallel markets and foreign exchange rates.

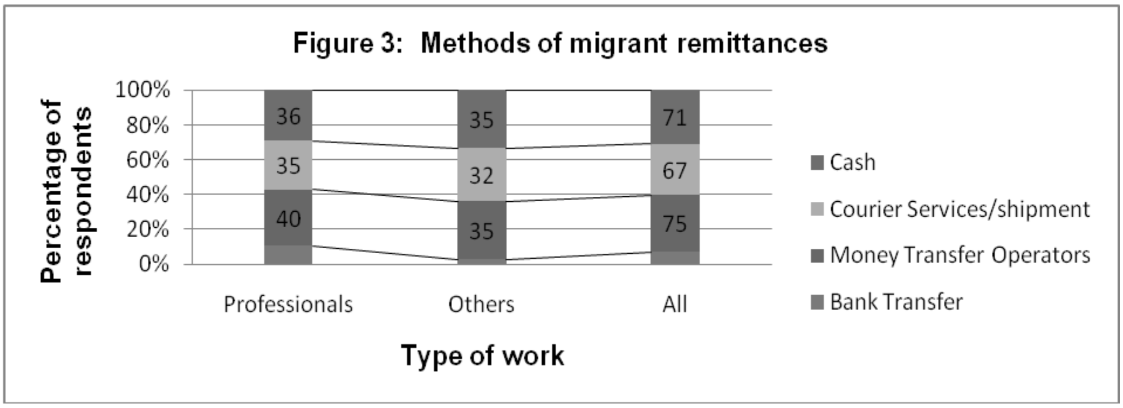
Foreign exchange bureaus

Exchange-rate fluctuations and economic uncertainty allow foreign exchange bureaus (usually referred to as *forex*) to undercut the official exchange rate and benefit from devaluations in the cedi (the Ghana currency) relative to hard currencies. Their competitive rates mean forex bureaus are commonly used for foreign exchange transactions and anecdotal evidence suggests they may also be key players in informal remittance systems in Ghana. They offer better exchange rates than the banks, a main reason for migrants’ aversion to banks and use of informal channels. Informal transfers are often made from so-called “ethnic stores” in the migrant’s country of residence and the money is received at unregulated agencies or forex bureaus in Ghana.

The Figure 3 shows the distribution of respondents by method they use in transferring remittances into Ghana. It also shows distribution of respondents by the type of work they do and how they transmit remittances. All four methods identified are used by migrants in varying degrees. Money transfer operators and cash are extensively used by all types of migrants.

Money transfer operators

This includes both formal and informal operators. There is a wide variety of informal money transfer operators used by Ghanaian migrants to send remittances. The remittance sending operators, working principally from developed countries, are as much a part of informal remittance systems as their receiving counterparts in Ghana. Migrants often prefer to use the transfer services offered by Ghanaian-owned shops or small businesses in their country of residence than banks or "formal" money transfer operators such as Western Union and Moneygram.



Source: Derived from UK-Ghanaian residents survey (2011)

Courier services and cash-in-hand transfers

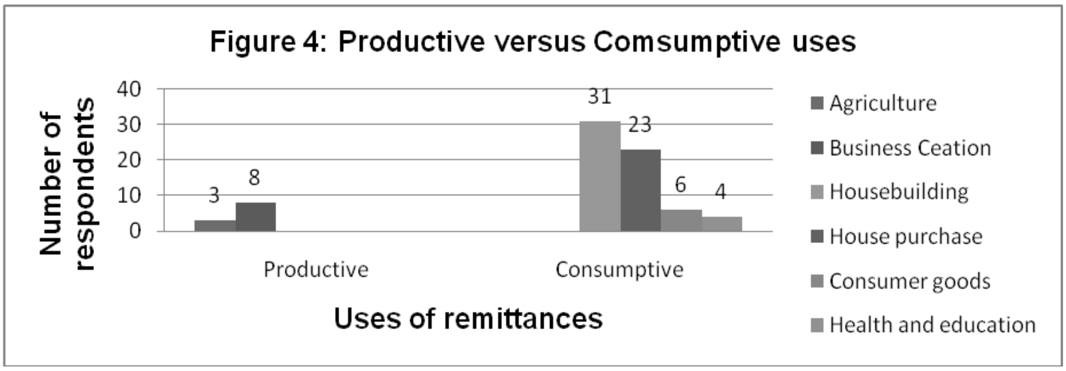
Money and in-kind transfers are carried by hand to Ghana by returning or visiting migrants and by couriers who offer direct money transfer services as a business. Indications are that Africans in general send a greater proportion of remittances through hand-carrying of cash or kind than other migrant groups (Blackwell and Seddon 2004). This may also be true for Ghanaian migrants, as shown by this research, 95 per cent of respondents use this method. The physical transportation of remittances to Ghana includes money transferred in cash or travellers cheques and goods, usually consumer durables, brought into the country by migrants for their families to use or sell to other people. In 2006 the government announced a proposal to tax part of migrant's remittances to pay for physical and social infrastructure associated with housing development and other type of capital projects used by Ghanaian migrants. This triggered a huge debate and encouraged cash-in-hand transfers. These transfers are very difficult to trace and do not enter official estimates of remittance volumes for Ghana.

Research by Tiemoko (2004) suggests that migrants who remit less frequently are more likely to use informal channels. Migrants who send remittances tend do so on a regular basis, but less-skilled migrants were generally found to send remittances more often than élites, and were more likely to remit through formal channels.

How are remittances spent?

The findings on the use of remittances are discussed under two main themes viz., 'productive investment' and 'consumptive investment'. Here, 'productive investment' refers to investment in activities that increase the household's capacity to earn money, this include agricultural production, and the establishment of small businesses. 'Consumptive investment' refers to goods and services that more immediately improve the wellbeing of the household members, this include house building, house purchase, purchase of consumer goods and the payment of health and education expenses. On average most respondents said a third of their incomes are remitted on regular basis for the allocated purposes.

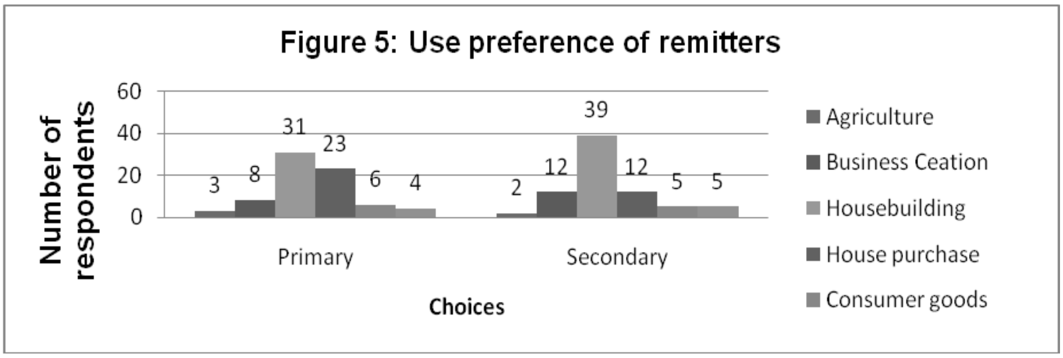
When asked to indicate their use-preferences, it is observed that a small proportion of respondents (14.7 per cent) indicated productive investment as a primary choice, while a vast majority (85.3 per cent) is used for consumptive investment such as house building (41.3 per cent) (see Figure 4). This observation is in line with trends in other developing countries as revealed by de Brauw and Rozelle (2003).



Source: Derived from UK-Ghanaian residents survey (2011)

Agricultural investment

In comparison with other areas of remittance usage, agriculture benefits relatively little from remittances. Out of the total of 75 respondents, only three or 4 per cent indicated agricultural as the primary reason and only 2 respondents indicated it as a secondary reason for sending money home (see Figure 5). The low rate of return to productive capital investment in agricultural in general perhaps discourages investment in such activities. Also, agriculture is often small-scale labour intensive family farming which does not generate need for sophisticated machinery.



Source: Derived from UK-Ghanaian residents survey (2011)

Business creation

According to the survey, business creation was indicated as primary reason for remittances by 11 per cent and secondary reason by 16 per cent of respondents. Although returned migrants who create businesses may not be large in numbers, the fact that some of them are entrepreneurial and have international experience means that their impact on the local economy may be greater than their numbers alone suggest.

House building and house purchase

In common with the families of most migrants the world over (see Lipton 1980; and Mills 1997) a large proportions of remittances to Ghana are used for house building and purchase combined. According to the interviews portrayed in Figure 5, 54 respondents or 72 per cent chose house building and house purchase as the primary reasons for remittances, and 51 respondents or 68 per cent chose it as secondary reason. Activities here include using remittances for house repairs, buying plots, housing construction, outright purchase and/or mortgage repayment. Improvements in accommodation are by no means valuable in enhancing family wellbeing.

In a society such as Ghana where prestige and respect is commanded by material wealth, it is nearly impossible for one to be respected if one does not have a house to show. Thus, using savings and earnings from overseas to build a house is essential for migrants to feel respected in their communities. Building a large house is therefore not simply an ostentatious display by migrant households; it is also a prerequisite for meeting the basic human needs of self-respect and full integration into the society.

It is interesting to note that along with the inflow of cash into the economy and the boom in house construction remittances have acted as catalyst in the emergence of real estate development companies in Ghana. For instance a previous study by Karley (2008) shows that around 65 per cent of customers of major real estate development companies in Ghana are Ghanaians who live overseas and make payments through remittances. In addition, small construction teams in urban areas have emerged and engaged in construction of houses on incremental basis, that is, as and when funds become available presumably including those from remittances.

This observation is consistent with assertion by some respondents who indicated that they approach construction of their dream homes gradually through regularly sending money back home to Ghana. Obeng-Odoom (2010) suggested that by this approach some Ghanaian residents in Sydney, Australia were able to build houses in Ghana within 3 to 6 years period. Whiles this has become a common and appreciable way to achieve the housing aspiration of most migrants; the downside is the emergence of urban sprawling as most have not been able to complete the houses as originally planned. Uncompleted houses are occupied by squatters and turned into slums (own observation).

Consumer goods, health and education

Ten respondents or about 13 per cent chose consumer goods, health and education combined as their primary and secondary reasons for sending money home. In terms of consumer goods remittances help family members back home to pay for everyday items such as soap, matches and clothes as well as contributions toward social events like marriage and funeral ceremonies. As alluded to earlier, instead of cash some remittances are sent in the form of durable modern consumer goods such as cars, Television sets, and other electronics and household effects. According to respondents, health and education expenses place a strain on household budgets and cannot be covered with income obtained through agriculture alone. So they send money to pay for medicines and other health services for children, parents, and other relatives, as well as paying school fees for children, siblings and other relatives. We now turn to discuss impact of the financial crisis on remittances and housing development process.

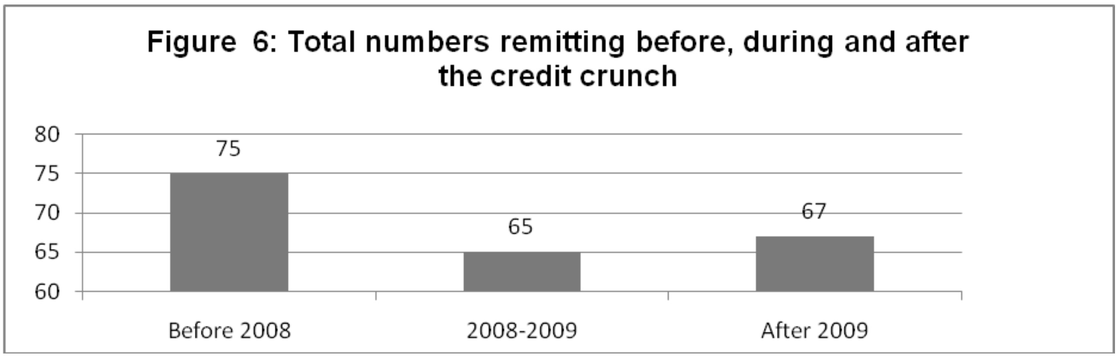
The impact of recent financial crisis

Essentially a financial crisis termed ‘credit crunch’ is a sudden cut in the availability of credit or loans, including mortgages, credit cards and interbank lending as banks worry about a lack of liquidity. In situations where lenders don’t want to lend, borrowers unable to borrow, builders unable to build and buyers unable to buy, economic activities could come to a standstill. This is a simple explanation of very complex set of issues which have been worsening and changing shape since the later part of 2007. The credit crunch affected firms and families in various ways as discussed presently.

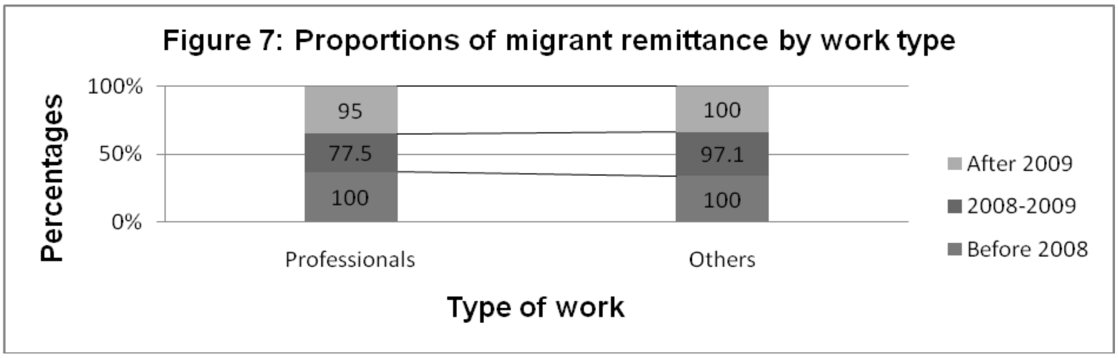
Reduced income and spending on real estate

In many advanced countries the squeeze on consumer as a consequence of the credit crunch, continue to ripple out into the wider economy with expected growth substantially lower than initial forecasts. In any period of economic squeeze, especially with regard to credit, the likely effect is that the economy could run into recession as it occurred in the US, the UK and other European countries during the crisis; low consumption led to low street sales and low business profits, which in turn led to redundancies and unemployment. With unemployment comes, reduced household incomes, which affects household spending, including family remittances. Figure 6 shows the total number of respondent's remittances before, during and after the credit crunch. All the seventy five respondents indicated they have remitted similar proportions before the crisis but this decreased by 13 per cent to 65 respondents during the crisis and increased slightly by only 3 per cent to 67 respondents after the crisis. This observation is somehow consistent with earlier analysis portrayed in Figures 2a and 2b where the official statistics from Bank of Ghana showed shares of individual transfers to Ghana during and after the crisis are lower than before the crisis.

However, the proportion of respondents by type of work (portrayed in Figure 7) remitting before, during (77.5 per cent) and after the crisis (95 per cent) for professionals are lower than those in 'other' group. As earlier alluded to, interviews with NTHC Properties shows a similar trend - reduction in their housing construction orders by 15 per cent during the crisis period, and improved after 2010. This has far reaching implications for long term efforts to promote residential property development where remittances constitute a significant income to families for consumption and for that matter housing development.



Source: Derived from UK-Ghanaian residents survey (2011)



Source: Derived from UK-Ghanaian residents survey (2011)

Declining investment

Borrowers, both retail and corporate are being squeezed by the global financial crisis, which spread as Banks suffered growing losses on mark downs on mortgage backed securities. Before the crisis it was much easier and cheaper in the UK and other advanced economies to obtain bank loans secured or unsecured on homes. These loans could be used for many purposes including financing property purchases abroad. But this has changed due to the decline in the housing market.

Declining housing affordability

Due to the global financial crisis, housing markets have assumed extreme levels of unaffordability as mortgage interest rates have risen and consumers burdened with huge debts. For example, in the UK consumers are burdened with more than £1.5 trillion of debt of which £1.2 trillion is mortgage debt (Parkinson et al 2009). Borrowers now face a much more draconian lending regime which hits all borrowers across the board and not just the subprime. This coupled with expensive mortgages and high deposits means most people (including those with intentions to send remittances to families or invest in properties abroad) are unable to afford properties home let alone remit or invest in properties abroad.

Reduced real estate development activities

Several changes have taken place in construction sector that affected the tenure and availability of jobs, purchases of land and completion of building schemes. Media reports show completed houses remain unsold even after price fell by 10 per cent in certain parts of the UK. In the UK, it is estimated that 200 small-scale house builders failed since late 2007; more than 20,000 newly built private homes lied empty; and about 110,000 builders and craftspeople lost their jobs during the crisis period (Parkinson 2009).

It could be argued that Ghana may be spared the direct effect of the global economic downturn outlined above. However, the same cannot be said of the indirect impact of the downturn. The argument goes as follows: Ghana's economy depends on commodities such as gold, cocoa, bauxite and others whose prices are relatively strong, compared to other periods of economic downturn, like that of the late 1990s. Because of the nature of Ghana's economic integration into the global system – including migrantion - if the global economic malaise continues, rising unemployment, low incomes and cutback on expenditure are likely to affect items such as remittances.

CONCLUDING REMARKS

There is a growing interest in the role of remittances in the Ghanaian economy. This interest has been heightened by the recent increase in the flow of remittances to Ghana. This investigation shows that migrant remittances are useful sources of income to many Ghanaians, particularly in times of economic shock. The importance of migrant remittances is evidenced by the proliferation of money transfer institutions in the country (both formal and informal) and the rapid growth in the volume of such remittances.

The survey shows that a significant proportion of remittances to Ghana are spent on consumptive investment activities, particularly house building and house purchases. The idea to introduce remittance tax may be laudable. But the economic feasibility of its intended policy is doubtful. First, this policy could serve as a disincentive to remit and consequently could derail the housing development process. Secondly, it is susceptible to failure because as the individual always try to maximise their utility and will therefore find alternative ways to remit home without using the official channels. It is therefore economically expedient, and politically wise for policies to direct more remittances through the formal channel instead of a policy that will divert remittances flow away from formal channels to the informal channel.

The recent financial crisis had considerable impact on urban economies, and impacted on the volume of remittances. Given the strong motivation to remit as in case of Ghana, migrants are less affected especially where they are engaged in ‘other’ jobs (by definition not professionals). This should also be seen as very important sources of remittances especially during economic downturn.

Finally, official sources of information on destination and use of household remittances are important in estimating the impact of remittances on housing sector. But it has not been possible to obtain such information. These are some of the difficulties that characterise most developing countries. However, remittances are perceived as useful and formidable sources of achieving the housing aspiration of the populace of many growing urban households and the Ghana case provides useful lessons. Nevertheless, challenges and opportunities facing housing systems in various countries can be distinctive and thus policy initiatives to address them may not necessarily be directly transferable from one economy to another.

REFERENCES

Ahmed, I. (2000) “Remittances and their economic impact in post-war Somaliland (2000)”. *Disasters*, 24(4): 380–9.

Acquah, P. (2007) Governor of the Bank of Ghana on Remittances, *Daily Graphic*, 27 July.

Asare, E and Whitehead, C. (2006) Formal mortgage markets in Ghana:

Nature and implications, RICS Research Paper Series, Vol. 6 Number 13, October, Bank of Ghana (BoG) (2008) Statistical Bulletin, February 2008, Accra.

Blackwell, M. and Seddon, D. (2004) *Informal Remittances from the UK: Values, Flows and Mechanisms.* A Report to DFID by the Overseas Development Group, Norwich, March 2004.

Caldwell, J.C. 1969. *African Rural-Urban Migration: The Movement to Ghana’s Towns*. Canberra: Australian National University Press.

de Brauw, A. and Rozelle, S. (2003) ‘Migration and household investment in rural China’, Department of Economics working paper, Williams College, USA, 29 December.

Diatta, M.A. and N. Mbow. 1999. “Releasing the development potential of return migration: The case of Senegal”. *International Migration*, 37(1): 243–66.

Findley, S. and S. Sow. 1998. “From season to season: Agriculture, poverty, and migration in the Senegal River Valley, Mali”. In R. Appleyard, ed., *Emigration Dynamics in Developing Countries: Sub-Saharan Africa,* pp. 69-144. London: Ashgate Publishing Ltd.

Ghana Real Estate Developers Association (GREDA, 2009) Discussions with President of GREDA, January 2009.

Karley, N.K. (2002) ‘Alternative Options to Mortgages in Ghana’, *Housing Finance International*, Vol. XVII /No.2: 26-30, December.

Karley, N.K. (2007) “An Overview and the Prospects of the Ghana Real Estate Market”, Report submitted to the RICS Education Trust.

Karley, N.K. (2008) "Ghana Residential Property Delivery Constraints and Affordability Analysis", *Housing Finance International Journal* Vol XXII No. 4, June 2008 pp 22-29.

Karley, N.K. (2009) "An Overview and the Prospects of the Ghana Real Estate Market", Royal Institution of Chartered Surveyors Research RICS Research Paper Series, (Forthcoming).

Koc, I. and I. Onan. (2001) "The impact of remittances of international migrants on the standard of Living of the Left-Behind Families in Turkey"."Conference Proceedings, XXIV International Union for the Scientific Study of Population (IUSSP) General Conference, Salvador, Brazil, 18–24 April.

Lipton, M. (1980) 'Migration from rural areas in poor countries: The impact on rural productivity and income distribution' *World Development*, 8 (1): 1 – 24.

Mills, M.B. (1997) 'Contesting the margins of modernity: women, migration and consumption in Thailand' American Ethnologist, 24(1): 37-61.

NTHC Properties (2009) Discussions with Managing Director NTHC Properties, January 2009.

Obeng-Odoom, F. (2010) Urban Real Estate in Ghana: A study of Housing-related Remittances from Australia, Housing Studies, Vol. 25, Issue 3: 357-373.

Parkinson, M., M. Ball and T. Key (2009) 'The Credit Crunch and Regeneration: Impact and implications', Independent Report to the Department of Communities and Local Government.

Russell S.S., K. Jacobsen and W.D. Stanley. (1990) *International Migration and Development in Sub-Saharan Africa*, Volume 2, Country Analyses. World Bank Discussion Papers No.102. The World Bank, Washington, D.C.

Solimano, A. (2003) *Remittances by Emigrants: Issues and Evidence.* WIDER Discussion Paper No. 2003/89. WIDER/UNU, Helsinki, Finland.

Solimano, A. (2003) Workers Remittances to the Andean Region: Mechanisms, Costs and Development Impact *Mimeo* ECLAC.

Stark, O. (1991) *The Migration of Labour*. Cambridge, Basil Blackwell. Sussex Centre for Migration Research in Ghana, 'Research Report on the use of Remittances', Ashanti Region, March 2003.

Taylor, J.E. (1996) "International migration and national development". *Population Index*, 62(2): 181–212.

Tiemoko, R. (2004) *Understanding the Opportunities for and Challenges to Migrants' Investment in Côte d'Ivoire and Ghana*. Africa Regional Sexuality Resource Centre, Lagos.

World Bank (2006) Regular Economic Report on Africa, January 2006, Washington DC.

World Bank (2010) 'Outlook for Remittance Flows 2010-11' *Migration and Development Brief* Development Prospects Group, World Bank April 23.

REVITALIZATION OF NIGERIAN URBAN CENTRES THROUGH EFFECTIVE USE OF OPEN PUBLIC SPACES: A CASE STUDY OF ONITSHA METROPOLIS

Ndidi Okolo[1], Chukwura Okpala, Kelechi Ezeji, Anthony Okolie
Department of Architecture, Anambra State University, Uli, Anambra state, Nigeria

Urban centres in Nigeria have largely experienced congestion due to the pressure of urban expansion, consequent upon uncontrolled population increase and growth. Urban Public spaces as part of urban structure and function constitute areas of physical, social and cultural interaction among urban dwellers. Open public spaces could be natural, communal or designated through government planning and policies. They exist as nodes of connectivity, spaciousness, balance and aesthetics in urban areas. Proper functioning of these spaces should be emphasized in the planning and realization of development schemes in urban areas. This would enhance the revitalization of existing urban centres and create a sense of order and efficiency within the urban fabric. Field work studies have been carried out on open public spaces in Onitsha and presented in this research. This paper examines the case of Onitsha and makes suggestions on revitalization of urban centres through proper utilization of these open public spaces.

Keywords: open public space, Onitsha, urban centre.

[1] ndifred2000@yahoo.com; arc.ndidi@gmail.com

Okolo, N., Okpala, C., Ezeji, K. and Okolie, A. (2011) Revitalization of Nigerian urban centres through effective use of open public spaces: a case study of Onitsha metropolis *In:* Laryea, S., Leiringer, R. and Hughes, W. (Eds) *Procs West Africa Built Environment Research (WABER) Conference,* 19-21 July 2011, Accra, Ghana, 841-841.

SECURITY MEASURES ADOPTED BY ESTATE SURVEYORS SHOPPING MALLS IN KADUNA, NIGERIA

David Ayock Ishaya[1] and Daniel Dabo[2]

[1]*Department of Estate Management, College of Built Environment, H.A. Federal Polytechnic, Kazaure, Jigawa State, Nigeria*

[2] *Department of Quantity Surveying, College of Environmental Studies, Kaduna Polytechnic, Kaduna State,Nigeria*

Agency surveyors have not been able to address the importance of security in shopping malls, as it affects life of customers, tenants and the shopping mall in developing countries. The provision of or availability of security guards in shopping mall attracts shoppers and visitors(window shoppers).This study focus on the security measures put in place by estate surveyors in shopping malls,5 shopping malls were selected for the study base on their location, size and shoppers patronage, using a combination of semi-structured questionnaire and personal interviews targeted at the tenants and managing surveyors, data was collected on the number of guards, measures adopted, equipments being use, size of the shops, rental values, previous security breach, fire incidence if any. Simple descriptive statistics was use in analyzing the data, the results show that the number of security guards and the work hours varies in the shopping malls, the measures adopted was reasonable however the equipment use were not in consonance with global trends also the number of security provided was not base on the size of the shopping malls and the number of shoppers, which contrasts to previous findings. The outcome of this research can help investors and security agencies curb security breach in shopping malls.

Keywords: agency surveyor, security, shoppers, shopping mall, tenant.

[1] idd2010@rocketmail.com

Ishaya, D.A. and Dabo, D. (2011) Security measures adopted by estate surveyors shopping malls in Kaduna, Nigeria *In:* Laryea, S., Leiringer, R. and Hughes, W. (Eds) *Procs West Africa Built Environment Research (WABER) Conference,* 19-21 July 2011, Accra, Ghana, 843-843.

SOURCES OF DEFICIENT INFORMATION REGIME IN URBAN REAL ESTATE MARKETS IN SUB-SAHARAN AFRICAN COUNTRIES

Stanislaus Adiaba[1], Felix Hammond[2], David Proverbs[3], Jessica Lamond[4], and Colin Booth[5]

1, 2, 4, 5 School of Technology, University of Wolverhampton, Wolverhampton, WV11LY, UK
3 Faculty of Environment and Technology, University of the West of England, Bristol, BS16 1QY, UK

Generally, land registration systems of developed countries produce sufficient and reliable real estate market information compared to that of developing countries including Sub-Saharan African countries. The purpose of this paper therefore is to show, on the basis of critical review of focal literature, how the adoption of defective and inefficient approaches to land registration by land registries in Sub-Saharan Africa have undermined the supply of adequate and reliable urban real estate market information compared to their counterparts in developed countries. On the basis of a framework developed from land registration principles in literature, the paper systematically reviews literature to trace the sources of the deficient information regime in Sub-Saharan African land registries. The findings suggest that notwithstanding legal, social, political, and resource constraints and challenges in various countries, defective land registration approaches adopted and being used by most land registries are the primary sources of information asymmetry in Sub-Saharan African urban real estate markets. The findings of the paper have policy implications for land administrators, governments and their international development partners to adopt the appropriate policy approach otherwise, the colossal sums of money being pumped into current land administration reforms in Sub-Saharan Africa and other developing countries could go to waste. The paper brings to focus the problem of land information asymmetry and how the adoption of inappropriate and blunt land registration approaches have contributed to the deficient information regime in Sub-Saharan Africa real estate markets.

Keywords: information asymmetry, land registration, systematic registration, sporadic registration, real estate market, Sub-Saharan Africa.

INTRODUCTION

This paper is an encapsulation of theoretical review of literature on land information systems and its scope is limited to generic principles underpinnings land registration systems. The paper shows how land registration systems contribute to land information asymmetry in Sub-Saharan African urban real estate markets. The paper is part of a doctoral study, which implicates land information asymmetry as the major cause of real estate market failures in many Sub-Saharan African (SSA) countries. The paper therefore through an extensive review of literature traces the sources and

[1] S.Y.Adiaba@wlv.ac.uk
[2] F.Hammond@wlv.ac.uk
[3] David.Proverbs@uwe.ac.uk
[4] J.Lamond@wlv.ac.uk
[5] C.Booth@wlv.ac.uk

Adiaba *et al.* (2011) Sources of deficient information regime in urban real estate markets in Sub-Saharan African countries *In:* Laryea, S., Leiringer, R. and Hughes, W. (Eds) *Procs West Africa Built Environment Research (WABER) Conference,* 19-21 July 2011, Accra, Ghana, 845-859.

causes of the deficient information regime characteristic of land registries in SSA. The paper also contributes to knowledge in this regard for policy consideration. The paper starts with a background to the study and the method for tracing the sources of the information problem. It then discusses the conceptual basis of information asymmetry and land registration. A thorough discussion of land registration systems follows guided by a framework then findings and finally conclusion of the paper.

BACKGROUND TO THE STUDY

The symptoms of market failures caused by information asymmetry are rife in many Sub-Saharan African (SSA) urban real estate markets. Literature substantially report on the symptoms of information asymmetry such as high transaction costs, opportunistic market behaviours and corruption, high overpricing of properties, market uncertainties, dishonesty, and multiple sales of land all evident by increasingly recorded land cases over ownership disputes (Hammond and Antwi, 2010; Ghana LAP Report, 2009 and 2010; Toulmin, 2008; World Bank, 2011; Abdulai, *et al.*, 2007; Mooya and Cloete, 2007; Hammond, 2006 and 2008; Gouth and Yankson, 2000; Kironde, 2000). The predominance of transactions in informal real estate markets as a *prima facie* case of government intervention and formal real estate market failures in many SSA and developing countries have also been significantly reported (Colin, 2009; Rakodi, 2006; Antwi, 2000; Kironde, 2000; Gouth and Yankson, 2000; de Soto, 2000; Fourie, 1998).

Real estate markets are information intensive and depend on the supply of certified information which according to experts in the field must be reliable, accurate, relevant, up-to-date, complete and intelligible (Feenan and Dixon, 1992; Hammond, 2006). To meet these requirements, governments over many years have established and mandated land registries or courts depending on the country (Pas, 2002; Dale and McLaughlin, 1998; Larsson, 1991) to among other functions supply land information as a public good (Deininger, 2003; Palmer, 1998 and Masser, 1998) and to broadly distribute the benefits associated with the information to the entire society (Hammond, 2008). In effect these registries exist to reduce transaction costs by coordinating and disseminating relevant market information. Registries that are discharging their mandate fully and with the appropriate methods have 100% registration coverage. Contrarily, registries that have also adopted blunt approaches that do not coordinate and disseminate information effectively and efficiently are characterised by deficient information regimes. Undoubtedly, the tendency for land registries to deviate from performing their mandates once established has been much anticipated (Stanfield and Lynct, 2009). It is therefore not surprising that land registration and other related land reforms have been high on the development agenda of most governments in developing countries including Africa and their international development partners over decades now (see Sikor and Muller, 2008). Ghana's Land Administration Project (LAP) since 2003 is an example in SSA. It can be argued that the trend of most of these reforms may still deviate from the solution to the market problem. Most of the reforms are aimed at addressing the symptoms of the market problem by advocating for conversion from deeds registration to title registration and touting land registration as guaranteeing security of title instead of as a means of gathering and supplying information. These deviations once they are detected needs to be corrected because the social cost can be high.

In Sub-Saharan African (SSA), the current information supply regime falls short of the real estate market requirements. It has been reported that the most typical feature of urban land market for instance is paucity of information (Kironde, 2000, p.26). This is because land registries as suppliers of the relevant market information are characterised by deficient information regimes. For example, de Vries (2004) citing Fourie (2001) posits that less than 1% of the total land area is administered under formal land registration system in Sub-Saharan Africa. Similarly, Alden Wily (2003, p. 32) cites Augustinus (2003) that ‘less than one percent of the total land area in Sub-Saharan Africa is covered by any kind of cadastral survey and entitlement’. Toulmin (2008) re-emphasises the point that only between 2 to 3% of land ownership have been registered for land markets in West Africa region of SSA. The source and causes of the low registration coverage is not yet fully understood meanwhile various reforms are being implemented to address the secondary problems of the market. This paper therefore through a systematic literature review, traces the sources and causes of the deficient information regime and contributes to knowledge in this regard for policy consideration. The approach adopted in reviewing literature is explained below.

METHOD AND FRAMEWORK FOR LITERATURE REVIEW

The paper adopts a historical comparison approach in reviewing focal literature. This approach provides deeper understanding of the origin and developmental stages of land information systems. The past is reviewed with reference to relevant colonial masters of Sub-Saharan African countries such as Belgium, Britain, Denmark, The Netherlands, France (Dale, 2000; Feder and Noronha, 1987). The present is also reviewed with reference to four Sub-Saharan African countries namely Ghana, Namibia, South Africa and Tanzania (see Table 1). The historical comparison approach is found appropriate in line with Tings *et al* (1999) Worldwide Comparison of Cadastral Trends. The approach is also in line with de Soto’s (2000) argument that the industrialised countries past is the present for many developing countries and admonishes developing countries to learn from the lessons of history. The historical comparison approach in land information systems studies and related fields has been used by Bogaerts (1998), Ting *et al*. (1999), Torhonen (2004) and Enemark (2009).

Additional information was gathered through international land administration systems inventories/surveys such as the Cadastral Template (Steudler *et al*, 2004 and Rajabifard *et al*, 2007), Inventory of Land Administration Systems in Europe and North America (Manthorpe, 2005) and Ting *et al.* (1999) Western Humankind – Land Relationship framework from the tribal period to the present. This was done to gain more insight and information on the historical comparison. The cadastral template according to Steudler *et al.(*2004) is an initial step to gather generic information about cadastral and land administration systems about countries that subscribe to it (see www.cadastraltemplate.org). The significant role of the template in land administration is well acknowledged in literature (Williamson and Ting, 2001; Enemark, 2005 and Enemrk, 2009). The study also, extensively used peer reviewed literature on land information systems and information gathered was used to corroborate and fill gaps in the above mentioned interventional inventory and survey sources.

LAND INFORMATION ASYMMETRY

Land information is very vital for investment decision making and in an ordered society no improvement or transaction in land can be made by a self-serving individual without first and foremost acquiring rights to the land. In Ghana for example, such rights can be obtained either from the state on state lands or from customary landowners as private landowners. The focus of this paper is mainly on how information on these rights particularly on private ownership is coordinated and disseminated through land information systems on condition that these rights have been well defined (see further Abdulai, 2010). In formal real estate markets, self serving individuals would normally not acquire these rights to the land until ownership of the land is ascertained. Formal ownership, however, can only be ascertained from formal sources on condition that the subject land is already surveyed and registered in the official public records (Simpson, 1976; Larsson, 1991). The official public records which are kept in various land registries in different countries may have sufficient or insufficient land information depending on the extent landowners or prospective land owners' part-take in the land registration process. When the official records are characterised by deficient information regimes and cannot adequately supply the required information to users, this results in information asymmetry between parties transacting in the market. This occurs because some market participants are information rich whereas others are information poor hence disproportionate possession of market information among market participants which adversely affects markets transactions and performance.

Generally, the consequences of the information asymmetry on market participants and performance are costly information (Stigler, 1961; Grossman and Stiglitz, 1980), high transaction cost (Coase, 1960; North, 1992), inferior quality goods, dishonesty and market uncertainties (Akerlof, 1970), opportunism and exploitation (Williamson, 1981 and 86), constrained trade volume (Feder and Feeney, 1991), adverse effects on transacting parties and society in general (Clarkson *et al.*, 2007) and property price distortion and efficiency loss in use of property (Hammond, 2006). To this effect, Palmer (1998) posits that land registries acting as information systems reduce information asymmetry. It also leads to uncertainties in market transactions (Bedard, 1986; Poe *et al.*, 1992). In Sub-Saharan African real estate markets, the effects of information asymmetry have been variously reported rather as the problems of the market. These include conflicting and unrecorded ownership claims, multiple sale of the same parcel of land, cost from insecurity of property rights, high transaction costs, lack of information on availability of land and general reliance on communication by word of mouth, considerable possibility of fraud and lengthy negotiations, no general framework for setting prices (Mooya and Cloete, 2007; Omirin and Antwi, 2004; Fekade, 2000; Kironde, 2000; Antwi and Adams, 2003; Antwi, 2002; de Soto, 2000; Gough and Yankson, 2000). These authors have discussed the symptoms of information asymmetry extensively in SSA real estate markets so this paper will not reinvent the wheel but rather focuses on the root cause of the market problem.

In the real world situation, it is not uncommon for self serving individuals who want to acquire lands to make some preliminary investigation about the land or property from the land registries regarding ownership and encumbrances. Firstly, land registries as information repositories and secondly, land registration as component of land information systems according to Palmer (1998) jointly play a vital role in ensuring certainty when it comes to property transactions. Thus land registries in acting as information systems reduce asymmetry of information between the parties in a transaction. Palmer (1998) further argues that a registration system offers security when it provides sufficient and accurate information prior to registration and protection of rights after registration. A registration system however, provides security on condition that the information is current but information can be current only provided people use the registration system (Palmer, 1998). Several factors may contribute to the currency of information and also minimise information asymmetries but this paper investigates the source of the problem in real estate markets particularly in SSA.

LAND REGISTRATION

Land registration is a component of land administration. Land administration according to the UN Economic Commission for Europe (UN-ECE, 1996) Guidelines on Land Administration is "the process of determining, recording and disseminating information about tenure, value and use of land when implementing land management policies. It is considered to include land registration, cadastral surveying and mapping, fiscal and multi-purpose cadastres and land information systems." (see Dale and Mclaughlin,1999; Willimson 2001; Bogaerts *et al*. 2002; Steudler, 2004; Steudler *et al.,* 2004; Bandeira *et al.*, 2010). Land administration functions according to Dale and McLaughlin (1999) can be divided into four components namely juridical component which deals with land ownership; fiscal component deals with land values; regulatory component dealing with land use and finally land information management component which is integral to all the three other components. The juridical, fiscal and regulatory components are traditionally organised around three sets of agencies and each responsible for surveying and mapping, land valuation and land registration (Dale and McLaughlin, 1999). In effect, data processing into information and information management are integral part of all the functions of the three agencies hence the need to trace the land information asymmetry from the point of land information systems.

Land Information System (LIS)

There are several definitions for LIS (see Larsson, 1991) but Dale and McLaughlin (1989) provide a summary that land information systems operation include the acquisition and assembly of data; their processing, storage and maintenance; and their retrieval, analysis and dissemination (see also Bandeira *et al.* 2010; Quinter, 2004; Bedard, 1986). The data may be stored in a manual or digital form although the trend now is that land related records are being computerised for ease of storage and retrieval. Irrespective of the mode of storage, the usefulness of the system depends on how often it is updated, its accuracy, completeness, accessibility, comprehensiveness, understandable and the extent to which the system has been designed for the benefit of the user rather for the producer of the information (Dale and McLaughlin, 1989).

Bedard (1986) asserts that a land information system achieves its goal if it helps to build, verify or improve the users' knowledge of the world without the need for him to directly observe everything. Lemmen and Oosterom (2001) emphasize that the requirements of the modern user of land information systems are faster procedure for land transfer, good access to information, guaranteed and reliable information, faster distribution channels, value for money and fitness for use and tailor made product/information. How this is achieved, however, depends largely on the land registration system which is a component of a country’s land information system and how it works. Tracing the source of land information asymmetries from first principles is thus imperative.

Historical Overview of Land Information Systems

An understanding of the historical context of land registration systems is very crucial in providing insight to challenges facing registration systems and land information systems in various countries in Sub-Saharan Africa and hoe these challenges can be addressed. The need for land records which subsequently transformed into land registration systems evolved from society's relationship with land. Larsson (1991) for example offers two basic historical reasons for land records. These are firstly, the need for the state to know all land units for taxation or other fees and dues and secondly, the need for prospective buyers of land to get publicity for their acquisition of land. According to Dowson and Sheppard (1956) and Larsson (1991) the earliest evidence of official land records for purposes of taxation and other services to the state based on survey of lands dates as far back as 3000 BC in ancient Egypt where such records were kept in the royal registry. These records were arrangements for collection of taxes levied by the Pharaohs and Kings on the farmers**.** Dale and McLaughlin (1989) further corroborate these facts that information systems have been in existence since society adopted sedimentary agriculture as evidenced by the Babylonians when they occupied the lands between the Tigris and the Euphrates and the Egyptians cultivated the fertile Nile regions. As a result of these settlements in the region, the need for land management arose and this in turn led to the development of rudimentary land information systems.

Larsson (1991) mentions similar patterns of land information systems development in ancient Rome during the 3rd Century, in China around 700 AD based on crop yields, in South India around 1000 AD and the famous Domesday Book ordered by William the Conqueror in 1086 (see Plucknett, 2001). With the Doomsday Survey, the whole of England was surveyed within a short time. Similarly, King Gustav of Sweden in 1540 ordered a survey of all taxable farms. The records were intermittently revised and updated and trials were made to include land surveying. The quality of taxation was enhanced by the addition of map information (Larsson, 1991). Napoleon I however, brought real breakthrough when he instituted the French Cadastre in 1807 which also became a model for European countries (Steudler, 2004; Larsson, 1991).

The Frecnh breakthrough has seen significant improvements till date. According to Dale and McLaughlin (1989) the recent examples of LIS include topographical and geographical mapping programmes, valuation and forest inventory surveys, land title survey and land registration systems. The changes are rather in degree and not in principle as what is new are the quantity of data handled, the speed at which data can be processed, and ways in which data can be manipulated, analysed and disseminated as land information. Additionally, the information is produced as a result of land registration functions carried out by government agencies and courts in various countries (Dale and McLaughlin, 1989). Germany according to Enemark (2005) was the first European country to take important steps to introduce registration of title based on cadastral survey as a practice which started in the mid Nineteenth Century and by 1900 it extended to cover the whole of Germany.

The role of Land registration systems

Successful land markets require efficient and up-to-date land registration systems which provide sufficient relevant market information to enable market transactions take place on fairly balanced information among participants in the market. Several benefits are mentioned in literature as benefits of land registration but Ward (2003) cited in Mooya and Cloete (2008) provides some positive outcomes of complete land and property registration in line with conventional wisdom to include;

a) bringing people into market where they can benefit from free sale at full market price;

b) providing security against eviction (legal security of ownership and land rights;

c) raising land value;

d) incorporating residents into the property-owning democracy and citizenry; and

e) providing the incentives to stimulate and invest in home improvements.

Farvacque and McAuslan (1992) contribute that registration and land markets have strong linkages and assert that land registration facilitates the transfer process and subsequently ensure the transparency of the transactions and further provides records for land market operations. Toulmin (2008) concurs that among other perceived benefits land registration provides government with information on land ownership and plot sizes as well as foundation for a property tax system. Ghyoot (1998) contributes that it helps in keeping inventory of national resources.

Dale (1997) posits that a functioning land registration system provides a safe and certain foundation for the acquisition, enjoyment and disposal of rights in land which some person or a group of persons is entitled to. Land registration system must create security not for only landowners and their partners, but also national and international investors, money lenders for traders and dealers as well as governments. Dale (1997) acknowledges further that land registration is increasingly becoming an instrument of national land policy and mechanism to support economic development.

Studies in Sub-Saharan Africa show that the benefits of land registration are not automatic because it may have some adverse effects. For instance Bassett *et al*. (2007) cited in Toulmin (2008) report that in Cote d'Ivoire the process of formalizing land rights led to increased conflict and contributed to the current state of the civil war. What this may imply is that land formalization should be introduced and implemented with careful empirical studies as well as cost and benefit analysis. It is important to mention that there are various and current initiatives towards land registration and titling across Sub-Saharan Africa with the aim of promoting investment, reducing poverty and encouraging natural resource management (Toulmin, 2008). In spite of these initiatives many land registration systems are still not functioning well because they are complex, expensive and slow to implement (Deininger, 2003; Toulmin, 2008). All these can be attributed to the fact that the methods being used are inefficient. There are other land registration options that can be used to improve the system.

Types of Land Registration Systems

Globally, there are basically two types of land registration systems namely the Deeds Registration System and the Title Registration System. (Abdulai and Hammond, 2010; Enemark *et al* 2009; Rajabifard et al, 2007; Enemark 2005; Larsson,1991; Palmer,1998; Zevenbergen, 2002**;** Bittner and Frank, 2002; Karikari *et al*, 2003, Torhonen, 2004; Enemark, 2009**).** The key differences between the two land registration systems relate to the extent of state involvement, cultural development and judicial setting of each country. The cultural and juridical aspect according to Enemark *et al.* (2005) depend on whether a country is based on Roman Law (deeds system) or Germanic or Common Anglo-Law (title system) as well as the country's colonial history. The Deeds system evolved from Roman culture whiles the Title system originated from German culture.

Both Deed and Title systems fundamentally operate under similar principles as they are different solutions to a common problem of determining the legal rights to a parcel of land (Bittner and Frank, 2002). The key difference between the two systems is that under the Deeds System, only the transaction is recorded and provides a register of owners and focuses on "who owns what" whereas under the Title System, the title itself is recorded, secured and focuses on "what is owned by whom" (Enemark *et el*, 2005). Deeds registration system focuses on the recording of legal facts (transactions that has taken place) whereas the Title registration system focuses on the recording of legal consequences (of transactions) and the content of the register are guaranteed by the state. Title System is common in Central European countries for example Germany, Austria, Switzerland whereas the Deeds System is common in Latin cultures in Europe for example France, Spain and Italy, and also in South America, parts of Asia and Africa and in most parts of the United States of America (Enemark, 2005). Palmer (1998) remarks that both title and deeds systems "require similar quality of information in order to function well" consequently it is better to introduce administrative reforms that will improve quality of information rather than to attempt to transform from deeds to title system.

The Title Registration System however has three variants based on the German System (Enemark, 2005; Enemark *et al*. 2005). These variants are peculiarly and found in (i) the United Kingdom, (ii) the Eastern European and Nordic countries and, (iii) the Torrens System which is a special version of title registration developed by Sir Robert Torrens and introduced in Australia in the mid 1800s. The system is practised in Australia, New Zealand, Western states of Canada and in some Asian for example Malaysia, and African countries (Enemark, 2005 and Enemark *et al*, 2005).

The Torrens system was developed in response to the needs of securing land rights of a newly emerging nation-state with vast tracts of unidentified land. It was a legal change in response to society's needs in Australia. It was revolutionary due to its ability to deliver certainty in land ownership as well as cheaper and speedier land registration (Ting *et al*, 1999).

Christensen (2004) cites Birrell *et al*. (2001) and points out that the Torrens System of registration possess five qualities namely certainty, integrity of title, reliability, simplicity and ease of use and economy. It is further argued that the fundamental principle of an indefeasible title guaranteed by the state stems from the fact of the quality of certainty and integrity of title (Whalan, 1982 cited in Christensen, 2004). It therefore follows that once the title is registered for an owner, absolute security of that title is guaranteed to the registered owner. According to Rouff (1952) cited Hanstad (1997) by Sir Tobert Torrens believed that a land register must show the actual state of ownership rather than provide evidence of ownership. Furthermore, Rouff (1952 and 1957) cited in Enemark *et al.* (2005) mention three basic principles of the Torrens System namely the Mirror Principle, Curtain Principle and the Insurance principle. By the Mirror Principle, title mirrors all relevant interests in the land and by the Curtain Principle, title creates a barrier or curtain ensuring that interest off the register need not be searched. Going by the Insurance Principle the state guarantees registered interests in land Christensen (2004).

Principles of land registration systems

According to Steudler *et al.* (2004) there are three generic principles that govern land registration system in almost every country. These principles are;

a) the type of registration system;

b) registration of land ownership; and

c) approach to establishment of the registration records (see also Cadastral Template, 2003).

Based on the above-mentioned registration principles and review of literature the study developed a framework to show the set registration of registration principles that leads to low registration coverage and contributes to deficient information regimes at land registries and information asymmetry in SSA real estate markets (see discussion on approach to establishment of registration that follows from Fig. 1).

Registration system Registration law Approach to registration

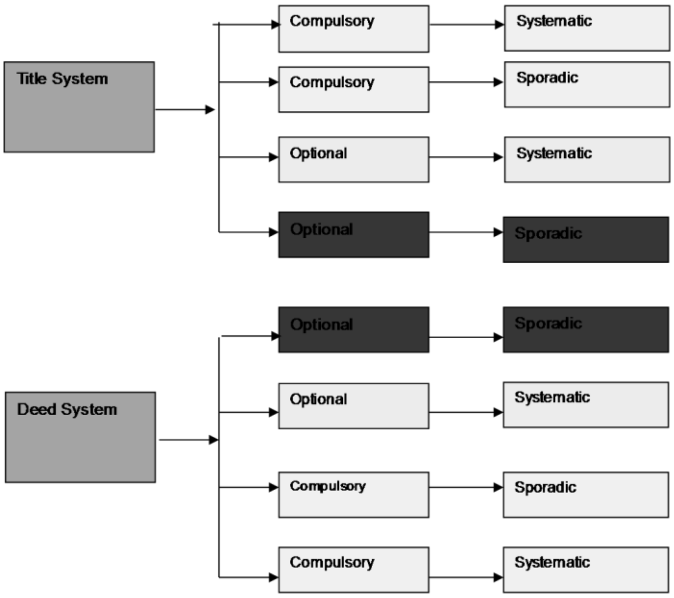


Fig. 1 Framework of Land Registration principles

Principle of Land Registration System

The type of registration system in a country whether based on deed or title system or a variant do not matter much in contributing to information asymmetry. This is because the fundamental principles underpinning both systems are similar but are different solutions to a common problem of determining the legal rights to a parcel of land (Bittner and Frank, 2002). Earlier, Palmer (1998) remarked that both title and deeds systems require similar quality of information in order to function well. Zevenbergen (2002) after a comparative study of four countries including Ghana's land registration system observes that the flaws in the country's Deeds System in terms of technical, organizational and legal aspects should have been corrected rather than introduce Land Title Registration Law of 1986.

There are evidences of countries that have adopted either Deeds or Title Systems and have 100% coverage of registered. Examples of countries operating the Deeds System with such feat are Belgium and the Nerthelands (Cadastral Template, 2003) and countries operating Title System with 100% registration are Germany, Denmark, Sweden, Swizerland, and Korea (Cadastral Template, 2003). On the contrary there are countries that operate either one or both systems but have incomplete coverage. Examples of Deeds System with incomplete coverage are South Africa with 70% urban land registered, Namibia with 60% urban land registered, India 99% and Mexico with 61% urban land registered (Cadastral Template, 2003). Examples of countries operating Title System and their coverage of registered urban lands are

Malaysia 98%, Japan 72%, Tanzania 10% and Portugal with 17,000,0000 parcels out of which 2,055,000 parcels are registered.

It could be deduced from the discussions so far that the extent of coverage of land registration probably influences the sufficiency of information in the records of the registry. The deduction also follows that with registries with 100% registration coverage have sufficient information base and capable of supplying information in an accurate and reliable manner. In line with this Palmer (1998) notes that registration systems offer security if only it provides sufficient information and accurate information as well as protection of rights after registration. The discussion proceeds to the next registration principle which provides slippery ground for information symmetry in Sub-Sahara Africa.

Principle of Registration of Land Ownership

The second cadastral principle pertains to whether registration of land ownership is by law compulsory or optional (Steudler, *et al*., 2004) or voluntary Torhonen, 2004; Larsson 1991). This principle is incentive based in the sense that individuals would like to comply if only the benefits of registration exceeds the costs of no registration. Thus compulsory or optional land registration may depend on a country's social, economic, legal and political environment. For example Bedard (1986) explains that the users of land information systems (LIS) information sometimes in the first place have the choice among LIS to obtain data and secondly, they may themselves observe the reality. The choice of the users among these two options depends on several factors such as time, cost, task requirements to obtain the information and quality of the information offered by the land information system. A land information system like a communication process therefore relies on the feedbacks from its users to continuously modify its functions according to internal and external demands and problems (Bedard, 1986). It is imperative that when the system is fraught with problems and unattractive, potential users may avoid the system and this will contribute to low registration coverage.

In any case, the registration law must be grounded on the culture and land tenure practices of the country for it to gain acceptance by the citizens and their knowledge of the registration laws. Mitchell *et al.* (2008), Feeder and Nishio (1999) point out that one of the factors that may lead to adverse social impact of land registration is the degree of understanding of the landholders of the processes and benefits of land registration. Germany for example has two operational land registration principles based on which the land register enjoys the "public faith". The principles are; (a) changes of rights to land do not take effect before being registered in the land register (b) until otherwise proven, the correctness of all titles on the register is assumed. The laws have been also decentralised and tailored to meet the needs of the various states needs (Steudler *et al.*, 2004 and Cadastral Template, 2003). Conversely, as part of the colonial legacy in Sub-Saharan Africa, Nkuruziza (2008) citing a UNCHS (1999) source indicates that state rules and procedures of land access/use have been variously described as inappropriate, alien, expensive and cumbersome. It is imperative that this state of affairs may not offer the required incentives for compulsory registration let alone optional registration.

Principle of Approach for Establishment of Registration Records

The third registration principle is the approach for establishment of the registration records. This principle provides as to whether land owners are required to register lands systematically or sporadically or both. Registration is said to be sporadic when it is performed upon demand by the individual land holder (Feeder and Nishio, 1999). This review argues further that the approach to land registration may be a major contributory factor to the deficient information regime in land registries and information asymmetry in Sub-Saharan African real estate markets. This stems from the point that four out of the five countries reviewed from the sub-continent appear to have taken the sporadic approach to land registration which extant literature suggests that does not provide incentive for voluntary land registration and has been a failure in past registration practices in some developed economies in most developing countries (Torhonen, 2004; Bogaerts and Zevenbergen, 2001; Hanstad, 1997; Larsson, 1991; Dale and McLaughlin, 1988).

Table1: Selected Land Registration Systems in Sub-Saharan African Countries

Country	*Registration System*	*Registration Law*	*Approach to Registration*
Ghana	Deeds	Optional	Sporadic
Namibia	Deeds	Optional	Sporadic
South Africa	Deeds	Optional	Sporadic
Tanzania	Title	Optional	Sporadic

Source: Based on Cadastral Template (2003) and Literature

Larsson (1991) notes objections to the sporadic approach to registration and cautions that;

a) sporadic approach to registration of titles takes a long time to complete the register;

b) registration costs per unit of land are high; and suggests that

c) systematic registration provides an overview of all the existing parcels and titles within an area.

Feeder and Nishio (1999) concur with Larsson (1991) and espouse that the level of corruption and the degree of understanding by landowners of the benefits of the land registration process are two major factors that may cause adverse social impacts of the approach to registration. It is further argued that the potential for the adverse social impacts is larger when registration and titling are sporadic and when the cost incurred by the individual for registration is high (Mitchell *et al*, 2008). This principle it appears in Sub-Saharan African countries have been largely ignored from the colonial era till the present day. The practices so far have been optional registration of title and the approach has been sporadic (see Table 1 and Framework shown). Instances when the approach has been systematic have not yielded the desired impact. Zevenbergen (2002) comments on Ghana's land title registration which is systematic to have progress slowly since 1986 and further says in practice most first registration has taken the form of more or less sporadic registration. Thus the sporadic concept or principle of registration never works anywhere and may not help SSA countries to achieve full coverage. Unfortunately this is the prevailing method in most developing countries (Torhonen, 2004; Bogaerts and Zevenbergen, 2001; Hanstad, 1997; Larsson, 1991; Dale and McLaughlin, 1988). Figure 2 below shows a graphical example between SSA and western European countries.

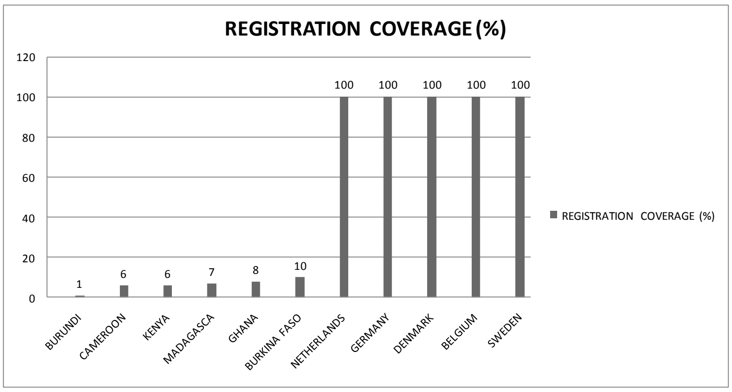


Figure 2: Land registration coverage in selected Sub-Saharan African and Western European Countries

Sources: (Miceli and Kieyah, 2003: McAuslan, 2003; Bruce and Knox, 2009; Hammond, 2006; World Bank, 2005 and 2011; Steudler et al. 2004; www.cadastraltemplate.org)

One may be tempted to argue that 100% registration coverage is associated with the number of years of land registration implementation and for that matter SSA countries need more time to achieve full registration coverage. The French national cadastre which started in 1807 and was completed in 1850 however teaches us a lesson that its utility diminished within a short time due to lack of updating the records and cadastral plans and this spread around Europe. As a result of this precedence, countries such as Germany which became the first country to introduce land registration based on cadastral surveys and the Netherlands and Denmark completed their cadastre within a short period (Larsson, 1999). These were done in far less than 50years.

CONCLUSION

The study concludes that the source of the deficient information regime and information asymmetries in SSA urban real estate markets is largely due to the optional sporadic land registration approach adopted. This approach has never achieved full registration coverage in any country. Hence Sporadic Approach to registration must gradually be phased out as piecemeal gathering of data does not provide comprehensive information in the land registry. The study suggests that the information problem can be fundamentally addressed through policy reforms that from best practice indicate that an initial full-scale registration of a country should be the appropriate approach towards addressing the deficient information problem. Alternatively, a supply-led approach to compulsory systematic land registration area by area can be adopted rather than a compulsory systematic approach which in practice operates through a demand led approach. The demand led approach causes no significant difference between systematic and sporadic registration. Finally, land registration must be seen as a land information tool as such efforts and resources aimed at addressing real estate market problems should rather be geared towards recognising and addressing the information problem.

REFERENCES

Abdulai, R., Hammond, F. N. (2010) ‘‘Landed property market information management and access to finance’’. Property Management. :28:4, 228-244.

Akerlof, G. (1970) ‘‘The Market for ‘Lemons’: Quality Uncertainty and the Market Mechanism’’. Quarterly Journal of Economics,:84, 488-500.

Alden Wily, L. (2003) ''Governance and Land Relations: A Review of Decentralisation of Land Administration and Management in Africa''. International Institute for Environmental Development. London

Antwi, A. (2002). ''A study of informal urban land transactions in Accra''. Ghana. Our Common Estate.

Augustinus, C. (2003) ''Comparative Analysis of Land Registration Systems: African Review With special reference to Mozambique, Uganda, Namibia, South Africa''. Prepared for the World Bank.

Bandeira, P., Sumpsi, J. M., & Falconi, C. (2010) ''Evaluating land administration systems: a comparative method with an application of Peru and Honduras''. Land Use Policy 27, 351-363.

Barnes, G. (2003) 'Lessons learned: an evaluation of land administration initiatives in Latin America over the past two decades', Land Use Policy , 20, pp 367-374.

Bedard, Y. (1986) ''A Study Of The Nature Of Data Using A Communication-Based Concept Framework Of Land Information Systems''. The Canadian Surveyor, 40, 449-460.

Bogaerts, T. (1997) ''A Comparative Overview of the Evolution of Land Information Systems In Central Europe, Computers, Environment and Urban Systems''. 21: 2,109-131.

Bouquet, E. (2009) ''State-Led Land and Local Institutional Change: Land Titles, Land Markets and Tenure Security in Mexican Communities''. World Development,:37:8,

Bruce, J. W. and Knox, Anna (2009). ''Structures and Stratagems: Making Decentralization of Authority over Land in Africa Cost-Effective''. World Development, 38 (8), 1360 - 1369,

Cadastral Template (2003) ''A Worldwide Comparison of Cadastral Systems. Established under UN mandate by Resolution 4 of the 16th UNRCC-AP in Okinawa Japan in July, 2003. available at www.cadastraltemplate.org

Chatterton, W. A. (1980) ''Land Information Systems for the Twenty-First Century. Real Property''. Probate and Trust Journal, 15, 890-900.

Christensen, S. (2004) ''Electronic Land Dealings in Canada, New Zealand and the United Kingdom: Lessons for Australia''. E Law – Murdoch University Elecpronic Journal of Law. 11:4

Clarkson, G., Jacobsen, T. E., Batcheller, A. L. (2007) ''Information asymmetry and information sharing''. Government Information Quarterly, 24, 827-839.

Coase, R. (1961) The problem of social cost. Journal of Law and Economics, Vol. 3 pp. 1-44

Dale, P. (1997) ''Land Tenure Issues in Economic Development''. Urban Studies, 34 (10), 621-1633.

Dale, P. (2000). The importance of land administration in the development of land markets-A global perspective. Land Markets and Consolidation in Central Europe, TU Delft-UDMS.

Dale, P. and McLaughlin, J. D. (1989) ''Land Information Management. An Introduction with Special Reference to Cadastral Problems in Third World Countries''. Clarendon Press. Oxford.

Dale, P. and McLaughlin, J. (1999) ''Land Administration''. Oxford University Press Inc. Oxford, New York.

de Soto, H. (2000) ''The Mystery of Capital: Why Capitalism Triumphs in the West and Fails Everywhere Else''. Bantam Press, Black Swan Edition, London.

de Vries, W. T. (2004) ''How progressive land titling could foster new surveying practice and land information systems – based on case studies in Namibia. Computers, environment and Urban Systems,:28, 531-544

Deininger, K. (2003) ''Land Policies for Growth and Poverty Reduction''. World Bank and and Oxford University Press, Washington DC.

Deininger, K. And Feder, G (2009) ''Land Registration, Governance, and Development: Evidence and Implications for Policy', The World Bank Research Observer, 24: 2, 233-266.

Enemark, S. (2005) ‘‘A Cadastral Tale’’. Week on Geomatics 2005, Bogota, Colombia, 8 – 13August, 2005.
Enemark, S. (2009) ‘‘ Land Administration Systems’’. Map World Forum, Hyderabad, India, 10-13 February, 2009.
Enemark, S., Williamson, I. and Wallace, J. (2005) ‘‘Building Modern Land Administration Systems in Developed Economies’’. Spatial Science, 50:2, 51-68.
Farvacque, C. and McAuslan, P. (1992) ‘‘Reforming Urban Land Policies and Institution in Developing Countries’’. Urban Management Program Policy Paper No. 5
Feder, G. and Feeny, D. (1991) ‘‘Land Tenure and Property Rights: Theory and Implications for Development Policy’’. World Bank Economic Review, 15:1, 135-153
Feder, G. and Nishio, A. (1999) ‘‘The benefits of land registration and titling: economic and social perspectives’’. Land Use Policy.:15:1, 25-43.
Feder, G. and Noronha, R. (1987) ‘‘Land Rights Systems and Agricultural Developmnet in Sub-Saharan Africa’’. World Bank Research Observer, 2: 2, 143-169.
Fekade, W. (2000) ‘‘Deficits of formal urban management and informal responses under rapid urban growth, an international perspective’’. Habitat International, 24(2), 127-50.
Feenan, R. and Dixon, T J. (1992) ‘‘Information and Technology Applications in Commercial Property. London:Macmillan.
Fourie, C. (1998) ‘‘The role of local land administrators: an African perspective’’. Land Use Policy, 25(1), 55-66.
Fourie, C. (2001) ‘‘Capacity building for sub-Saharan Africa: Towards a more relevant approach’’. Paper presented at the workshop on capacity building in land administration for the developing world, ITC, Enschede 13-15 November 2000.
Gough, K.V. and Yankson, P.W.K. (2000) ‘‘Land markets in African cities: The case of puri-urban Accra, Ghana’’. Urban Studies 37(13), 2485-2500.
Ghyoot, V., (1998) ‘‘Public Sector Policy in The Property Industry: A Framework For Analysis’’. Urban Forum, 9(2), 255-257.
Grossman, S. J., Stiglitz, J. E. (1980) ‘‘On the Impossibility of Informationally Efficient Markets’’. The American Economic Review: 70: 3:, 393-408
Hammond, F. N. (2006) ‘‘The Social Cost of Real Estate Market Information Gaps in Ghana’’. Urban Policy Research, 24: 3, 391-408.
Hammond, F. N. (2008) ‘‘Marginal Benefits of Land Policies in Ghana’’. Journal of Property Research,:25:4, 343-362.
Hammond, F. N. and Antwi, Y. A. (2010), Economic Analysis of Sub-Saharan Africa Real Estate Policies, Palgrave Macmillan, Basingstoke and New York.
Hanstad, T. (1997) ‘‘Designing Land Registration Systems for Developing Countries’’. American University International Law Review.:13:3, 649-702.
Karikari, I., Stillwell, J. and Carver, S. (2003) ‘‘Land Administration and GIS: The Case of Ghana’’. Progress in Development Studies 3: 3, 223-242
Kironde, J. M. L. (2000) ‘‘Understanding land markets in African urban areas: the case of Dar el Salaam, Tanzania’’. Habitat International 24: 2, 151-165.
Larsson, G. (1991) ‘‘Land Registration and Cadastral Systems: Tools for land information management’’. Longman Scientific and Technical. Longman Group UK Ltd, England.
Lemmen, C., van Oosterom, P. (2001) ‘‘Cadastral Systems’’. Computers, Environment and Urban Systems, 25:4-5:, 319-324.
Manthorpe, J. (2005) ‘‘Inventory of Land Administration Systems in Europe and North America’’. HM Land Registry, London. Available at http://www.unece.org/env/wpla/welcome.html
McAuslan, P. (2003) ‘‘Bringing the law back: essays in land, law and development’’. Ashgate Publishing Ltd. Aldershot, England.
Mitchell , D., Clarke, M. and Baxter, J. (2008) ‘‘Evaluating land administration projects in developing countries’’. Land Use Policy 5, 464 - 473.

Mooya, M. ., Cloete, C. E. (2007) ‘‘Informal Urban Property Markets and Poverty Alleviation: A Conceptual Framework’’. Urban Studies,:44:1, 147-165
Nkurunziza, E., (2008) ‘‘Understanding informal urban land access processes from a legal pluralistic perspective: The case of Kampala, Uganda’’. Habitat International 32: 109-120
North, D. C. (1992) ‘‘Institutions and Economic Theory. American Economis’’. 36:1:, 1-4
Palmer, D. (1998) ‘‘Security, risk and registration’’. Land Use Policy, 15:1: 83-94
Pas, J. (2002) ‘‘The Commercialization of Government Information and the Proposal for a Directive COM (2002) 207 by the European Commission’’. E Law – Murdoch University Electronic Journal of Law, 9: 4.
Olsson, O. (2009) ‘‘On the democratic legacy of colonialism’’. Journal of Comparative Economics 37, 534-551
Plucknett, T. F. T. (2007) ‘‘A concise history of the Common Law’’. Firth Edition, the Lawbook Exchange Ltd. Union , New Jersey.
Poe, L. G., Bishop, R. C., & Cochrane, J. A. (1992) ‘‘Benefit-Cost Principles for Land Information Systems’’. URISA Journal.
Quintero, J. R., (2004) ‘‘Land Information Systems’’. International Encyclopedia of the Social & Behavioral Sciences, 1-6.
Rajabifard, A., Williamson, I., Steudler, D., Binns, A. and King, M. (2007) ‘‘Assessing the worldwide comparison of cadastral systems’’. Land Use Policy, 24, 275-288.
Stanfield, D. J., and Licht, J. (2009) ‘‘Modernizing the Register of Deeds in Dane County, Wisconsin’’. Journal of Urban and Regional Information Systems Association, 21:1:, 31-42.
Steudler, D. Rajabifard , A. & Williamson, I. P. (2004) ‘‘Evaluation of Land Administration Systems’’. Land Use Policy 21: 371-380.
Steudler, D., Williamson, I. P., Rajabifard, A. and Enemark, S. (2004) ‘‘The Cadastral Template Project’’. FIG Working Week 2004, Athens , Greece, May 22-27, 2004.
Stigler, G. J. (1961) ‘‘The Economics of Information. Journal of political Economy’’.:69:3, 213 - 225
Ting, I ., Williamson, I.P., Grant, D. and Parker, J.R. (1999) ‘‘Understanding the Evolution of Land Administration Systems in Some Common Law Countries’’. Survey Review.
Toulmin, C. (2008) ‘‘Securing land and property rights in sub-Saharan Africa: The role of local institutions’’. Land Use Policy 26, 10-19.
Torhonen, M. (2004) ‘‘Sustainable land tenure and land registration in developing countries, including a historical comparison with an industrialised country’’. Computers, Environment and Urban Systems, 28:5, 545-586.
Woodman, G. R. (1987), ‘Land Registration Without Prejudice: The Ghana Land Title Registration Law, 1986’, Journal of African Law, 31, pp 119-135.
Williamson, I.P. (2001) ‘‘Land Administration "best practices" providing infrastructure for land policy implementation’’. Land Use Policy 18: 297-307.
Williamson, I., Ting, L. (2001) ‘‘Land administration and cadastral trends – a framework for re-engineering’’. Computers, Environment and Urban Systems, Volume 25: 4-5:, 339-
Williamson, E. O. (1981) ‘‘Contract analysis: the transaction cost approach’’ in :P. Burrows & C. G. Veljanovski (Eds) *The Economic Approach to Law* (London:Butterworths).
Williamson, E. O. (1986) ‘‘Markets or government: framework and implications, *Economics as a Process-Essay in the New Institutional Economics’’*. 171-202 (Cambridge: Cambridge University Press).
World Bank (2005) ‘‘Doing Business in 2005. Removing obstacles to Growth’’. Washington DC: World Bank.
World Bank (2011) ‘‘Doing Business in 2011’’ Washington DC: World Bank.
Zevenbergen, J. (2002) ‘‘Systems of Land Registration-Aspects and Effects’’. PhD Thesis Published by Nertherlands Geodetic Commission, delft, The Nertherlands.

SPATIAL SCALES AND MEASUREMENT OF HOUSING VALUES IN NIGERIA: THE CASE OF METROPOLITAN LAGOS

Ola Aluko[1]

Department of Urban and Regional Planning, University of Lagos, Lagos, Nigeria

This research paper tries to answer the questions that can heterogeneous zones be grouped to produce spatial markets? And are the submarkets produced meaningful geographically? The study shows that the use of small geographical scale helped to identify similar zones and neighbourhoods that have the same housing values and socio-economic characteristics. This is unlike some of the previous studies that combined wider areas together and so failed to identify spatial submarkets. Four different geographical scales were examined to determine the level of disaggregation of data, and the highest level of disaggregative data occurs where cities are divided into small areas by zones. This study utilized both secondary and primary sources of data. The study is based on data collected from sixteen Local Government Areas consisting of 53 residential zones in metropolitan Lagos. Out of the total number of 135,820 properties, a size of about 1% (1,500) was randomly selected. The hypothesis was tested using a combination of analysis of variance, multiple regression model, expansion method and the non hierarchical technique of grouping. The variations in house values by zones are more distinct than house values for communities and local governments that bear the same name. The grouping of the zones with similar house values also helps to identify housing submarkets that exist in the study area. The submarkets have variations in housing values that conform with the socio-economic characteristics of the households.

Keywords: housing value, Lagos, Nigeria

INTRODUCTION

The fact that there is spatial disparity in the distribution and quality of public services and infrastructural facilities means there is locational variation within the sub-areas of the Lagos metropolis (Aluko, 2008, 2003). For a city is in reality a very heterogenous entity. This paper therefore shows how house values vary by area and the role of changes in spatial scale in the understanding of housing values. Spatial scales are geographical terms which also mean geographical scale. It relates to space, position, shape or changes that take place within the environment. The hypothesis being tested is that the use of distinct spatial scales within cities for investigation affects the measurement and interpretation of housing values. That is distinct spatial scales of investigation within the cities yield different measures of housing values through the use of neighbourhood, location and physical attributes of houses to determine house values. This is to argue that rental values could vary significantly between large and heterogeneous neighbourhoods and more defined near homogeneous areas of investigation (Aluko, 2008, 2000). Thus, the choice of an appropriate scale is

[1] eoaluko@yahoo.com

Aluko, O. (2011) Spatial scales and measurement of housing values in Nigeria: the case of metropolitan Lagos *In:* Laryea, S., Leiringer, R. and Hughes, W. (Eds) *Procs West Africa Built Environment Research (WABER) Conference*, 19-21 July 2011, Accra, Ghana, 861-869.

necessary for correct interpretation of the nature and pattern of variation. This paper examines these variations across different definitions of sub-area units for investigation and relates this to issue of defining housing markets spatially.

STUDY AREA

Metropolitan Lagos developed from a narrow low-lying Island situated on latitude 6° 27' North and longitude 3° 28' East along the West African coast (Ayeni, 1979). The original settlement on the site on which Lagos grew was first inhabited by fishermen and farmers and was called Eko. This settlement was christened in 1492 as Lago de Kuramo by the Portuguese who used it only as a harbour in their attempts at finding a route to the far east (Ayeni, 1979). Lagos comprises the former 70 square kilometres of the Federal Territory of Lagos which was composed of the geographically formed Islands of Eko (Lagos Island), Ikoyi, Victoria Island, Iddo-Otto, Ijora and Apapa (Aluko, 2000). The central and most developed of this Island chain is Lagos Island. It also incorporates the municipal settlements of Ebute-Metta, Yaba, Surulere Tin-Can Island (Mekuwen) and the Eti-Osa areas all of which cover 85.53 square kilometres from these initial settlements, development has proceeded northward to the mainland up to about latitude 6° 40' North (Aluko, 2000). Lagos, however, remains the most populous state in Nigeria and is still the country's commercial capital.

METHOD

This study utilized both secondary and primary sources of data. Primary information was collected from both direct interviews and personal observations. The main primary information was obtained from responses to questionnaires administered by the author and trained assistants. The study is based on data collected from sixteen Local Government Areas consisting of 53 residential zones in metropolitan Lagos. Out of the total number of 135,820 properties, a size of about 1% (1,500) was randomly selected. The hypothesis was tested using a combination of analysis of variance, multiple regression model, expansion method and the non hierarchical technique of grouping. This is necessary in order to show that using proper spatial scale in the delineation of zones and wards, distinct spatial pattern exist within the cities' various housing attributes.

On how the spatial scale of areas of investigation within the cities affects the measurement of housing values, the non hierarchical technique of grouping was used to identify the similar clusters of zones. The factor scores of the housing values subjected to non hierarchical technique of grouping on zonal basis identified four clusters of groupings (as four sub-groups). The cluster analysis invariably followed the socio-economic groupings that high and upper middle income households segregate themselves from low income households. This is not a matter of physical denial but of the fact that most high and upper middle income households have strong economic power for legally perpetuating neighbourhood socio-economic segregation. The choice of the study area, Metropolitan Lagos, is based on many factors. First, the housing markets are very well developed in Lagos. Consequently, it is possible to identify and analyze variations. Secondly, comprehensive data is available on property values in the state. The data are expected to be useful in the explanation of the variations of housing attributes over space.

CONCEPTUAL FRAMEWORK

The conceptual framework focuses on housing at both micro and macro levels. The micro is the household, while the macro is spatial and relates to areas within the city.

There are urban micro-economic and macro-economic theories that provide conceptual issues for the study. The first include the trade-off models and their more recent reformulations, the hedonic model and the expansion method. While the second involves the urban spatial structure and the ecological approach to urban land values. Expansion method is a sequential approach that uses the multiple regression models to evaluate specific contribution of housing attributes on house prices (Can, 1991; Follain and Can, 1982; Richardson and Cain, 1974). It also helps to examine the effects of these housing attributes on house values. The expansion method outlines a routine for creating or modifying models made of a sequence of clearly identified logical steps (Can, 1991; Dublin and Sung, 1990; Cronin and Rasmusson, 1980). The expansion method can be considered as a special case of systematically varying coefficients in a regression model (Sheffer, 1990; Ndulo, 1985; Andrew, 1987; Ayeni, 1979). The heterogeneity in the phenomenon under study is reflected in parameter values that differ for each observation. In the terminology of the expansion method, the original simple homogeneous specification is called the initial model, whereas the complex heterogeneous formulation is called the terminal model (Megbolugbe, 1991, 1986; Downs, 1979).

SPATIAL SCALE AND PATTERN OF HOUSING ATTRIBUTES

Housing values or rental values within a city are either aggregated or disaggregated over households in order to examine their variations (Aluko, 2008, 2003). Consequently, the geographical scale or spatial scale used always determines the level of the disaggregation of data (Aluko, 2008, 2003). In this section, variation over four different scales will be examined. The description of the different levels of geographical scale or spatial scale is presented in figure 1. The first level is when a city is studied as a whole and this is the highest level of aggregative data. Another level of scale is when analysis is performed on the basis of local governments that exists within the metropolitan area. Although most cities in Nigeria have few local governments, the study area (metropolitan Lagos) has 16 local governments. The level of data at second scale is also still aggregative. The third level of scale is the analysis of the city on basis of communities that exist therein. This is when the city is either studied on neighborhoods basis or when one uses specific areas as explained in the multiple nuclei model. The data at this level may or may not be disaggregated depending on the size of the zones. The example of such neighbourhoods as related to the study area are: Ikeja, Mushin, Ketu, Oshodi, Apapa-Ajegunle, Surulere, Yaba, Ojota, Ikoyi and so on.

The fourth level of geographical scale or spatial scale is when the city is divided into zones, wards, enumeration areas or other small units. The highest level of disaggregative data occur where cities are divided into small areas for better examination of the households characteristics and distinct analysis of submarkets. For the collection of valuation data, the estate agents identified 53 zones in metropolitan Lagos. The zones were sufficiently homogeneous to constitute distinct spatial markets. The zones and the description of the areas are presented in table 1. In the next section, we shall evaluate variation in house values at the three levels for comparative purposes. However, the greatest emphasis will be on the fourth scale which is the zonal level because of the need to evaluate the extent to which the units at this level are distinct.

Variation of Housing Values by Local Governments, Communities and Zones

The local government areas in metropolitan Lagos are Agege, Ifako ljaye, Eti-Osa, Ikeja, Alimoso, Lagos Island, Apapa, Lagos Mainland, Mushin, Somolu, Kosofe, Surulere, Amuwo- Odofin and Oshodi Isolo. Mean annual housing rental values for each of the local government areas are shown in table 2. Clearly there are 3 or 4 types of groups from the table. The first group which comprise of Eti-Osa/Ibeju-Lekki local government is a very distinct local government, with mean annual house rental values of ₦1,860,000. There was no other local government that has any value as high as this figure. The second group consists of Ikeja and Alimosho local governments with annual house rental values of between ₦300,000 and ₦720,000. The third type of group contained local governments with annual house rental values that range between ₦100,000 and ₦250,000. The local governments in this group are Lagos Island, Lagos Mainland Somolu and Surulere. The fourth identified group of mean annual house rental values was also very distinct with low figures, they were extremes of the first group. They are below ₦100,000 and they consist of Agege, Mushin and Oshodi local governments.

Table 2: Housing Values by Local Governments

Local Governments	Annual House Rental Values (Means) (₦)	No. of Properties
Agege/Ifako-Ijaye	60,658	15,170
Eti-Osa/Ibeju-Lekki	1,860,000	6,471
Ikeja	710,250	13,176
Alimosho	300,000	4,052
Lagos Island/Apapa	180,650	8,046
Lagos Mainland/Ajeromi	150,850	15,070
Mushin	80,400	17,003
Somolu/Kosofe	170,200	27,966
Surulere/Amuwo-Odofin	150,700	18,568
Oshodi/Isolo	80,500	10,298

Sources: Lagos State Valuation Office; Field Work, 2010
Exchange rate: US Dollar 1$=150 ₦ Nigerian Naira

It is suffix to clarify that most of the properties in low income areas are between 1-2 rooms per household. That is, most of the households rent or occupy 1-2 rooms and the mean annual rental values are between ₦48,000-72,000 ($320-480). Most of the properties in medium income area are flats and the mean annual rental values are between ₦120,000-360,000 ($800-2,400). While in high income areas the common properties are flats, bungalows and duplexes and the mean annual rental values are ₦500,000- ₦1million ($3,333=6,667). The average exchange rate of Nigeria currency (Naira) to United States Dollar ($) is $1= ₦150. There are twenty five communities defined on geographic units within which certain social relationships exist (see Table 3 and Figure 1). Table 3 shows the variations in the housing rental values by communities. The house values by communities in table 3 could also be grouped into four. The first group are the communities with annual house rental values less than ₦220,000 ($1,467). They consist of communities like Mushin, Ketu, Oshodi, Ojota, Eko, Agege, Oyingbo, Aguda, Ojodu, Ipaja, Alagbado and Abule Ijesa. The second group of communities are those with annual house rental values between ₦220,000 and ₦400,000 ($1,467-2,667). The communities with these values are Apapa, Isolo, Sogunle, Ijesa Tedo, Somolu, Alausa and Gbagada. The communities within the third group are Surulere, Yaba and llupeju and they have annual house rental values between ₦401,000 and ₦900,000 ($1,467-6,000). The fourth type of communities are those, with annual house rental values above ₦900,000 (>$6,000). The communities in these group are Ikeja, Ikoyi and Victoria Island and they have the highest annual house rental values.

There are two reasons that make the house values by local governments in table 2 different from house values by communities in table 3. The first one is that mean house values by local governments are lower than house values for communities that bear the same name, and this is because of the more aggregative data of the local government.

The second thing that distinguish table 2 from table 3 is that the number of properties in the local governments are more than the properties in the communities. This is because the areas covered by the communities are smaller than the areas covered by the local governments. This account for the reason why house values in the communities are more than the house values in the local governments because the properties are fewer and the mean values are disaggregated. Therefore, the geographical scale on community basis is better than that of the local government.

Table 4 shows the variation in house values by zones. The zonal values could be grouped into four. The first zonal group are zones with house monthly rental values below ₦10,000. The zones consist of Oyingbo, Iponri, Abule Ijesa, Ajegunle, Oju Elegba, Ketu, Isolo, Mushin, Oshodi, Alagbado, Ipaja and Oniwaya. The second type of zonal group are the zones with house monthly rental values between ₦10,000 and ₦25,000. The zones in the second group are Oba's Palace, Yaba, Ijora, Masha, Aguda, Igbobi, Ogba, ltire and Ajao Estate. The house monthly rental values between ₦25,000 and ₦49,000 are those that form the third group and the areas in this group are Marina, Awolowo Way, Agidingbi, Alausa, Adeniyi Jones and Sogunle. The fourth zonal group consists of zones with house monthly rental values above ₦50,000 and they include Alagbon, Ikoyi, Falomo, Eleke Crescent, Victoria Annex, Thomas Okoya, Ikeja G.R.A., Allen Avenue and Opebi. The variations in house rental values by zones are more distinct than house values by communities and local governments because the areas covered are very small. The house rental values in Ikeja by zones is ₦106,000, the rental values by communities in Ikeja is ₦90,000 and the values by local government in Ikeja is ₦71,250. That is, the house rental values in the zone are more than the house rental values in the communities and local governments because the number of houses covered in the zones are fewer and the data are most disaggregated. The grouping of the ones with similar house values also help to identify the housing submarkets that exists in the metropolitan Lagos.

The variation in housing values in table 4 could also be due to differences in socio-economic characteristics of the households. As some areas have very high values while others very low values. Areas like Ikoyi, V.I. and Ikeja G.R.A. which are high income areas could not be compared with Suru1ere, Yaba and llupeju which are medium income areas, and also Mushin, Oshodi and Oyingbo which are low income areas. The characteristics of the households in these zones are related to their housing values. This necessitated the grouping of the zones with similar housing values by non hierarchical grouping technique in the next section.

Spatial Dimension of Housing Submarkets

There is evidence that the variations over space are better studied by the zones defined by the estate values. The pattern is not too clear and there are questions to be answered in this section. The questions are: can the zones be grouped to produce spatial markets? Are these submarkets meaningful geographically? In order to answer the questions, there is need to group the zones on the basis of house values and their attributes. We used the non hierarchical techniques of grouping. Multivariate grouping techniques are based on the use of orthogonal dimension of variables. Consequently, we used factor analysis to produce these dimensions from the set of variables. The variables are shown in table 5. Therefore, we first examined the factor scores of the house values and later discussed the non hierarchical techniques of grouping. The results of the grouping of clusters provided better explanation to issue of housing submarkets in metropolitan Lagos.

The spatial variation of housing values in metropolitan Lagos involves the groups of variables of the attribute matrix (35 in all) described in table 5 were subjected to a factor analysis from which emerged three dimensions. The three dimensions explained a total of 62.4 percent of the variance contained in the original variables. The first dimension, which dominates the housing values of metropolitan Lagos accounts for 46 percent of this explained variance while the other two components explain 16.6 and 16.4 percent's respectively (see Table 6). The factor loadings show the extent, to which each variable belongs to or is mostly associated with the factor, while the factor scores show the performances of the cases on the factors.

The first component is characterized by high positive loadings on the neighbourhood and structural variables and rather low positive loadings on locational attributes. The high positive loadings are on number of kitchen, toilet and bathroom facilities; maintenance of the building; good appearance of the neighbourhood; number of parking facilities; the noise level and number of waste disposal system in the neighbourhood (see Table 5). The interpretation of this factor is facilitated by the pattern of scores shown in table 7. It is a structural neighbourhood dimension. This dimension of housing values divides the city into three important socio-economic groups; the high income, the middle income and the low income. The high income is made up of Ikoyi Park, Alagbon, Falomo Bar Beach, Eleke Crescent, Maroko, Maryland, Ajao Estate, Allen Avenue, Opebl, Ikeja GRA and Adekunle Fajuyi Street. These zones have factor scores ranging between 1.0 and 1.5. The middle, income group, on the other hand, is made up of zones with scores between 0.5 and 0.9 and includes Yaba, Ijesha Tedo, Igbobi, Awolowo Way, Ogba Estate and Ilupeju. While the low income group is made up of Oyingbo, Abule Ijesha, Itire Road, Isolo, Mushin, Oshodi and Oniwaya. These latter zones have low positive and high negative scores - 0.6 to 0.4.

The second component loads on socio-economic variables with high positive loadings on such variables as number of rooms, income number of persons in the household and education (see Table 8). The socio-economic variables examined include age of the household heads, education, occupation, number of rooms occupied by household, number of persons in the household, length of stay in the house, type of buildings, income, and house tenure. Consequently, it may be said that this dimension is socio-economic. The pattern of scores in table 7 which include quality areas like Igbobi, Mainland, Ajao Estate, Thomas Okoya, Opebi and Ikoyi Park shows that the zones are made up of high and medium residential areas.

While the first two components identify both the housing attributes and the socio-economic variables of the city, the third dimension identifies the infrastructural facilities provided in the neighbourhoods. This component, accounting for only 16.4 percent of the variance, loads highly on, the condition of the road, drainage, provision of water, electricity, and recreational facilities. This dimension therefore may be described as the infrastructural facilities of urban housing of' metropolitan Lagos. The pattern of scores shows that areas such as Idi Araba Road, Olusosun, Aguda-Ogba, Ijora, Iponri, Oyingbo and Oba's Palace have high scores and they are high density areas.

The analysis of the spatial variation of metropolitan Lagos could be described in terms of three major dimensions of neighbuorhood/ structural attributes, the socio-economic variables and the infrastructural facilities of variation. While they do not show any discernible spatial variation in terms of being either concentric, sectoral or found in nucleations, they undoubtedly outline the historic development of the city.

The results of the factor analysis conform with some findings in other parts of the world. Most of the developed and developing countries have traits of this delimitation in their metropolitan areas (Aluko, 2008; Cohen, 1990; Phipps, 1987; Freeman, 1979; Lakshmanan et al, 1978; Mayes, 1979; Ayeni, 1979; Nellis and Longbotton, 1981; Stutz and Kartman, 1982). In United States of America, the process of urban development produced high quality neighbourhoods and community environments for nearly all high income households and middle income households in US metropolitan areas (Downs, 1981). It has also provided reasonably good quality environments of many moderate income house and some low income households. Other works on Singapore, Japan, Korea and Hong Kong confirmed the indicators of housing and neighbourhood (Mills, 1972). The most important point to note is that the behaviour or condition of many urban areas of the world is influenced by locally prevailing culture more than the similarities of objective situations among places - such as overcrowding, poverty and high density.

Spatial Variation in Housing Submarkets

In order to identify similar clusters of zones, the factor scores of the housing values were subjected to non hierarchical techniques of grouping on zonal basis. Four clusters of groupings were identified as four sub-groups. The cluster analysis coincidentally followed the socio-economic groupings where high and upper middle income households segregate themselves from low income households (see Table 8). Most high and upper middle income households have strong economic power for legally perpetuating neighbourhood socio-economic segregation. We understand the fact that the different models of residential location believe or explain the spatial pattern of residents according to their income group segregation. The non hierarchical grouping technique is the most effective in cluster analysis because it makes groupings to be optimal and dissimilar cases are not grouped together.

CONCLUSION

This study has shown that the use of small geographical or spatial scale helped to identify similar zones and neighbourhoods that have the same housing values and socio-economic characteristics. This is unlike some of the previous studies that combined wider areas together and failed to identify spatial submarkets. Four different geographical scales were examined to determine the level of disaggregation of data, and the highest level of disaggregative data occurs where cities are divided into small areas by zones. The variations in house values by zones are more distinct than house values for communities and local governments that bear the same name. This is because the areas covered are very small and the number of properties covered are fewer than the· properties in the communities and local governments. The grouping of the zones with similar house values also helps to identify housing submarkets that exist in the study area. The submarkets have variations in housing values that conform with the socio-economic characteristics of the households. Some areas have very high values while others very low values. The analysis revealed that spatial variation of metropolitan Lagos could be described in terms of 3 major dimensions of neighbourhood structural attributes, socio-economic variables and the infrastructural facilities.

The classification and identification of spatial areas will help planners, estate surveyors and valuers, government policy makers and other allied professionals in housing to make valuable and quality decisions in the location of amenities/ facilities, ratings of properties and collection of tenement rates, and for proper planning. Areas that need urgent attention because they are inhabited by low income earners will be reconsidered and provided with basic facilities while areas with high income earners could be properly organised to contribute to the provision of essential amenities/ services in their neighbourhoods especially in security services (police stations/ posts).

REFERENCES

Aluko, Ola (2008) *Housing and Urban Development in Nigeria*, Kins Publishers, Nigeria.

Aluko, Ola (2003) Housing Values and Determinants of Housing Submarkets in Nigeria, *Journal of the Nigerian Institute of Town Planners*, Vol. XVI, October, pp. 55-68.

Aluko, Ola (2000) The Effects of Relative Units of Housing on House Prices in Metropolitan Lagos, *Lagos Journal of Environmental Studies, vol*. 2 No.1 Oct. pp.85-94.

Andrew, C.L. (1987) *The Role a/Rental Housing in Developing Countries.* Urban Development Discussion Paper UDD-I04. Washington, DC: The World Bank.

Ayeni, Bola (1979) *Concepts and Techniques in Urban Analysis*, Croom Helm, London.

Can, A., (1991) Spatial Variation in the Propensity to move of Household, *Sistemi Urban,* No. 1, pp. 107-27.

Cohen, M.A. (1990) *Macroeconomic Adjustment and the City*, Butterworth and Co. Ltd., London.

Cronin, F.J., and Rasmussen, D.W. (1980) *Renter Choice in Detroit.* 'Report No. 1375-2, Washington, DC: The Urban Institute.

Downs, A. (1979) *The Future of Rental Housing in America,* Washington, DC: The Brooking Institution.

Dublin, R.A. and Sung, C. (1990) Specification of Hedonic Regressions: Non-nested test on Measures of Neighbourhood Quality, *Journal of Urban Economics*, Vol. 27, 1990, pp.97- 110.

Follain, J. and Can A. (1982) Housing Crowding in Developing Countries and Willingness to Pay for Additional Space. The Case of Korea, *Journal of Development Economics,* vol. 11, pp. 249-272.

Freeman , A. M. III (1979) The Hedonic Price Approaches Measuring Demand for Neighbourhood Characteristics, in Marshall, A. (ed.) *Principles of Economics*, pp. 191-217.

Lakshmanan, T.R., *et al.* (1978) Housing Consumption and Level of Development: A Cross National Comparison, *Economic Geography,* Vol. 54. Pp. 222-233.

Mayes, D. (1979) *The Property Boom*, Oxford: Martin Robertson.

Megbolugbe, I. F., (1986) Econometric Analysis of Housing Trait Prices in a Third World City, *Journal of Regional Science,* Vol. 26, pp. 533-547.

Megbolugbe, I. F., (1991) Hedonic Indices and Housing Programme Benefits, *Urban Studies,*Vol. 28, No. 5, pp. 773-781.

Mills, Edwin, (1972) *Urban Economics*, Scott, Foreman.

Ndulo, M. (1985) The Determinants of Urban Housing Value: The Evidence from Zambia, *Malaysia Journal of Tropical Geography*, Vol. 12, pp. 31-36.

Nellis, J.G. and Longbottom, J.A. (1981) An Empirical Analysis of the Determinants of House Prices in the U.K., *Urban Studies,* Vol. 13, pp. 9-21.

Phipps, A.G. (1987) Household’s Utilities and Hedonic Prices for Inner-City Homes, *Environment and Planning A*, Vol. 19, pp. 59-80.

Richardson, H. W. and Cain A. (1974) Determinants of Urban House Prices, *Urban Studies*, Vol. 11, pp. 189-199.

Sheffer, D. (1990) The Demand for Housing and Permanent Income in Indonesia, *Urban Studies*, Vol. 27, pp. 259-272.

Stutz, F.P. and Kartman, A. E. (1982) Housing Affordability and Spatial Price Variations in the Unites States, *Economic Geography*, Vol. 53, pp. 221-235.

SUSTAINABLE CONSTRUCTION IN NIGERIA: METHODS OF DELIVERING SUSTAINABLE CONSTRUCTION IN THE NIGERIAN CONSTRUCTION INDUSTRY

James Jatau[1] and Anthony Westcott
School of Built and Natural Environment University of the West of England Bristol, BS16 1QY, UK

Various worldwide Summits have been held regarding sustainable development such as the United Nations Earth Summit held at Rio de Janeiro in 1992 which gave rise to the adoption of the Agenda 21 by governments, however, since the Rio de Janeiro Summit in June 1992, many countries have embarked on various environmental reform agenda to attain the sustainability mark. The issue of sustainable development is very challenging in developing countries especially when the priority concerns are poverty alleviation, institutional strengthening and socio-cultural issues to sustain harmony and peaceful co-existence. The purpose of this research was to determine the most suitable approach towards achieving Sustainable Construction in the Nigerian Construction industry as a developing country. After careful analysis of the problems at hand, with the use of questionnaires to survey the journey so far in sustainable construction in Nigeria, this document analyses various approaches towards achieving sustainable construction all of which cover key sustainability issues from waste management to noise reduction in construction processes.

Keywords: developing country, sustainable construction, Nigeria.

INTRODUCTION

Sustainable construction is a small part of the general topic of Sustainable development which is a key theme in today's world. The issue of sustainable development is very challenging in developing countries especially when the priority concerns are poverty alleviation, institutional strengthening and socio-cultural issues to sustain harmony and peaceful co-existence. Sustainability as divided into economic development, social growth and environmental protection are usually addressed at macro levels with broad based goals without being translated into micro project specific levels which makes it difficult to address due to lack of in-depth understanding and detailed planning (Ugwu and Haupt, 2005).

After looking at sustainable development on a large scale, it can therefore be narrowed to the idea of sustainable construction as a progressive path to achieving sustainable development. Just as there have been various definitions of sustainable development so also are there varying definitions of sustainable construction. Charles Kibert (2008) in defining sustainability in construction said the terms high performance, green and sustainability are often used interchangeably. However, he proceeded to defining sustainable construction as that which most comprehensively addresses the ecological,

[1] jamesjatau@hotmail.co.uk

Jatau, J. and Westcott, A. (2011) Sustainable construction in Nigeria: methods of delivering sustainable construction in the Nigerian construction industry *In:* Laryea, S., Leiringer, R. and Hughes, W. (Eds) *Procs West Africa Built Environment Research (WABER) Conference,* 19-21 July 2011, Accra, Ghana, 871-882.

social and economic issues of a building in the context of its community. Nikolas Kohler (2003) stated that governments are coming up with new policies towards the creation of 'green' or environmentally progressive buildings which will however fail due to the narrowness in defining the term. In order for this to succeed, the transfer and acceptance of technologies and skills have to be grounded on a firm understanding of regional cultures. Thus, understanding the concept of sustainable construction and how it can be applied to various countries especially developing countries.

In a bid to narrow down the concept of sustainable development which are broadly classified into economic development, renewable resources and social growth, Carillion in a presentation have further classified these concepts into social progress, economic growth and prosperity, protection of the environment and prudent use of natural resources. These concepts comprise of the following:

- Protection of Environment: this category consists of land impacts, biodiversity, water pollution and atmospheric impact.
- Prudent Uses of Natural Resources: this category consists of resource use, supply chain, design and waste.
- Economic Growth and Prosperity: this category consists of shareholder benefit, customer benefit, cost and risk and community investment.
- Social Progress: this category consists of Health and safety, Employee interest, learning and development and community involvement.

These will be the major factors which need to be considered when developing a sustainable construction strategy especially in developing countries where poverty alleviation, employment creation, capacity building and creating peaceful coexistence.

The need for this research was developed from the author's interest in sustainable construction in developing countries in a bid to contribute to the development and awareness of this field in these countries with particular interest to the Nigerian construction industry. From research and practice, the author has found the need to contribute to this cause and help create a more efficient and dynamic construction society which may stir up a chain of further knowledge and how to consolidate the four major sustainability factors with the current challenges faced by developing countries.

SUSTAINABILITY AND THE CONSTRUCTION INDUSTRY

Office of Government Commerce defined sustainable construction as the achievement of a better quality of life through the efficient use of resources, which realise continued social progress while maintaining stable economic growth and caring for the environment. There have been other definitions of sustainable development such Dr Gro Harlem (1987) who defined sustainable development as "the development that meets the needs of the present without compromising the ability of future generations to meet their own needs".

According to the publication in 1999 titled "A Better Quality of Life: A Strategy for Sustainable Development for the UK". The United Kingdom government clearly stated its commitment to sustainable development by identifying four main aims which are:

- Social Progress, which is aimed at recognising the needs of everyone
- Effective protection of the environment

- The prudent use of natural resources
- Maintenance of high and stable levels of economic growth and employment.

These areas are heavily impacted on by the built environment and as a result, the United Kingdom Government, being that the government in the United Kingdom as well as many other countries is the major client of the construction industry, has recognised the importance to embrace sustainability through all its construction process. In a bid to achieve this, the United Kingdom government developed ten action key schemes aimed at promoting sustainable development in the construction industry which as stated in the Achieving Excellence Guide 11, are: Re-use existing built assets, Design for minimum waste, Aim for lean construction, Minimise energy in construction, Minimise energy in use, Do not pollute, Preserve and enhance biodiversity, Conserve water resources, Respect people and local environment. Sets targets (monitor and report as a bench mark for performance)

These above mentioned actions are majorly focused on the environmental factors and as such form the basis for further discussions on the impact of construction on the environment. As the world's population continues to increase, this also creates an inverse need for more buildings and public infrastructure, which results in the increase of waste production, energy usage and water consumption.

Key Sustainability Issues

Table 1: Key Sustainability Issues (source: Student Construction Journal 2010)

Amenities and recreation	Landscape and Visual Aspects
Biodiversity	Land Use
Climate Change	Material Use
Community	Pollution and Nuisance
Crime and Security	Shareholder and customer relations
Cultural Heritage	Social Inclusion and accessibility
Drainage and Flooding	Stakeholder engagement
Energy	Training and Development
Geology and Soils	Travel and Transport
Health, Safety and well-being	Waste
Human rights and Ethics	Water Use

SUSTAINABLE CONSTRUCTION

According to Lanthing (1995), sustainable construction may be a special case of sustainable development targeting the specific group of construction industry in which the group is expected to develop, plan, design, build, alter or maintain the built environment which should include the building materials, manufacturers and suppliers. Charles Kibert (2008) in an attempt to define sustainability in construction said the terms high performance, green and sustainability are often used interchangeably. However, he proceeded to defining sustainable construction as that which most comprehensively addresses the ecological, social and economic issues of a building in the context of its community. These are the three pillars of sustainability which should be addressed in every sustainable construction issue. These are depicted in Table 2. Table 2 shows the impact of the built environment on humanities social, environmental and economic performance. The Office of Government Commerce United Kingdom suggested that sustainable construction is not only in the process of construction but the lifecycle of the building, hence developed a framework for sustainable construction procurement using the lifecycle approach which balances the three pillars of sustainability.

Table 2: Key impacts of construction (Source: ARCOM 2009)

Social	Environmental	Economic
Provides basic shelter	Accounts for half of all energy use	Employs 110 million people
Provides Cultural spaces	Responsible for 40% of resource use	Accounts for 70% of all man-made wealth
Creates the basis for social and manufacturing capital	Responsible for land use	Between 8 and 10% of GDP

SUSTAINABLE CONSTRUCTION IN AFRICA

Sustainable construction has not received adequate attention in Africa as a developing continent even though it has been recognised as an important aspect of sustainable development. There exists a gap in consolidating theory and practice especially in African countries and this constitutes a conflict of understanding and implementation (Adebayo, 2002). Taylor et al (1994) suggested that the ideology of norms and systems which have emerged as a result of certain experiences by developed countries have been thought to readily be adoptable by developing countries. He further argued that this ideological way of thinking typified the stage of economic growth which involved hypothesis of the emergence of nations as universal ignoring national circumstances, value systems or current priorities. According to Adebayo (2002) it has been proven inappropriate where the principles of the developed world have been applied developing countries without modification to suit the current prioritised needs. Considering the various problems facing Africa as a developing continent, Adebayo (2002), suggested that for sustainable construction to take place there has to be an understanding of the political, economic, social and developmental issues of a place making it clear that sustainable construction is an integral part of sustainable development.

According to a research carried out by the International Council for Research and Innovation in Building and Construction (2001), which covered Africa, Asia and Latin America commenting on different regional understandings of sustainable construction, the issues and challenges facing the regions, the impact of the construction industry on the economy, the environment and society in the regions, the barriers of sustainable construction, the strengths and opportunities presented by cultures and traditional practices of the region and suggested actions for the research community, governments and the construction industry. The issues identified included the following:

The need for a new model of development, Urbanisation and rural i.e. the consolidation of urban growth with the reciprocal affect on rural areas and development, Sustainability in housing which concerns both formal and informal housing provision as well as regulation of policies that provide housing, Education: the need for adequate information on sustainable construction, Innovation in building materials and methods, Gender equity: a consideration of discrimination where women are seen as second-class citizens should be given a n opportunity to improve in order to make the construction site more female friendly, Financing and procurement and Governance and management.

Government policies in areas of housing, economics, environment and spatial planning are often attributed to factor affecting sustainable construction. These have in most cases directly affected the construction industry and related developmental issues. These policies are concerned with alleviation of poverty employment creation, capacity building and quality of environment amongst many others. The construction industry cannot exist as a single entity without being impacted on and impacting on economic, social, environmental, technical and policy issues Adebayo (2002). The definition of sustainable construction in the African context can best be adopted from the Amsterdam Treaty's (1997). This definition sees sustainable construction as the determination to promote economic and social progress of their peoples. The Nigerian government due to urbanisation and population growth provided housing among other national needs and have geared the housing policies towards the delivery of low cost housing on a large scale down to state government levels with each state having similar policies and delivering core housing and walk-up flats. The government also developed satellite towns, and government employee high-rise apartments such as those found in Gwarinpa Abuja and Suleja Nigeria. The complexity of housing policies in developing countries varies to an extent which may be due to different emerging needs. It may be said that the Nigerian Housing policies are not as complex as the South African housing polices. This may be due to politics, ethnicity and the South African need to the critical issue of equality regardless of race, ethnicity or gender. These constitute part of the issues of sustainable construction in developing countries.

NEED FOR THE STUDY

Due to the global outcry for a sustainable existence, despite the challenges faced in developing countries such as Nigeria, these countries should not be left out and contribute greatly to achieving a sustainable environment through sustainable construction, as the first though which comes to mind when considering development is the construction of infrastructure and basic facilities.

AIMS AND OBJECTIVES

The aim of this research is to find out the ***"most suitable method or approach towards achieving sustainable construction in developing countries primarily Nigeria?"*** and how these suitable methods can be adopted by Nigeria as a developing country to attain sustainable construction and possible ways in which they could be adopted in to the system considering ethical approaches. Because there are various approaches towards achieving sustainable construction, thus, the term 'most suitable' which may meet the basics of best value as emphasised by Egan (2002) who suggested that the best way to achieve best value is to replace the idea of lowest price tendering with integrated teams of professional involved in delivering improvement, productivity, safety and customer satisfaction. This may be likened to aspects of sustainable construction. However, to support the central research question, the following objective was put forward. ***What may be the most suitable approach towards achieving sustainable construction in Nigeria?***

The aims and objectives are to be achieved by a study of the Nigerian construction industry and the methods they have put in place to achieving sustainable construction. This is intended to be carried out with the use of ethical questionnaires to source information.

RESEARCH METHOD

The research was carried out with the use of interviews of three (3) construction professionals in the Nigerian construction industry as a pilot test to analyse the validity questions to be asked in the questionnaire which was the major source of collecting the data. The questionnaire was designed as an online based questionnaire to ease time and travelling convenience and was structured to meet the various construction disciplines in Nigeria from Main Contractors, Architects, Structural Engineers, Quantity Surveyors and Sub Contractors.

Gillham (2000) advices that questionnaire is a very easy, quick and cheap method of data gathering. On the other hand, he argues that a good project cannot be based on poorly collected data and that questionnaires are only efficient if used in conjunction with other methods. This view is strengthened further by Kumar (2005) who states that responses to questions may be affected by other people since it is possible to consult others. He also provides a valid point that additional information cannot be supplemented with the questionnaires whereas it is possible to obtain such information during interviews. Although, questionnaires may reach a large geographical area and ensure anonymity (Kumar, 2005) non-returns and lack of honesty of questionnaires are the common problems which are difficult to overcome (Goddard and Melville, 2004). The Questionnaires were sent to some of the major construction companies in Nigeria at the moment such as Julius Berger Nigeria Plc, Dantata & Sawoe Const. Co. Nig. Ltd, Setraco Nigeria Ltd, RCC Nigeria Ltd, Costain West Africa Plc, PW Nigeria Ltd and Government bodies such as Federal Capital Development Authority (FCDA) which is the main construction client in Abuja, Nigeria. This questionnaire was also sent to research staff in various universities in Nigeria who carry out construction based research for the Nigerian Government in various aspects from procurement to design. These researchers that participated in this survey where from Ahmadu Bello University, Zaria, Nigeria and the Federal University of Technology, Minna, Nigeria.

Following the literature review the design of the questionnaire was carried out and it was primarily based on the research objectives and literature review findings. The author also used his own knowledge about sustainability and decisions with the co-author and colleagues back in Nigeria and in the United Kingdom to develop the questionnaire even more. The main purpose of the questionnaire was to obtain as much of the real data as possible to draw the initial picture of methods which have been adopted by various construction companies in Nigeria towards attaining sustainable construction and analyse these various methods and select viable methods. The questionnaire was designed online and was sent to various participants via email. The problem that eventually became apparent was getting the appropriate questions to fit into the context of the Nigerian construction industry. However, with careful selection from review of literature a few open ended questionnaire was prepared in order to maintain the focus of the research.

Also some of the feedback received from respondent was that some of them needed clarification as to understanding the concept of sustainability in construction. This was the need for a test survey using a draft questionnaire. However, this was addressed and was clarified in the introduction of the final questionnaire. The major difficulty of getting a questionnaire was acquiring the relevant email addresses as it is of importance that the questionnaire was sent to key management personnel in order to get valid responses. Hence 50 respondents were contacted about 76% (38) of the targeted respondents replied and about 24% (12) did not respond to the questionnaire.

FINDINGS AND DISCUSSION

Based on the Chartered Institute of Architects (CIAT), which requires every construction professional to have a sustainability policy it was deduced from the respondents thirty-six percent (36%) of the respondents had company sustainability policies and sixty-four percent (64%) of the respondents did not have company policies covering sustainability. Further to this was a follow up question mainly for respondents who had company sustainability policies. This question was to find out what aspects of sustainability these policies covered amongst choice areas of waste management, reducing water consumption, reducing energy consumption, Local employment, use of local materials, safe and healthy working environment, Noise reduction and the minimisation of nuisance/nuisance of construction on local community which were based on the sustainability policy issues as described by the CIAT. The feedback to this response however, is as shown in Figure 1 below.

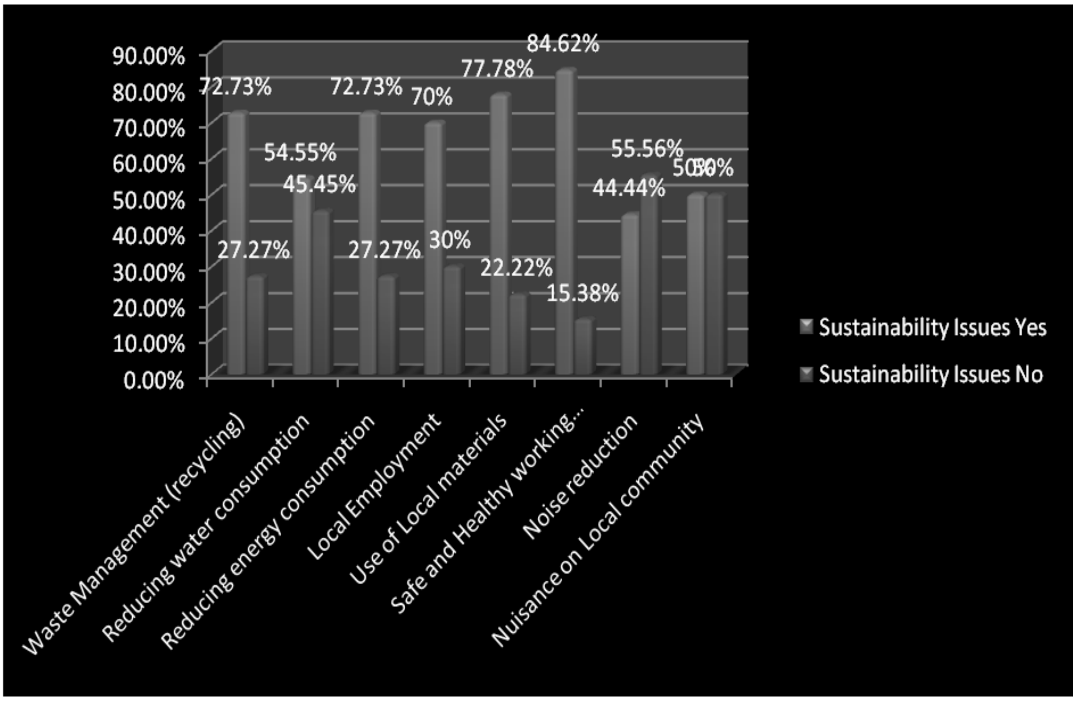


Figure 1: Issues Covered by Sustainability Policy

Based on the sustainable construction issues considered so far by the author in this research which are waste management, reduction of water consumption, reduction of energy consumption, local employment, use of local materials for construction, safe & healthy working environment, noise reduction and the management of the impact/ nuisance of construction activities on the local community, the respondents were asked to rank in order of importance based on company experience and how they considered these issues while working on construction projects on a scale of “Not at all important”, “quite important”, “important”, “very important” and “extremely important”. The feedback from the respondents may be seen as depicted in Figure 2 below.

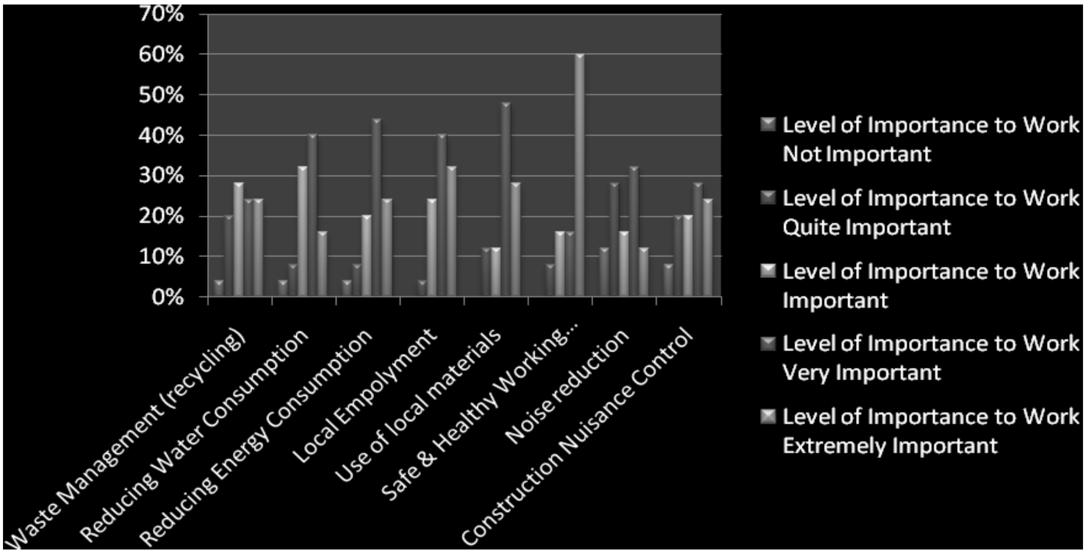


Figure 2: Level of importance of sustainable issues to construction work

Based on Figure 2 above, it may be derived that about four percent (4%) of the respondents considered the issue of waste management not important, about twenty percent (20%) of the respondents considered waste management to be quite important, about twenty-eight percent (28%) of the respondents considered waste management to be important, about twenty-four percent (24%) of the respondents considered waste management to be a very important issue during construction and about another twenty-four percent (24%) considered waste management to be a very important issue during construction. It may also be deduced that on the issue of reduction in water consumption, about four percent (4%) of the respondents considered this issue to be not important, about eight percent (8%) of the respondents considered the reduction in water consumption to be a quite important issue in construction, about thirty-two percent (32%) of the respondents considered reduction in water consumption to be an important issue in construction, about forty percent (40%) of the respondents considered reduction in water consumption during construction to be a very important issue and about sixteen percent (16%) of the respondents considered reduction in water consumption during construction to be a very important issue. The issue of reduction in energy consumption was considered by about four percent (4%) of the respondents to not be an important issue during construction, about eight percent (8%) of the respondents considered reduction in energy consumption to be quite an important issue during construction, about twenty percent (20%) of the respondents considered reduction in energy consumption to be an important issue during construction, about forty-four percent (44%) of the respondents considered the issue of reduction in energy consumption during construction to be a very important issue and about twenty-four percent (24%) of the respondents considered reduction in energy consumption during construction to be an extremely important issue as seen in Figure 2 above. The issue of local employment was considered by about four percent (4%) of the respondents to be quite an important issue during construction, about twenty-four percent (24%) of the respondents considered local employment as an important issue during construction, about forty percent (40%) of the respondents referred to the issue of local employment as a very important factor during construction and about thirty-two percent (32%) of the respondents considered local employment to be an extremely important issue during construction as depicted in

Figure 2 above. When considering the issue on the use of local material for construction, about twelve percent (12%) of the respondents considered this to be quite an important issue, about another twelve percent (12%) of the respondents considered the use of local materials to be an important issue during construction projects, about forty-eight percent (48%) of the respondents considered the use of local materials in construction to be a very important issue and about twenty-eight percent (28%) of the respondents considered the use of local material in construction projects to be an extremely important issue during construction as derived from Figure 2 above. Health and safety is one of the important factors mostly considered during construction, however, about eight percent (8%) of the respondents considered the issue of delivering a safe and healthy working environment to be a quite important issue during construction, about sixteen percent (16%) of the respondents considered a safe and healthy work environment during construction to be an important issue, about another sixteen percent (16%) of the respondents considered safety and health in the work area during construction to be a very important issue and about sixty percent (60%) of the respondents considered the ability to provide a safe and healthy work environment during construction to be an extremely important issue as extracted from Figure 2 above. It may be seen also from Figure 2 above that when considering the issue of noise reduction, about twelve percent (12%) of the respondents considered this to be not at all an important issue, about twenty-eight percent (28%) of the respondents considered noise reduction to be quite an important issue during construction, about sixteen percent (16%) of the respondents considered the issue of noise reduction to be an important issue, about thirty-two percent (32%) of the respondents considered noise reduction to be a very important issue to be addressed during construction and about twelve percent (12%) of the respondents considered noise reduction t be an extremely important issue during the construction process. Considering the issue of the management of the impact / nuisance created by construction on the local community, about eight percent (8%) of the respondents considered this issue as not at all important, about twenty percent (20%) of the respondents considered minimisation of the impact/ nuisance on the local community to be an important issue during construction, about twenty-eight percent (28%) of the respondents considered this issue to be very important during construction projects and about twenty-four percent (24%) of the respondents considered management to minimise the impact / nuisance of construction activities on the local community during construction to be an extremely important issue as may be seen in Figure 2 above. It may be inferred from the above analysis that the most considered issue by the respondents to be extremely important during construction is that of providing a safe and healthy work environment during construction projects.

A list of options was given which were derived from the outcome of the research by Plessis *et al* (2001) and the respondents were required to select three options which they deemed fit to achieve this goal. This result may be seen in Table 3 below which gives further a clearer depiction of the outcome.

From Table 3 it may be seen as depicted that about fifteen percent (14.7%) of the respondents suggest the introduction of sustainability into university syllabus for construction disciplines, about seventeen percent (16.8%) of the respondents suggest innovation in the area of building material which may act as alternatives to regular construction materials, about seven percent (7.4%) of respondents suggest that modernising traditional methods of construction may be a suitable method of delivering sustainable construction, about six percent (6.3%) of the respondents suggest that patronage of local suppliers and manufacturers will be a suitable method of delivering sustainable construction, about seventeen percent (16.8%) of the respondents suggest that stricter enforcement of government policies could deliver sustainable construction, about eleven percent (10.5%) of the respondents suggest that higher standards of planning and building regulations could be a method of delivering sustainable construction, about six percent (6.3%) of the respondents suggest that higher taxation rates on inefficient buildings may be a suitable approach to achieving sustainable construction, about another seven percent (6.3%) of the respondents suggest that the provision of incentives, grants or tax allowances to encourage renewable energy sources can be a method of attaining sustainable construction, about eleven percent (10.5%) of the respondents suggest that the establishment of a new procurement route which support sustainability will be a method of achieving sustainable construction and about four percent (4.2%) of the respondents suggest that an improvement in supply chain management may be a method of delivering sustainable construction to the Nigerian construction Industry.

Table 3: Methods of delivering Sustainable Construction

Option	**Percentage**
Introducing Sustainability into university syllabus for construction disciplines	14.7%
Innovation in building materials (finding alternatives to regular construction materials	16.8%
Modernising traditional methods of construction	7.4%
Patronising local suppliers and manufacturers	6.3%
Stricter enforcement of government policies	16.8%
Higher standards of planning and building regulations	10.5%
Higher taxation/business rates on inefficient buildings	6.3%
Incentives/grants/tax allowances to encourage renewable energy sources	6.3%
Establish New procurement route which support sustainability	10.5%
Improve supply chain Management	4.2%

CONCLUSION AND RECOMMENDATION

The following were the conclusions derived from the research;

From the results obtained in this research the following methods seemed to be the most suitable methods of delivering sustainable construction in the Nigerian construction industry were selected because they had the highest percentage from respondents of about seventeen percent (16.8%) each, the next suggested method which had about fifteen percent (14.7%) and the last two considered by the author to have about eleven percent (10.5%) of responses and these methods are as follows respectively;

- Innovation in building materials (by finding alternatives to the regular construction materials
- Stricter enforcement of government policies targeted to the construction industry
- Introducing Sustainability into universities for construction disciplines
- Introducing higher standards of building and planning regulations and
- The establishment of a new procurement route which support sustainability
- The following were the recommendations asserted to the research findings;

- With the issues being raised throughout this research document a series of recommendations have been suggested. These recommendations are as follows:
- The government should endeavour to introduce with stricter penalties for defaulters of the policies instituted by legislation to curb the level of indiscipline in the construction industry.
- Governing bodies such as the Nigerian University Commission (NUC) should endeavour to re-evaluate the syllabus of Nigerian universities in construction disciplines in order to introduce sustainability at an early stage to those who will afterwards be a part of the construction industry in order to help in innovation and ideas on the development of sustainable construction in the Nigerian construction Industry.
- Professional bodies like the Nigerian Institute of Quantity Surveyors (NIQS), Nigerian Institute of Builder (NIOB) and the like should create sustainable construction policies that will put members in check penalising members if they fail to meet these standards.
- Higher standards of building regulations may be introduced by local housing authorities such as the Federal Housing Authority (FHA), Kaduna State Urban and Planning Development Authority (KASUPDA) and the likes should implement higher and achievable standards which must be met before approval of any construction may be granted.
- The procurement route used in Nigeria have still remained the same over the years with no development over the years, however, it may be worth the try to develop and introduce new procurement methods which encourage and promote sustainable construction in all aspects from water conservation, energy conservation, employment, waste management and noise reduction.
- It may be worth considering that the use of local traditional materials in the construction on buildings may be a good alternative to modern construction materials providing better accessibility and availability of construction materials.
- The Nigerian government should not neglect the development of rural areas as constant rural-urban migration causes unavailability to resources and hence constitutes a nuisance to the society. Provision of adequate construction infrastructure in rural areas will reduce the effect of the rural-urban migration.
- Construction companies should endeavour to have their staff trained and educated on sustainable construction.
- Construction companies should endeavour to have Key performance indicators which measure company policies against meeting sustainability roles.

REFERENCES

Adebayo .A (2002) Sustainable Construction in Africa: Agenda 21 for Sustainable Construction in Developing Countries. Africa Position Paper.

Association of Researchers for Construction Management (ARCOM) Sustainability in the Built Environment. Doctoral Research workshop. Rolle Building 201 & 202, University of Plymouth, 16 November 2009

BREEAM (Building Research Establishment Environmental Assessment Method). *www.products.bre.co.uk/breeam/index.html*. Accessed on 20th June 2010.

Carillion (2007) Sustainability at the University of the West of England. A presentation at the University of the West of England. University resources.

Chartered Institute of Builders (CIOB). http://www.ciob.org.uk

Chartered Institute of Architects (CIAT) Sustainability Policy. Available at http://www.ciat.org.uk/en/the_institute/Regulations/Institute_policies/sustainability_policy.cfm sourced on October 25th 2010.

Dania, A. et al (2010). Sustainable Construction Education: Assessing the Adequacy of Built Environment Professionals Training. WABER Accra, Ghana 2010

Du Plessis .C. (2005). Action for Sustainability: Preparing an African Plan for Sustainable Building and Construction. Building Research & Information, 33(5) 1-11

Du Plessis .C. (2002), Agenda 21 For Sustainable Construction in Developing Countries. CIB Information Bulletin Nr.2/01

Egan. J (1998). Rethinking Construction. UK Government, DETR

Goddard, W and Melville, S (2004). Research Methodology: An introduction. Juta and Company

Kumar, R. (2005). Research Methodology: a step-by-step guide for beginners. SAGE

Latham, M (1994). Constructing the Team. Constructing Excellence

Lanthing, R (1995) Sustainable Development and the future of Construction. CIB W82

Office of Government Commerce (OGC), Achieving Excellence Guide 11: Sustainability Crown copyright 2007

Royal institute of Chartered Surveyors (RICS). Student Construction Journal 2010.

Ugwu, O. & Haupt, T (2007). Key Performance Indicators and assessment methods for infrastructure sustainability – A South African Construction Industry Perspective. Published Article Building and Environment 42 (2007) p665 – 680.

United Nations Conference on Environment and Development (UNCED), Agenda 21, 1992.

United Nation. Report of the world summit on sustainable development, Johannesburg, South Africa, 26 August – 4 September 2002, United Nations, New York, 2002. pp173.

"SUSTAINABLE" OR "GREEN" CONSTRUCTION IN LAGOS, NIGERIA: PRINCIPLES, ATTRIBUTES AND FRAMEWORK

Immaculata Nwokoro[1] and Henry Onukwube[2]

[1]*Department of Urban and Regional Planning, University of Lagos, Lagos, Nigeria*
[2]*Department of Building, University of Lagos, Lagos, Nigeria*

The concept of sustainable development is used as a basis for enhancing understanding of sustainable construction. Principles of sustainable construction cover four attributes: social, economic, biophysical and technical. The research examined these concepts, principles and attributes in understanding sustainable and green construction as well as current practices and challenges of sustainable construction in Lagos, Nigeria. The research embraced both quantitative and qualitative methods of data collection. The sample frame is the total number of built industry registered and practising professionals in Lagos. A total number of 85 respondents were randomly selected for study from each group. A 5-point likert scale was used to assess respondents' judgement on the identified social, economic, bio-physical and technical indicators. Focus group discussions (FGDs) were also conducted with all the above professional groups to corroborate the primary information. For a wider coverage, three different construction sites are selected to reflect income neighbourhoods-Lekki (high income), Yaba (medium income) and Bariga (low income). Data Collected were analysed using the mean item score. A multi- stage framework which required the application of environmental assessment and environment management systems for construction projects was utilised. Research findings indicate that the most important factors considered for sustainable construction with their mean item scores are quality of working conditions (0.852) strengthening and enforcement of relevant law and regulations(0.872), encouraging construction waste management(0.819) and design for flexibility and adaptability. Results from the FGDs indicate that the current practice on sustainable construction does not take into consideration integrated design process, acoustic and visual comfort in the planning and construction of sustainable projects. The research, therefore, concludes that government should improve existing laws to enhance quality of working life, education, training as well as knowledge management for all stakeholders in sustainable construction.

Keywords: green construction, Nigeria, sustainable construction.

INTRODUCTION

Sustainable construction has emerged as a guiding paradigm to create a new kind of built environment: one that meets the needs of humans in the present without limiting the ability of future generations to meet their own needs (Ofori, 2001).The creation, operation and disposal of the built environment dominate humanity's impact on the natural world (Kibert et al, 2000).The construction industry is the largest destroyer of the natural environment (Woolley, 2000). It is a major consumer of non-renewable

[1] Ifunanya66@yahoo.com
[2] Onukwube12345678@yahoo.com

Nwokoro, I. and Onukwube, H. (2011) "Sustainable" or "green" construction in Lagos, Nigeria: principles, attributes and framework *In:* Laryea, S., Leiringer, R. and Hughes, W. (Eds) *Procs West Africa Built Environment Research (WABER) Conference*, 19-21 July 2011, Accra, Ghana, 883-895.

resources, produces substantial waste, pollutes air and water, and contributes to land dereliction (Wallbaum and Buerkin, 2003).The construction industry's overall impact on people and society cannot be overestimated. By providing housing and infrastructure, the industry makes a vital contribution to the social and economic development of every country (Wallbaum and Buerkin, 2003). Sustainable development is a development that meets the needs of the present without compromising the ability of future generations to meet their own needs (United Nations, 1987). A primary goal of sustainability is to reduce humanity's environmental or ecological footprint on the planet. Sustainable development has given rise to green buildings. Most green building practices fall into seven basic categories: energy saving, land saving, storm water runoff-reducing, material conservation and pollution reduction (ECO Northwest, 2001).A green building uses an average of 30% less energy than conventional building (Economist, 2004) Material waste generated during construction is reduced or recycled. Materials are re used. Energy efficiency is improved, perhaps by relying on the use of natural light and ventilation or solar power. Less water is used, or rainwater harvesting system is installed to ensure wiser use. Measures taken to make buildings and construction more sustainable rely increasingly on life cycle approaches.

Construction is a major and primary sector of Nigerian economy and its consideration of the issues of sustainability covers a huge spectrum of the sector (Nwafor, 2006). Thus, the role buildings play is fundamental to the realisation of sustainable development. Public awareness of environmental issues has increased significantly in Nigeria. Property owners and clients are seeking commercial buildings that meet acceptable environmental and health levels. Unfortunately, there is lack of institutional structures promoting green buildings; awareness on the part of clients, tenants, professionals in the built environment and other stake holders; professional capacity to incorporate green building issues and opportunities and; financial resources to undertake green building construction and upgrades. The aim of this paper therefore is to examine the principles, attributes, current practices and challenges of sustainable construction in Lagos, Nigeria. This study addressed the following research questions-(a) what importance is attached to attributes of sustainable construction in Lagos? (b) What are the current practices and challenges facing sustainable construction in Lagos? (c) How can the proposed framework address the challenges of sustainable construction in the study area?

LITERATURE REVIEW AND CONCEPTUAL ISSUES

To advance the understanding of sustainable construction, this study examines four attributes of sustainability, social, economic, biophysical and technical.

Social Attributes and Principles

According to Hill and Bowen (1997) the social attributes of green construction calls specifically for addressing poverty and inequality. The basic principle of social sustainability is to improve the quality of human life by ensuring secure and adequate consumption of basic needs, which are food, clothing, shelter, health, and beyond that by ensuring comfort, identity and choice. The first step towards achieving this goal is poverty alleviation. Social sustainability attributes include: Improve quality of human life, including poverty alleviation, make provision for social determination and cultural diversity in development planning, protect and promote health through a healthy and safe working environment, implement skills training and capacity enhancement of disadvantaged workforce, seek fair distribution of the social costs of construction, seek equitable distribution of the social benefits of distribution, and seek intergenerational equity.

Economic Attributes and Principles

According to Sultan (2005),economic sustainability attributes include: Labour – intensive construction policies (promotion of employment by mandating minimum crew size and supervisors and use of less machinery in construction projects, associated with import reduction of machines, spares and foreign exchange savings. Energy – Efficiency policies in Design and Construction (Mandating the use of low embodied energy materials such as granite, minimizing high energy materials such as cement and steel. Energy reduction in buildings via insulation, day lighting, optimize material use and minimize site waste).Credit and Policies to selected projects, strategies for sustaining the continuity of affordable infrastructure projects (infrastructure projects can help enhance the process of industrialization by raising productivity and reducing production cost).Strengthening the law and regulations in construction and land affairs Pricing policies (maintain the monetary and fiscal discipline required to promote price control) and improve administration effectiveness and reduce bureaucratic procedures. Choose environmentally responsible suppliers and contractors. Ensure financial affordability for intended beneficiaries, and maintain sustained and efficient use of resources and materials, sustained employment opportunities through formal construction, material production and distribution, maintenance during the economic life span of buildings.

Bio physical Attributes and Principles:

This is founded on the second part of the definition of sustainability proposed by IUCN (1991). The IUCN stated that sustainability requires the improvement of the quality of human life within the carrying capacity of supporting ecosystems. Bio physical sustainable attributes include: Project design facilities that reflect consciousness of the fragility of the ecology in which it is situated and the awareness of its impact upon it; The use of renewable building materials from sustainable sources and designs that take into consideration existing cultural patterns and behaviours, materials and techniques; Prevention of pollution from construction activity and preserving sites in their natural state and water use reduction and conservation and rainwater collection and; Reduction of energy use and on-site renewable energy and encourage construction waste management(Wolley,2000)

Technical Attributes and Principles:

The technical attribute of sustainability has been used in this paper to group a number of concepts, including concepts that relate to the performance, quality and service of a building. The emphasis on the application of these principles should be on implementing a process which seeks to achieve consensus among interested parties on which principles are more and which are less important. Sustainable technical attributes include: Design for flexibility, adaptability and durability of exposed building parts. Pursue quality in creating the built environment and use serviceability to promote sustainable construction as well as revitalize existing urban infrastructure. (Hill and Bowen, 1997; Sultan, 2005; Wolley, 2000)

Process-oriented principles of sustainable construction

In this paper the essence of process oriented principles is to articulate ways of achieving - social, economic, biophysical and technical indicators of sustainable construction. The concept is to emphasize that the following stages is essential in sustainable construction. That is, undertake prior assessments of proposed activities and involve all stakeholders on the project in due time. Promote interdisciplinary collaborations and recognize the complexity and multiplicity of objectives inherent in the concept of sustainability. Utilize a life cycle framework, which recognizes the need to consider all of the principles of sustainable construction at each and every stage in planning, assessment, design, construction, operation and decommissioning of projects. Comply with relevant legislation and regulations and manage activities through the setting of targets, monitoring, evaluation, feedback and self-regulation of progress (Gardner, 1989), in a process that is iterative and adaptive in nature.

Current Practices and Challenges of Sustainable Construction in Lagos

Energy Efficiency

According to Santoli and Matteo (2003), the energy performance of a building must be calculated using standards that indicate the insulation of the buildings, the characteristics of technical systems and installed equipment, the position and orientation of the building in relation to other climatic aspects, exposure, its own capacity for renewable energy sources and other factors, such as indoor environmental quality, that could influence the energy requirements of the building.

Integrated Design

Reed and Gordon (2000), emphasised that the integrated design process encompasses cross-disciplinary team work enabling the improved integration of building, community, natural and economic systems and therefore is a key to sustainable design. There is considerable agreement among those in the field of sustainable design that cross-disciplinary team work early in the design process is essential to achieve the successful integration of building, community, natural and economic systems. Without the process of integration, systems are over designed and commonly function in conflict with one another. In this concept, the client takes a more active role than usual, the architect becomes the team leader rather than the sole form-giver, and the structural, mechanical, and electrical engineers take on active roles at early design stages. The team includes an energy specialist (simulator) and hopefully, a bio-climatic engineer, depending on the nature of the project, a series of additional consultants can be added.

Indoor Air Quality

The quality of indoor air depends on the concentration of pollutants at a particular moment in time. The perceived air quality is also dependent on the air temperature and the relative humidity which, in turn are linked. Health problems from inferior air quality include lung cancer, sick building syndrome(SBS),symptoms' and discomfort problems like bad smells and experience of dry air (Bornehag, *et al.*,2004)

Thermal Comfort

Creating thermal comfort for man is a primary purpose of the heating and air conditioning industry and this had a radical influence on the whole building industry. Comfort is not a product which is provided for building occupants, it is a goal which they achieve provided they are able to exert the necessary control over their environment (Shove *et al*., 2008). The control they exert over the environment will partly be decided by the building they occupy and its services and may be subject to constraints (Cole *et al.*, 2008). The aim of the building must be to allow occupants to achieve their comfort goal. People adapt more readily to thermal environments with which they are familiar. The building should therefore be designed to provide a thermal environment that is within the range customary for the particular type of accommodation, according to climate, season and cultural context.

Visual comfort

Visual comfort is brought about by having good lighting which is adequate both in quality and quantity. The source of light may either be natural or artificial or a combination of both. In any case, windows have distinct advantages. Today there are still many new buildings that do not fully utilize the benefits derived from using natural light. Efficient day lighting considers heat gain, glare, different light levels, uniformity and solar penetration. The three basic rules of good day lighting are: avoid direct sunlight on heavy viewing tasks to prevent glare; let natural light in through skylights and good-sized windows that give deeper penetration and better distribution; and, filter daylight and bounce it off surrounding surfaces with the use of vegetation, curtains, sunscreens and shades. When locating buildings in a particular site, correct spacing together with proper orientation must be maintained to enhance natural lighting. Adequate window openings must be maintained to ensure that building interiors get enough natural lighting (Ochoa and Capeluto, 2009)

Site Suitability

Site suitability enquiry is essential as this ensures that the site can legally and physically accommodate the type and size of project being envisaged. When selecting sites for developmental purposes avoid sites in noise areas and ensure compatibility with existing facilities. Determine what else is planned for the site in the future (Nwafor, 2006)

Acoustic Comfort

Sleeping disturbances are commonly reported as an important problem related to traffic noise (Griefahn and Spreng, 2004).Apart from secondary stress effects from sleeping disturbances, there are studies that suggest an association between residential road traffic noise exposure and hypertension(Bluhm *et al*.,2007)

Spatial Comfort

This is a concept that is used to express building layouts that are designed to maximise the space use and improve accessibility within the buildings such that the occupants derive comfort from such arrangements (Hiller and Hanson, 1984).

Building Integrity

The crippling costs of corruption in the practice of sustainable construction can be reduced significantly through the application of proven principles and mechanisms such as building integrity. The basic approach is to stipulate actions that are corrupt both morally and ethically and expected punishment attached to such actions. If individuals recognise their actions are illegal, and that they may be discovered and imprisoned, this deters corruption (Lucas and Rubel, 2004)

Environmental Laws and Regulations on construction in Nigeria

The Federal Government of Nigeria has promulgated various laws and Regulations to safeguard the Nigerian environment. The prevailing laws within the built environment include: Federal Environmental Protection Agency Act of 1988 (FEPA Act),National Policy on the Environment (NPE) 1989 and Environmental Impact Assessment Act of

1992 (EIA Act).The Federal Ministry of Environment (FME) administers and enforces environmental laws in Nigeria.. The Federal Ministry of Environment has published several guidelines for the administration of the FEPA and EIA Acts and procedures for evaluating environmental impact assessment reports (EIA Reports).

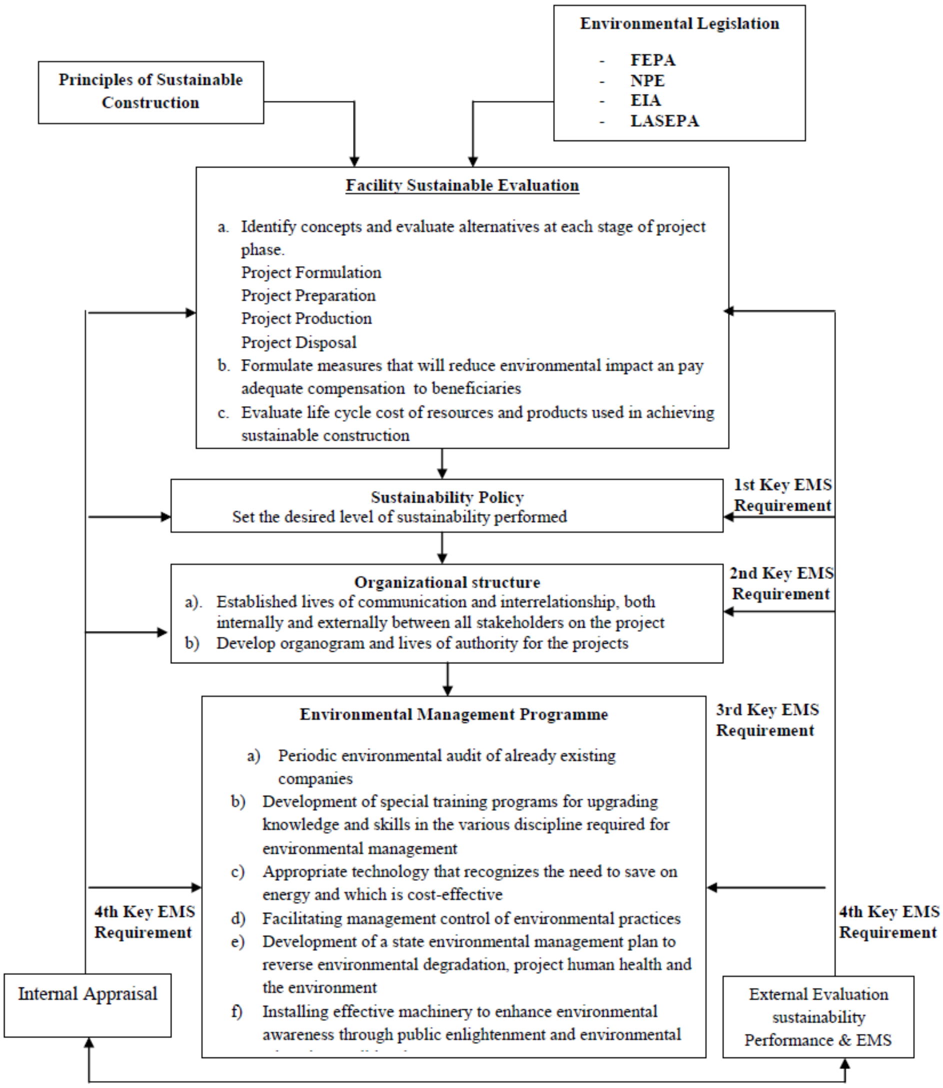
The approach of regulatory agencies is the prevention of environmental damages, the regulation of potentially harmful activities and the punishment of wilful harmful damage whenever this occurs. The environmental agencies also adopt the approach of engaging individuals and communities at risk of potential environmental damage in dialogue. The EIA approval process adopted by the FME involves a system of public hearings during the EIA evaluation process and interested members of the public are invited to such hearings. Lagos State Environmental Protection Agency (LASEPA), also takes the same approach. Unfortunately, the major challenge confronting FEPA is how to translate the laudable provisions of the Act into an effective tool for managing the environment. This is because most Nigerian legislations crumble at the implementation stage

A framework for the attainment of sustainable construction

The essence of this framework is to suggest how sustainable construction can be achieved. We are of the opinion that Environmental impact Assessment (EIA) should be carried out during the planning and design stages of projects, provided that the traditional EIA is expanded to include assessment of all four `indicators' of sustainable construction and is undertaken in accordance with the process-oriented principles of sustainable construction, and enforcement by FEPA, NPE and LASEPA for each project, during construction, operation and, where appropriate, even decommissioning. The framework and its components are summarized in Figure 1 and discussed below. In this paper, a broad meaning is given to the term `environment', to include the physical, biological, social and economic indicators that affect the individuals and groups within the developmental area. `Environmental impact Assessment' could include assessment of all four `indicators' of sustainable construction.

There is need to set up a sustainability policy. Such a policy would set the desired level of environmental performance. Construction organizations could adopt a general environmental policy which could inform policies for specific projects. At the level of individual construction projects, environmental policy would emanate from company policy, if available; relevant legal requirements, and the EIA for the project, which would identify those principles of sustainable construction deemed relevant to the project through consultation with interested parties at an early stage in the EIA. The second key requirement is to provide an organizational structure and to determine the responsibilities, authority, lines of communication and the resources needed to implement the EMS. An EMS would need to determine the required interactions between the various contractors, consultants and clients involved in the project. Similarly, lines of communication should link the organizations involved, and should also provide a connection with a range of interested and affected parties external to the construction process.

The third key requirement is to develop an environmental management programme (EMP) that stipulates environmental objectives and targets to be met and work instructions and controls to be applied in order to achieve compliance with the environmental policy. At project level, the EMP would contain operational procedures for controlling various activities, which would include: work instructions for determining the manner of conducting an activity; inspection procedures to ensure that mitigating measures are applied; procedures for dealing with accidents and emergencies; and, procedures for the measurement of performance indicators. In construction, where the primary goals of the contractor and the environmental management team may be different, the EMP may need to rely on penalties and bonuses to ensure compliance with standards. The fourth key requirement is to undertake periodic audits of the environmental performance of the construction team and the effectiveness of the Environmental Management System.



(Source: Adapted and modified from Hill and Bowen, (1997:234)

Figure 1: Framework for Sustainable Construction

RESEARCH METHOD

The study embraces both quantitative and qualitative methods of data collection. Relevant information is sourced from professionals in the construction industry, contractors, developers and clients. Using a structured questionnaire information on how social, economic, bio physical and technical indicators facilitate sustainable construction are elicited. Respondents were asked to indicate their judgement on identified social, economic, bio-physical and technical indicators. A 5-point scale was used to assess the importance of these factors. Section A addresses questions on name and type of organisation, years of construction industry experience. For each factor, an important index was determined. Questions on section B to F are quantitative in nature. Section B comprises nine questions on social attribute of sustainable construction while section C comprises twelve questions on economic attribute of sustainable construction. Sections D, E and F comprise eight, six and six questions on bio physical, technical and process-oriented principles of sustainable construction respectively. The sample frame is the total number of registered professionals in the built industry in Lagos. A total number of 85 respondents were randomly selected for study from each group. In addition two construction sites each were randomly selected and visited in 3 different income class neighbourhoods, thus, Lekki (high income), Yaba (medium income) and Bariga (low income).

Focus group discussions (FGDs) were also conducted with all the above groups to corroborate the primary information. This involved a meeting of ten (10) stakeholders drawn from professionals of the built industry in each of the three selected neighbourhoods. These groups were also gender and age sensitive to achieve diverse information. The work of Sultan (2005) was identified and used for the quantitative aspect of the study because of the similarity of data in both researches. The response format designed by Sultan (2005) was altered. In this study instead of using a 3-point likert scale used by Sultan, a 5-point likert scale was used to achieve operationality of variables. Cronbach’s alpha is a measure of internal reliability. This is bound by 0 and 1, with measures closer to 1 representing strong reliability for the items in the research instrument. Data Collected are analysed with using mean item score. The sustainability instrument in this study recorded a Cronbach’s alpha value of 0.91 and the data collected was analysed using statistical packages for social sciences (SPSS).

RESULTS AND DISCUSSION

Data collected from Section A of the research instrument shows that 24(28%) of the respondents are consultants, 21(25%) are developers, 20 (23.5%) are contractors while the remaining 20 (23.5%) are clients. Majority of the respondents 35 (41%) had more than 25 years construction industry experience, while 28 (33%) had experience ranging between (15- 20) years. Others are 13 (15%) for industry experience ranging between (10-14) years while the last group recorded 10 (11%) for industry experience of (5-9) years. The implication of this result is that most of the respondents had enough knowledge and experience to make useful contribution to this area of research.

The information elicited from the respondents were discussed along the lines of the different attributes of sustainability thus; social, economic, bio physical, technical and process oriented. This is further supported by the responses from the FGDs conducted in three different income residential areas. The ranking of these various indicators corresponds with the respondents need in order of importance.

(Mean item score = 0.852) as an important social factor in achieving green construction. This means that the respondents expect improved working conditions, fringe benefits and social amenities’ that will facilitate better standard of living. This finding supports the contribution of Hill and Bowen (1997) in their study on principles of sustainable construction. The finding of Sultan (2005) in this area of study is also in agreement with this result. Education and training, and knowledge management are ranked 2nd and 3rd respectively. This is a major factor in the developed countries where sustainable construction has been achieved. Respondents agreed that implementing skills training and capacity enhancement will help the disadvantaged workers. This will also create awareness about the benefits of green construction. Table 1 reveals that most respondents rated quality of working conditions very high

Table 1: Relative index of social indicators in "sustainable" construction

Social Indicators	Mean Item Score	
Quality of working conditions	0.852	1
Education and training	0.845	2
Knowledge management	0.833	3
Impact on employment	0.795	4
Health and safety	0.762	5
Innovative potential	0.760	6
Social characteristics and cultural diversity in development planning	0.718	7
Societal product benefit	0.694	8
Societal dialogue	0.663	9

Other social factors that were ranked high by respondents are impact on employment, health and safety and innovative potential. Currently the rate of employment is high and this contradicts the purpose of social sustainability. These factors are important factors that must be taken into consideration in planning for social sustainability.

For the economic indicators for sustainable construction, strengthening the law and regulations in construction ranked highest with a mean item score of 0.872 as shown in table 2. This includes sorting out all legal rights for investors and tenures via legal agencies to ensure the well conduct of the industry activities in a sustainable and efficient manner. The respondents also feel strongly about getting strategies for sustaining the continuity of affordable infrastructure projects and sustained and efficient use of resources and materials as these indicators ranked 2nd and 3rd respectively.

Table 2: Relative Index of Economic Indicators in "Sustainable" Construction

Economic Indicators	Mean Item Score	Ranking
Strengthening the law and regulations in construction	0.872	1
Strategies for sustaining the continuity of affordable infrastructure projects.	0.833	2
Sustained and efficient use of resources and materials	0.828	3
Choose environmentally responsible suppliers and contractors	0.826	4
Local material protection policy	0.816	5
Energy – Efficiency policies in Design and Construction	0.798	6
Pricing policies	0.793	7
Improve administration effectiveness and reduce bureaucratic procedures	0.788	8
Ensure financial affordability for intended beneficiaries	0.767	9
Sustained employment opportunities	0.760	10
Credit and Policies to select projects	0.760	11
Labour – intensive construction policies	0.734	12

The ranking of certain bio physical factors that enhance sustainability in construction is highlighted in table 3. Respondents strongly agree that waste management in construction should be encouraged. This indicator is ranked first (mean item score = 0.819). This is a major challenge in most Nigerian construction sites and also corroborated by the FGDs across income areas. The inability to manage construction waste leads to air pollution and other health hazards. This construction waste problem manifested seriously at all construction sites visited. Another very important bio physical indicator for sustainable construction is the use of renewable building materials from sustainable sources. This will reduce the cost of maintenance due to the durability of materials used. The issue of renewability is considered as a key factor by the respondents as promotion of the use of rapidly – renewable materials also rank high. Table 3 shows other details of relative index of bio physical indicators in sustainable construction. All the indicators based on their respective (MIS) are very important and important factors, hence their consideration in sustainable construction is very essential, this agrees with the observation of (Wooley, 2000) that these factors will facilitate the attainment of sustainable construction.

Table 3: Relative Index of Bio physical Indicators in "Sustainable" Construction

Bio Physical Indicators	Mean Item Score	Ranking
Encourage construction waste management	0.819	1
Renewable building materials	0.816	2
Project design facilities	0.814	3
Promote the use of rapidly – renewable materials	0.805	4
Prevention of pollution from construction activity	0.795	5
Designs that takes into consideration existing cultural patterns and behaviours	0.791	6
Reduction of energy use	0.741	7
Water use reduction and conservation and rainwater collection.	0.704	8

Both results from questionnaire information and FGDs revealed that the most important technical indicator for sustainable construction is Design for flexibility and adaptability (item mean score = 0.875) as shown in table 4. Design for durability of exposed building parts and ensuring quality in creating the built environment are other two highly ranked indicators. Table 4 further indicates that the other factors were not considered necessary for green construction. To achieve this in Nigeria, the technological base has to be enhanced. Participants at the FGDs also showed concern at the low level of infrastructural and technological base which affect the quality of building materials and design.

Table 4: Relative Index of Technical Indicators in "Sustainable" Construction

Technical Indicators	Mean Item Score	Ranking
Design for flexibility and adaptability	0.875	1
Design for durability of exposed building parts	0.828	2
Pursue quality in creating the built environment	0.814	3
Use serviceability to promote sustainable construction	0.784	4
Construct durability of exposed building parts	0.778	5
Revitalize existing urban infrastructure.	0.764	6

Focus Group Discussions on Current Practices/Challenges of Sustainable Construction.

Participants at the FGDs are of the opinion that the current practice on sustainable construction does not take into consideration integrated design process, acoustic and visual comfort in the planning and construction of sustainable projects. However, some participants are of the opinion that they apply the principles of site suitability, spatial comfort and building integrity in the sustainable projects that they were involved.

CONCLUSIONS

This research demonstrates how sustainability can be viewed in the context of Nigeria. It points to the importance of process in any efforts at sustainable construction. Sustainable construction requires a process that looks at sustainability comprehensively, exploring each of its component dimensions to discern its fit and relevance to a given context.

- The prioritization of social needs clearly shows that to achieve social sustainability in Nigeria, emphasis is on quality of working life, education and training as well as knowledge management.
- The ranking of economic indicators of sustainable construction in Nigeria indicates that strengthening of existing laws, efficient use of resources, appointment of environmentally responsible contractors and local material protection are essential factors necessary for attainment of economic sustainability in construction.
- The application of efficient waste management system, the use of renewable construction materials and effective use of project design facilities will facilitate the attainment of biophysical sustainability in Nigeria
- Design for flexibility, durability, adaptability and quality are essential factors necessary for the attainment of technical sustainability in construction.
- Compliance with relevant legislation and regulations, ability to carry out preliminary assessment of purposes and activities as well as utilize a life cycle framework and manage activities through the setting of targets are essential factors necessary for attainment of sustainable construction.
- Emphasis should also be placed on integrated design process, site suitability, acoustic, visual, spatial and thermal comforts as well as building integrity in the practice of sustainable construction.
- A multi- stage framework for sustainable construction is proposed which requires application of Environmental impact assessment (EIA) and implementation of Environmental Management Systems (EMS) for all stake holders involved in sustainable construction.

RECOMMENDATIONS

In the light of research findings and conclusions, the following recommendations are made in order to motivate the application of sustainable construction in Nigeria.

- Government should improve existing laws in this area of research paradigm so as to improve quality of working life, education, training as well as knowledge management for all stakeholders in sustainable construction.
- A clause should be introduced in the conditions of contract that will address environmental issues of sustainable construction as this will facilitate the appointment of environmentally responsible contractors and suppliers.
- Seminars, workshops and lectures should be organised for all stakeholders in sustainable construction to address issues on efficient waste management, environmental management systems, and design for flexibility, durability, adaptability and the use of renewable construction materials.

PRACTICAL IMPLICATIONS

This study also expands the current literature on sustainable construction by carrying out a comprehensive overview of social, economic, biophysical and technical indicators associated with sustainable construction as well as the current practice and challenges facing sustainable construction (Hill and Bowen, 1997; Wolley, 2000; Sultan, 2005). Most research in this area of study has been qualitative in nature. This study has gone a step further by adding quantitative dimension to identified social, economic, biophysical and technical indicators. This prioritizing will guide policy thrust in the area of sustainable construction. Another major contribution of this study is the modified multi- stage framework developed for stakeholders in sustainable construction. From a practical perspective, this study's results have implications for stakeholders in sustainable construction. First, our findings suggest that effective enforcement of existing laws on the environment will definitely encourage the practice of sustainable construction. Further the results shows that improvement on quality of working life, education and training of stakeholders will facilitate rapid growth in application of principles of sustainable construction. This agrees with the opinion of Hill and Bowen (1997).

REFERENCES

Bluhm, G. L., Berglind, N., Nordling, E. and Rosenlund, M. (2007). Road Traffic Noise and Hypertension. OccupationalEnvironmental Medicine, 64,122-126.

Bornehag, C.G., Blomquist, G., Gyntelberg, F., Ja¨rvholm, B.,Malmberg, P., Nordvall, L., Nielsen, A., Pershagen, G. and Sundell, J. (2001). Dampness in Buildings and Health. Nordic Interdisciplinary Review of the Scientific Evidence on Associations between Exposure to 'Dampness in Building and Health Effects (NORDDAMP). Indoor Air, 11(2), 72–86.

Bourdeau, L. (2000) "Sustainable Construction: A Framework and International Agenda for Change." Publication No. 260, Int. Council for Research and Innovation In Building and Construction CIB.

Cole, R.J., Robinson, J., Brown, Z. and O'shea, M. (2008) Re-contextualizing the notion of comfort. Building Research & Information, 36(4), 232–336.

ECONorthwest (2001). Green Building: Saving Money and the Environment Opportunities for Louisiana. ECONorthwest, Eugene, Oregon: October 2001.

Gardner, J.E. (1989) Decision Making For Sustainable Development: Selected Approaches to Environmental Assessment and Management. Environmental Impact Assessment Review, 9(4), 337- 66.

Griefahn, B. and Spreng, M. (2004) Disturbed Sleep Patterns and Limitation of Noise. Noise and Health, 6(22), 27–33.

Hill, R.C and Bowen, P.A (1997) Sustainable Construction, Principles and Framework for Attainment, Construction Management And Economics, 15, 223-239

Hillier, B. and Hanson, J. (1984). The social logic of space. Cambridge: Cambridge University Press.

International Union for the Conservation of Nature and Natural Resources (IUCN) (1991) World Conservation Strategy. Gland, Switzerland.

Kibert, C, Sendzimir, J, and Guy, G. B. (2000) "Defining an Ecology of Construction." Construction Ecology: Nature as the basis for Green Buildings, Ed. Kibert, Sendzimer, and Guy. New York: Spon Press, Pp 7-28.

Lucas, G and Rubel, W (20004) The Moral Foundations of Leadership, Boston, MA: Pearson Education, Pp 116.

Nwafor, J.C (2006) Environmental Impact Assessment for Sustainable Development. Enugu: Eldermark Publishers.

Ochoa, C.E and Capeluto, I.G (2009) Advice Tool for Early Design Stages of Intelligent Facades Basedon Energy and Visual Comfort Approach, Energy Build, 480-488.

Ofori, G (2000) Challenges of Construction Industries in Developing Countries: Lessons from various Countries. Proceedings of The 2nd International Conference of the UB TG29 On Construction In Developing Countries Challenges facing The Construction Industry in Developing Countries 15-17 November 2000, Gabarone, Botswana, Pp1-3

Reed, G.R and Gordon, E.B (2000) Integrated Design and Building Processes, Building Research and Information, 28(5), Pp 325-337.

Santoli, L. D and Matteo, U.D (2003) Building Energy and Environment Performance system, Building Systems,24(2), Pp 61-68.

Shove, E., Chappells, H., Lutzenhiser, L. and Hackett, B. (2008) Comfort in a lower Carbon Society. Building Research &Information, 36(4), 307–311.

Sultan, M K (2005) The Construction Industry In Yemen : Towards Economic Sustainability. A Thesis Submitted in Partial fulfilment of the requirement for Doctor of Philosophy.

United Nations, (1987)"Report of the World Commission on Environment and Development." General Assembly Resolution 42/187, 11 December 1987"

Wallbaum, H, And Buerkin, C (2003). Concepts and Instruments for a Sustainable Sector. Industry and Environment: Sustainable Building and Construction. United Nations Environment Programme 26(2-3): 53-57.

Woolley, T (2000). Green Building: Establishing Principles. Ethics and the Built Environment, Ed. Warwick Fox. Rutledge, London: Pp 44-56.

SUSTAINABLE TOURISM ARCHITECTURE: USER EVALUATION OF ARGUNGU FISHING VILLAGE

Stephen Nwabunwanne Oluigbo[1]
Department of Architecture, Ahmadu Bello University, Zaria, Nigeria

Architectural design for sustainable tourism facilities demands the creation of spaces which will attract and satisfy the market, based on solutions which preserve, reinforce, or project destinations' natural and cultural attributes. In order to determine the extent to which this was reflected in the design of Argungu fishing village, Kebbi state, Nigeria, visual survey was conducted. This was followed by user perception survey through on-site questionnaires administration. Obtained data were subject to descriptive analysis and non-parametric tests. Findings from the questionnaire survey include: Perception of low level of response to the market; moderate level of response to local culture; and, high response to the natural environment. Results also show positive attitude towards the combination of indigenous and modern architecture in the design. The study concludes that the design of Argungu fishing village reflected considerable attempts at sustaining the natural and cultural environment. However, there is need for more attention to user needs and preferences in order to enhance patronage and economic sustainability.

Keywords: culture, fishing, market, natural environment, sustainable tourism.

INTRODUCTION

One of the key physical features of tourism development is the construction of facilities. These facilities are an important part of the tourist experience at destinations and their adequacy is often central to visitor attraction and satisfaction (Mill and Morrison, 1985; Moscardo, 2001). They contribute in shaping tourism landscapes by influencing the type and number of tourists in a particular location as well as their spatial activity patterns (Middleton and Hawkins,1998). They are one of the most visible features of tourism destinations with the potential to alter the characteristics of their location if designed insensitively (Marin and Jafari, 2002). Their fixed nature and large footprint makes them the most likely sectors to be blamed by destination authorities and communities for any perceived environmental or social degradation (Weaver, 2006). In line with this, the World Tourism Organisation (WTO) (2005) emphasized the importance of appropriate architectural design of tourism facilities and the place of architecture in shaping and enhancing the image of tourist destinations or destroying it altogether.

Two key stakeholders in sustainable tourism facilities development are the tourists and members of the host community. These two also constitute the users. Robinson and Picard (2006) noted that tourists and member of the host community had a stake in sustainable tourism development. Therefore, their input is essential in sustainable tourism facilities design. While the benefit of the tourists was largely linked to

[1] snolui@yahoo.com

Oluigbo, S.N. ((2011) Sustainable tourism architecture: user evaluation of Argungu fishing village *In:* Laryea, S., Leiringer, R. and Hughes, W. (Eds) *Procs West Africa Built Environment Research (WABER) Conference*, 19-21 July 2011, Accra, Ghana 897-904.

recreational experience, host communities have a direct stake in tourism in ensuring that developments do not degrade their environment or erode local culture. Studies have also identified significant difference between tourists and the local community in perception of tourism facilities developments (Mcnicol, 1996; Jones et al. 2000; Yung et al, 2003). Others have noted that what some considered as progress may be viewed by others as detrimental to the environment (Kaltenborn 1998; Cheng et al. 2003; Cresswell, 2004; Rowena, 2005). These factors need to be put into consideration for the sustainable tourism facilities design.

This paper applied user perception and evaluation in order to determine the extent to which the architectural design of Argungu fishing village reflected consideration for sustainable design. The objectives of the paper are:

(i) To conduct a review of sustainable tourism facilities design requirements with reference to the three pillars of sustainability;

(ii) To survey the perception of users on the reflections of sustainable design in Argungu fishing village; and,

(iii) To determine whether there are significant differences between key user groups (tourists and the local population) on the importance attached to various aspects of sustainability in the design of tourism facilities.

SUSTAINABLE TOURISM FACILITIES DESIGN

Designing for sustainability firstly requires the identification of the entities that needed sustaining and what their requisite state should be (Gibberd, 2003). This study looks at the design of sustainable tourism facilities through the three pillars - the environment, culture, and economy.

The Market as Basis of Economic Sustainability

One of the keys to economic sustainability of tourism facilities is the ability to attract tourists, increase their expenditure, while providing them with quality services and satisfying experiences (Ritchie and Crouch, 2003 Al-Masroori, 2006 *op cit*). In order to achieve this, tourism facilities design should be based on study of market trends, needs, expectations and preferences of tourists, and the type of facilities which would best satisfy them. This will aid the design of facilities based on the characteristics of the destination (Michael, 1986; Western Australia Tourism Commission (WATC), 1990; Southern Australia Tourism Commission (SATC), 2007; http:// www.rainforest-alliance.org). SATC (2007) listed the following as the basic questions to ask in the study of the existing market for the purpose of development as: How many visitors come to the region, town, area, or specific sites? Where do they come from – international, specific region, local? What do they seek – desires and preferences? Who are they – origin, demography, psychographic and behavioural segmentation? Where do they stay – accommodation preferences?

Sustaining the Natural Environment

Environmental conscious tourism facilities design entails optimal use of environmental resources (SATC, 2007). To achieve this, controls should be applied in tourism facilities design in order to minimise adverse impacts on the natural environment, maintain and promote the image of the facility, optimize the experience, and enhance the attraction (WATC, 1990). At the destinations, design should minimize any form of environmental degradation or pollution. It should also aim at maintaining the visual quality of the setting (SATC, 2007). This demands that design be based on ecological factors of the location such as solar energy, soil, water supply, humidity, wind, topography, and altitude, and the use of sites natural attributes as primary experience and design determinant (Denver Service Centre, 2009). At the global level, the major issues are the minimization of greenhouse gas emission and conservation of non-renewable energy (SATC, 2007). Design with natural characteristics of tourism destinations reduces capital and operating costs by relying on the site's natural features thus downsizing mechanical systems through smart and efficient energy systems (WATC, 1990; Sustainable Sitting, 2007; Denver Service Centre, 2009). Tourists are also responding to good design. According to a 1996 study by the Travel Industry Association of America, some 43 million Americans are willing to pay an 8.5% premium to stay in what they perceive to be an environmentally sensitive property (Sustainable Sitting, 2007).

Sustaining Local Culture

Sustainable tourism facilities design should promote the identity and sense of place of the host community rather than overshadowing it. In line with this, Huffadine (2000) recommended the assimilation of local customs and heritage with the function of tourism facilities. Similarly, SATC (2000) called for the reflection of community values in tourism developments and recommended that architectural style, landscape design, and construction materials of new developments should reflect the cultural heritage of the locality or region. This can be achieved through the use of the cultural attributes of sites as primary experience and design determinant (Denver Service Centre, 2009). Design should also encourage the use of local knowledge, skills and traditions, and promote tourist activities and behaviours which are respectful of cultural activities, sites and values (Williams, 2007; SATC, 2007). While focusing on local built environment, submissions from the international conference on Built Environments for Sustainable Tourism (BEST) held at Muscat, Sultanate of Oman held in 2005 showed that modern tourism facilities were not necessarily antagonistic to sense of place (WTO, 2005). Memorandum of the conference stated that modern components can blend successfully with traditional built environments.

ARGUNGU FISHING VILLAGE

Argungu Fishing Village is the venue of the annual Argungu fishing and cultural festival which is one of the most popular cultural tourism attractions in Nigeria. It is located in the Sudan Savannah grassland zone of Nigeria and lies in the Sokoto river basin at an altitude of about 225 metres above sea level and covers an area of about 276 hectares (Adamu, 1982; http://argungufishingfestival.gov.ng/index.php).

Argungu has been a strong centre of administration, right from its establishment at the beginning of the nineteenth century, to date (Adamu, 1982). The dominant ethnic group at the destination is the Hausa with a small minority of the inhabitants from other groups. (http://argungufishingfestival.gov.ng/index.php).

Place responsive design for this destination is clearly reflected in the traditional architecture (Hausa architecture). Features of this include: Use of courtyard in design; massive mud walls of high thermal capacity with an eight hour time lag; small size openings; longer sides of buildings facing the north and south; use of trees for shading; flat, domed or thatched roof; pinnacles; arches; decoration of door and window surrounds; general abstract wall decorations; entrance room (azure) and inner courtyards, among others (Evans, 1980; Denyer, 1982; Moughtin, 1985; Sa'ad, 1985; Dmochowski, 1990; Ogunsote, 1991).

Four categories of buildings are distinguishable from the visual survey of Argungu fishing village. These are: the fully traditional buildings represented by Gidan D. O. (former District officer's residence); combination of modern and traditional styles represented by the round huts; fully modern with no distinguishing characteristics, represented by the lodges; and, symbolic buildings, represented by the "fish house" (Nigerian Tourism Development Corporations' station) (see Plates I to IV).

These multiple and apparently contradictory architectural characteristics could however be explained by the history and evolution of the village which shows that each of these categories of buildings was constructed at different periods starting from the colonial era to the present age.

Plate I and II: Gidan D.O. showing fully traditional Hausa architectural characteristics; group of ‘round huts’ in the landscape showing resemblance to a village setting.   Source: field survey 2010.

Plate III and IV: Front view of one of the lodges showing reflection of modern architectural characteristics; ‘fish’ house showing fish-like building form. Source: field survey 2010.

METHODOLOGY (EVALUATION)

The study adopted visual survey and user perception in the evaluation of architectural design of Argungu fishing village with reference to the three pillars of sustainability - economy, environment, and culture. The users include tourists and members of the host community. Site/user survey method was adopted. This approach has the advantage of high response rate and medium cost (Veal, 2006). 392 questionnaires were administered through systematic random sampling. This was based on a combination of respondent and interviewer completed methods through stationary interviewers distributed around the survey site. The questions were placed on a five point Likert scale. The scale consists of a set of items of equal value and a set of response categories constructed around a continuum of important/not important and low/high. The study also tested a null hypothesis: Ho1 - There is no significant difference between residents and visitors on importance of destination's resources to sustainable tourism facilities design. Analysis was based on descriptive account, descriptive statistics and non-parametric tests. These involved the use of Statistical Package for Social Science (SPSS).

RESULT

Design with the Market

With regards to the market, the survey sought to ascertain the level of importance attached to seven facilities and users' rating of provision of such facilities at Argungu fishing village. The facilities are: High quality accommodation facilities; outdoor relaxation spaces; sports facilities; performance spaces; shopping facilities; outlets for food and drinks; and, conference facilities. The result shows that the most important facility was outdoor relaxation spaces with a score of 4.60 on a five point Likert scale, while the provision of such facilities obtained a score of 2.09 on the same scale. The facility scored low on all aspects except for the provision of performance spaces. (see Table 1).

Table 1: User needs and its reflection in Argungu fishing village

Facility	Importance	Reflection
High quality accommodation facilities	4.52	2.09
Outdoor relaxation spaces	4.60	2.29
Sports facilities	4.00	2.09
Performance spaces	4.10	3.64
Shopping facilities	2.52	2.05
Outlets for food and drinks	4.51	2.04
Conference facilities	3.50	1.15

Sustaining the Natural Environment

Five resources were investigated with respect to the sustenance of the natural environment. These are: Respect for topography; preservation of vegetation; natural lighting; natural ventilation; and, use of renewable energy. The result shows high correlation between the level of importance attached to the destination's natural environment and the reflection of this. Argungu fishing village however scored low in the use of renewable energy (see Table 2).

Table 2: Natural resources and its reflection in Argungu fishing village

Natural resource	Importance	Reflection
Respect for topography	3.78	3.04
Preservation of vegetation	3.82	3.60
Natural lighting	4.82	3.50
Natural ventilation	4.89	3.65
Use of renewable energy	2.85	1.00

Sustaining Local Culture

Survey result shows that: 241 respondents representing 61.5% were pleased with the combination of indigenous and modern (western) architecture in the design; 117 respondents representing 29.8% believed it should have been based on indigenous architecture alone; while, 34 respondents representing 8.7% believed it should have been solely based on modern architecture (see Table 3).

Table 3: Respondents' choice of Architectural Style for Tourism Facilities at Argungu

Modern (Western) architecture	Combination of indigenous and Modern (Western) architecture	Indigenous architecture	Total
34 (8.7%)	241 (61.5%)	117 (29.8%)	392 (100%)

The study also sought to determine the level of importance attached to five cultural resources and their levels of reflection in the existing facility. These elements are: Expression of indigenous architectural heritage; use of indigenous building materials; use of indigenous building techniques; application of indigenous ornaments and decorations; and, preservation of local lifestyle. The result shows that expression of indigenous architectural heritage and preservation of local lifestyle, were the most important cultural resources with scores of 4.49 and 4.37 respectively. Respondents perceived moderate level of expression of indigenous architectural heritage and high level of preservation of local lifestyle. Details of these are given in Table 4 below.

Table 4: Cultural resources and their reflection in Argungu fishing village

Cultural resource	Importance	Reflection
Expression of Indigenous architectural heritage	4.49	2.83
Use of indigenous building materials	3.19	2.16
Use of Indigenous building techniques	3.11	2.08
Application of Indigenous ornaments and decorations	4.16	2.07
Preservation of local lifestyle	4.37	3.98

Test of Hypothesis

The study sought to determine whether there were differences between tourists and the local population on the importance attached to various resources of the destination with regards to sustainable tourism facilities design as indicated in various studies (Mcnicol, 1996; Jones et al. 2000; Yung et al, 2003; Cheng et al. 2003; Cresswell, 2004; Rowena, 2005). A null hypothesis (Ho1) was therefore proposed which states that there is no significant difference between residents and visitors on importance of destination's resources to sustainable tourism facilities design.

Table 5: Residents versus Visitor Differences on Importance of Argungu's Resources in Tourism Facilities Design

Characteristics	X^2	p
Need for design to preserve destinations natural vegetation	4.458	.348
Need for design to preserve destinations topography	10.173	.038
Need for design to express indigenous architectural heritage	10.465	.033
Need for design to preserve and reflect local lifestyle	2.639	.620

The result showed no significant difference on the need for design to preserve destinations natural vegetation with x^2 value of 4.458 and p-values of $0.340 > 0.05$. On the need to preserve destinations topography significant difference was detected with x^2 value of 10.173 and p-value of 0.038. On the need to project destinations architectural heritage, significant difference was detected with x^2 value of 10.465, and p-value of 0.033. On the need for design to preserve and reflect local lifestyle, the hypothesis was accepted with x^2 value of 2.369 and p-value of 0.620 (see Table 5).

CONCLUSIONS

This paper applied user perception and evaluation to determine the extent to which the architectural design of Argungu fishing village reflected consideration for sustainable design. The result shows moderate level of correlation between the importance attached to local cultural characteristics and their reflection in design; and, fairly high level of correlation between importance attached to the destination's natural environment and its reflection in design. However, while previous studies have buttressed the need for tourism facilities design to be based on user needs and preferences in order to enhance economic sustainability (WATC, 1990; Ritchie and Crouch, 2003 Al-Masroori, 2006 op cit; SATC, 2007; www.rainforest-alliance.org), there was a low level of correlation between facilities demanded by users and that which was available at the fishing village. Majority of respondents believed that tourism facilities should be based on a combination of indigenous and modern architectural styles. This confirms WTO's (2005) findings that modern architecture was not antagonistic to sense of place and that local vernacular architecture could be reinterpreted through contemporary lenses for tourism facilities design. Test of hypothesis confirmed the existence of differences in perception between tourists and hosts as indicated in previous studies (Mcnicol, 1996; Jones et al. 2000; Yung et al, 2003; Cheng et al. 2003; Cresswell, 2004; Rowena, 2005).

Based on these findings the study recommends the following:

(i) Provision of additional outdoor spaces and improvements of quality of accommodation facilities in order to satisfy the market;

(ii) Renewable energy should be explored since some amount of importance was attached to it by the users;

(iii) Design should combine modern architecture with local character to enhance attraction since modern architecture was not antagonistic to the host community;

(iv) Differences in perception between tourists and the host community should be harmonised to ensure sustainability.

REFERENCES

Adamu, M. B. (1982). Argungu fishing festival: Its impact on town's development, Unpublished M.Sc. thesis, Ahmadu Bello University, Zaria.

Al-Masroori, R. S. (2006). Destination competitiveness: Interrelationship between destination planning and development strategies and stakeholders' support in enhancing Oman's tourism industry. Unpublished Doctoral thesis, Department of Business and Asian Studies, Griffith University, Australia.

Cheng, A. S., Kruger, L. E., and Daniels, S .E. (2003). "Place" as an integrating concept in natural resource politics: Propositions for a social science research agenda. Society and Natural Resources. 16: 87–104.

Cresswell, T. (2004). Place: A short introduction. Malden Ma: Blackwell Publishing.

Denver Service Centre (2009). Guiding principles of sustainable design. Retrieved May 4, 2009 from http://www.nps.gov/dsc/d_publications/d_1_gpsd.htm.

Denyer, S. (1982). African traditional architecture. London: Heinemann.

Dmochowski, Z. R. (1990). An introduction to Nigerian traditional architecture, Volume one: Northern Nigeria. London/Lagos: Ethnographica/ National Commission for Museum and Monumnts.

Gibberd, J. (2003). Integrating sustainable development into briefing and design processes of buildings in developing countries: An assessment tool. Unpublished PhD thesis, Department of Architecture, University of Pretoria.

Government of the Federal Republic of Nigeria, United Nations World Tourism Organisation, United Nations Development Program and Tourism Development International (2006). Nigeria tourism master plan: Institutional capacity strengthening to the tourism sector in Nigeria. NIR/03/002.
Huffadine, M. (2000). Resort Design: Planning, Architecture, and Interiors. New York: Mcgraw-Hill.
Jones, C. D., Patterson, M. E., Hammitt, W. E. (2000). Evaluating the construct validity of sense of belonging as a measure of landscape perception. Journal of Leisure Research. 32(4): 383–395.
Kaltenborn, B. P. (1998). Effects of sense of place on responses to environmental impact: A case study among residents in an Arctic community. Applied Geography. 18(2): 169–189.
Marin, C. and Jafari, J. (2002). Sustainable hotels for sustainable destinations. Annals of Tourism Research, 29, 266–8.
Middleton, V. and Hawkins, R. (1998). Sustainable Tourism: A Marketing Perspective, Butterworth: Heinemann.
Mcnicol, B. J. (1996). Views of residents, developers, and government planners about tourism and tourism resort developments in Canmore, Alberta. Unpublished PhD thesis, University of Calgary, Alberta, Canada.
Michael, I. O. (1986). Tourism in relation to hotel industry. Nigerian trade journal 5(2), 30.
Mill, R. C., and Morrison, A. M. (1985). The tourism system: An introductory text. New Jersey: Prentice- Hall.
Moscardo, G. (2001). Visitor evaluations of built tourist facilities: Pontoons on the Great Barrier Reef. The Journal of Tourism Studies, 12(1), 28-38.
Moughtin, J. C. (1985). Hausa architecture. London: Ethnographica Limited.
Ogunsote, O. O. (1991) Introduction to building climatology. Zaria: Ahmadu Bello University Press.
Robinson, M. and Picard, D. (2006). Tourism, Culture and Sustainable Development.Paris: UNESCO.
Rowena, B. (2005 October 17- 21). Peripheral vision: Implications of spatial contextualization for communities surrounding heritage sites. Proceedings of the ICOMOS 15th General Assembly and Scientific Symposium on “Monuments and sites in their setting: Conserving cultural heritage in changing townscapes and landscapes”. Xi’an, China.
Saad, H. T. (1985). The role of individual creativity in traditional African art: The gwani amongst master builders of Hausa-land. Nigeria magazine, Vol. 53, No 4, pp. 3- 16.
South Australian Tourism Commission (2007). Design guidelines for sustainable tourism development. Sydney: SATC.
Sustainable Siting (2007). The sustainable siting, design and construction of tourism facilities. Retrieved December 10, 2007 from http://www.ih-ra.com/marketplace/docs/3environmental-teaching.pdf.
Veal, A. J. (2006). Research Methods or Leisure and Tourism. Third Edition. London: Prentice Hall.
Weaver, D. (2006). Sustainable tourism: Theory and practice. Amsterdam: Elsevier Butterworth Heinemann.
Western Australian Tourism Commission (2000). Designing tourism naturally – A review of world best practices in wilderness lodges and safari camps. WATC
Williams, D. E. (2007). Sustainable design: Ecology, architecture, and planning. New Jersey: John Wiley and Sons, Inc.
World Tourism Organisation (2005, February 5-8). Final report of the international conference of Built environment for Sustainable Tourism (BEST) held in Muscat, Sultanate of Oman.
Yung, L., Freimund, W. A., Belsky, J .M. (2003). The politics of place: Understanding meaning, common ground, and political difference on the Rocky Mountain Front. Forest Science. 49(6): 855–866.

THE CONTEXT OF HUMAN RESOURCE IN THE GHANAIAN PUBLIC SECTOR

Michael Adusei Boadu[1] and Emmanuel Opoku-Ware[2]
[1]*Human Resource Office, Takoradi Polytechnic, P. O. Box 256, Takoradi, Ghana*
[2]*Sunyani Polytechnic, Sunyani, Ghana*

This paper examines the context of human resource management in the Ghanaian public sector to the effective management of employees in an organization in which they work. For one thing, such an understanding could provide managers with the opportunity to cater to the needs of their employees, for another, this could provide clues on which effective strategies towards the improvement of the work environment cold be based. For a country such as Ghana where it is generally acknowledged that employee productivity is abysmally low, knowledge about the milieu in which employees work as well as fact ors influencing their behaviour, are certainly critical to effective human resource management.

Key words: employee, Ghana, human resource management, productivity, public sector.

[1] micky15151@yahoo.com

Boadu, M.A. and Opoku-Ware, E. ((2011) The context of human resource in the Ghanaian public sector *In:* Laryea, S., Leiringer, R. and Hughes, W. (Eds) *Procs West Africa Built Environment Research (WABER) Conference*, 19-21 July 2011, Accra, Ghana, 905-905.

THE LIKELY EFFECT OF SUSTAINABLE LANDSCAPE ON THE QUALITY OF LIFE THROUGH TOURISM: FOCUS ON NIGERIA

Dorcas A. Ayeni[1], O.J. Ebohon and A.H. Taki

De Montfort University, School of Architecture, Developing World Built and Natural Research Unit. United Kingdom

Increase in leisure time, improved rising standard of living and concerns for healthy life style has geared people into taking part in tourism activities and landscape, play a very important role in the choice of the tourist destination. The desire of every tourist is to enjoy beautiful landscapes either natural or human-made which come in a variety of forms. A well landscaped attraction with nature, wildlife, water and other elements help people enjoy the environment, fresh air, engage in physical exercise, reduce anxiety and feel relaxed thereby adding to the quality of life. This paper sheds light on the need for proper development of tourist potentials in Nigeria through landscaping in order to improve on the quality of life of its people and tourists in general. It reviews literature in landscaping and examines the role it plays on the quality of life. It also analysed data collected from field survey in Nigeria using the descriptive summary measures and concludes that landscaping has the potential to contribute to the human wellbeing if considered, and should feature in the development of the Nigerian tourists' attractions.

Keywords: landscaping, Nigeria, quality of life, sustainability, tourism.

INTRODUCTION

Tourism is becoming one of the main focus for economic revitalization globally and especially in developing countries where attention is being directed, to serve as avenue for economic diversification. It benefits not only the country as a whole as noted by Bankole and Odularu (2006), but also local areas in tourist destinations. Tourism also affords the opportunities for diversity of landscapes. In view of this, Abraham, Sommerhalder and Abel (2010) argued that landscapes have the potential to promote mental wellbeing, physical wellbeing and social wellbeing; as such tourism presents an avenue for leisure activities which eventually improves well-being and quality of life.

As noted by Jim and Chen (2009), people are willing to pay a premium for attractive environment. Similarly, VanDerZanden and Cook (2010) argued that aesthetic appearance is the criterion by which most people judge a landscape, in addition, there is a premium on neat and tidy looking landscapes; hence the need for the Nigerian tourism industry to enhance tourists' attractions through landscaping to maximise the benefits from tourism. The environment is an important asset to tourism development, for this reason, Inskeep (1987) noted that tourism and the environment are interrelated

[1] dorcasayeni2@yahoo.com

Ayeni, D.A., Ebohon, O.J. and Taki, A.H. ((2011) The likely effect of sustainable landscape on the quality of life through tourism: focus on Nigeria *In:* Laryea, S., Leiringer, R. and Hughes, W. (Eds) *Procs West Africa Built Environment Research (WABER) Conference,* 19-21 July 2011, Accra, Ghana, 907-918.

and planning tourism environmentally is essential, as such whatever setting a tourist destination presents, be it heritage, coastal, natural, urban, or rural, it must be conducive and exciting. In view of Butler (1991), tourism is dependent upon the environment, however, the prevailing lack of knowledge, responsibility and long term planning has resulted in development which is neither environmentally nor culturally sensitive. This is particularly the case with Nigerian tourism where effective training and education are not provided in order to create the professionalism the industry needs towards efficient service delivery (Ebohon, Ayeni and Taki, 2009).

Nigeria is highly blessed with natural resources (Jiboku and Jiboku, 2010) unfortunately, has failed to capitalise on them for effective and sustainable development, even with the glaring fact that the tourism sector has the potentials to generate significant foreign exchange earnings, employment and investment towards economic development (Adora, 2010). Thus, as revealed in the World Tourism Organisation yearbook of Tourism Statistics (2008) Nigeria is still far behind in the lists of the world top earners in terms of tourists' arrivals and receipts as compared to developed countries; where destinations are constantly monitored and changes effected from time to time in order to be up to date with new developments. In this regard, Figueira (2001) suggested that to enhance positive effects of tourism, the authorities should be involved in tourism planning and development.

As averred by Butler (1991), tourists' destination areas evolve and change over time, responding to and being altered by changes in tourism. Furthermore, the environment is not static and need responsible and proactive planning and management for it to be sustainable. Sustainable tourism development can only be ascribed to the Nigerian tourism sector if many of the tourists' attractions are given facelift and made welcoming. We advance the argument that introducing landscape elements is the most effective ways to transform tourist sites in Nigeria and made attractive to local and international tourists.

THEORETICAL FRAMEWORK

The definition of sustainable development by the Brundtland commission WCED (1987) as ''development that meets the needs of the present without compromising the ability of the future generations to meet their own needs'' is widely acknowledged. This definition addresses the need of the present and that of the future. As noted by VanDerZanden and Cook (2010), if resources are over used or misused, there will be fewer resources for the future generation to draw on. Indeed, sustainable development is about maintaining balance between human needs to improve wellbeing and at the same time preserving natural resources and the ecosystems; thereby ensuring the integrity of the natural environment. Hence, as noted by Ercan (2011), sustainability is about meeting human needs without having to compromise the ability of the natural resources to replenish itself, hence its carrying capacity.

In the field of tourism, sustainable tourism as defined by the World Tourism Organisation refers to tourism that leads to the management of all resources in such a way that economic, social and aesthetics needs can be fulfilled while maintaining cultural integrity, essential ecological process, biological diversity and life support systems. Also, applying the Brundtland report definition, Swarbrooke (1999) argues that, tourism which meets the need of tourists, the tourism industry, and host communities today without compromising the ability of future generation to meet their own need is sustainable tourism. Thus, sustainable tourism is tourism development which avoids damage to the environment, economy and cultures of the locations where it takes place and coordinated such that its activities does not destroy nature. Nohl (2009), consider that sustainability can only be achieved if economy, ecology and culture processes take place without destroying natural resources and at the same time provide employment and welcome generally opportunities towards effective social development (Tzanopoulos et al, 2011).

Tourism is a tool which can aid development as well as enhance the quality of life of visitors and the host community. As such, if poorly planned as noted by AMSET (2007), it can be a destroyer to the special quality which is so central to sustainable development. The reason why tourists visit attractions is due to the attractiveness of the tourism product. These tourism products includes common goods such as the quality of the landscape, wildlife, historic and cultural attributes of the area as well as leisure and recreation facilities used by both tourists and local residents(Supplementary Planning Guidance, 2004). On the other hand, Liu, Ko and Ko (2011) defines attraction as things to see, activities to do and experiences to be remembered. Therefore, tourism can improve the quality of life in an area by increasing the number of attractions, recreational opportunities and services. Furthermore, it offers residents' opportunities to meet interesting people, make friendships, learn about the world and expose themselves to new perspectives (Kreag, 2001). It can therefore be argued that the overall level of wellbeing and fulfilment that people enjoy from a combination of their social, economic and community environment help improve their physical and material conditions (Morais and Camanho, 2011).

Landscape refers to the combination of natural and cultural, physical and symbolic elements and features on land that is the product of interaction between natural and human activity (Supplementary Planning Guidance, 2004). Furthermore, it is increasingly seen as a valued resource both in terms of its contribution to quality of life, tourism and leisure industry (Supplementary Planning Guidance, 2004), in this regard; more sustainable approaches are needed for planning and managing landscapes worldwide (Leitao and Ahern, 2002) and should support those ecological processes required for the landscape to deliver biodiversity services for the present and future generations (Opdam, Steingrover and Rooij, 2006). Enhancing the environment will leave a legacy for the future generations. As stated by the Scottish Natural Heritage (2003), the quality of the environment is important for functional, aesthetics, scientific and economic reasons; ensuring that the environment remain useful; that is, there is tranquillity and recreational opportunities, important places are safe guarded for study as well as support jobs and at the same time act as key resource for tourism.

Dejean-pons and Chaboisseau (2000) noted that landscape is an important part of the quality of life for people everywhere and a key element of individual and social wellbeing. Emphasizing on the meaning of quality of life, Pacione (2003) argued that it is not necessarily a simple function of material wealth but refers either to the conditions of the environment in which people live or the same attribute of people themselves. Thus giving the definition of landscape as earlier defined, landscape is more than a view as argued by CPRE (2010), its character make an area unique and directly affects the quality of life; Its features are important influences on visitor experiences (white, 2006).

As noted by Nohl (2011), an improvement of landscape aesthetics will have much to do with sustainable development of landscapes, thus, sustainability is an all embracing principle for developing and managing nature and resources. Ling and Dale (2011) argued that, interaction with nature is as vital for community as is social intercourse; without landscape and cultural diversity, both ecological and human systems will stagnate and eventually collapse or fail. Creating and managing sustainable landscapes as highlighted by Dodson (2010) encourages people to spend more time outside and exercise as well as families spending more time playing together in safe public parks. Furthermore, trees help insulate and shade buildings. In addition, Landscaping elements help provide relief from heat, Creates community cohesion and encourage friendliness.

In the works of Selman (2008); Backhaus (2008) and Gailing (2005), five dimensions were reflected in the debate of Sustainable landscape and summarized as environmental sustainability having sufficient size and quantity and maintaining healthy and viable population; economic sustainability expressed as the maintenance of attractive scenery to support tourism and recreation; social sustainability addressing the participation and inclusivity of decision making and access; political sustainability reflecting the effective governance structure for both private and public domain; and aesthetic sustainability, addressing visual amenity and healthy functioning of underlying system. Thus landscape play important role of visual appeal and are the results of the interaction of people with their environment, therefore it should be developed in a sustainable way.

Sustainable landscape is landscape which contributes to human wellbeing, protects and enhances the ecosystem (flora and fauna) by constantly maintaining and improving on what currently exists, thereby giving the future a better place to live. This can be achieved as stated by Bousselot, Badetscher and Roll (2005) by using the various principles and techniques of landscaping which includes having attractive environment that is in balance with the local climate and requires minimum inputs of fertilizer, pesticides and water. In addition, it should be functional, cost effective, visually pleasing, environmentally friendly and of appropriate design.

SUSTAINABLE LANDSCAPE AND THE QUALITY OF LIFE

Landscape as noted by Selman (2006) provides an avenue in which the balance of economic, environmental and society commonly described in sustainable development may be pursued. In tourism, environmental quality can act as a major attraction or an impediment (Jafari, 2003); furthermore, a tourism facility or destination which strives to build and maintain an attractive, functional and secure environment of high quality can anticipate increase in patronage. Thus a well planned tourist destination will not only improve the individual life but also will increase patronage; as stated by Shah, Kale and Patki (2002), a well planned and maintained gardens develops man's aesthetic awareness and help people to ponder the values of life. Similarly, Andereck and Jurowski (2006) said quality tourism experiences depend on a receptive host population and an attractive natural environment.

Similarly, Buchanan (2000) averred that, a well designed landscape will enhance the quality of life; also, Thompson et al (2007) stated that the quality of the landscape in which we lead our lives makes a difference to the quality of the lived experience. As such quality of life refers to the degree of well-being felt by an individual or group of people and relates to both physical (health, diet, pair and diseases) and psychological (worry, stress and pleasure) aspects of life. It is also defined by Felce and Perry (1999) as the satisfaction of an individual's values, goals and needs through the actualisation of their abilities or life style. In the words of Benson and Roe (2007), quality of life is used to define a broadest of indicators that describe the environment, opportunities and services available to those living in a given area and has significant overlap with environment quality, people's day to day lives in an attractive and accessible landscape. It can therefore be said to be an individual's wellbeing and personal satisfaction.

Indeed, it can be argued that knowing the needs of people and putting them into consideration at the design stage of the urban environment is very important; as this would allow the creation of attractive and accessible environment that may enhance their experience and quality of life. Landscaping the environment where man lives contribute to the health and well-being of the individual, this is particularly true in places where there is the availability of open parks with various landscape elements and the opportunity of visiting such places and also around the garden within the home environment. Finding time out of the busy schedule will help release or reduce stress and help the individual keep fit and at alert.

A direct contact with nature and planting around the garden and the environment with a pleasing landscape design help people to relax, also, having to watch nature of different variety and colour also give a regenerative effect. Further arguing on the effects nature has on the quality of life, Thompson et al (2007) stated that access to green space and nature is a key contributor to quality of life and patterns of healthy living; in addition, various forms of contact with nature are known to produce restorative benefits, as such there is the need to understand what qualities of landscape are relevant for different people's health, wellbeing and quality of life. A Well landscaped set up with nature, wildlife, water and other elements help people enjoy attractive surrounding, fresh air, and physical exercise, reduce anxiety and feel relaxed. Other forms of benefits include psychological-stress reduction, physiological-physical health. As noted by SEEDA(2005) research shows that nature, open spaces and countryside, bring health benefit such as lowering blood pressure significantly; similarly, Morris (2003) stated that visual contact with nature was beneficial to the emotional, psychological health of a city dweller and has a restorative effect on the individual.

Furthermore there are five keys as summarised from the works of Morris (2003) to which exposure to natural environment is beneficial to human health are as listed below

a. “Enhancing personal and social communication skills” Recreating in landscape garden help encourage social interaction, meeting people and help foster a more socially beneficial society.

b. “Increases physical health”. Walking and outdoor sports improves people physical health and mental well-being.

c. “Enhances mental and spiritual health” Exercise can help improve psychological and spiritual health, carrying this out in a natural and well landscaped environment, and increased life-span, greater well-being and increased ability to function better at work and home. The aesthetics of natural and green landscapes can have an important impact upon mental health.

d. “Enhances spiritual, sensory and aesthetics awareness” Outdoor recreation helps to free the mind; listening to water running in the pond or fountain, the wind rustling in the trees, smell from the damps soil and heat of the sun, encourage natural relaxation and bring a feeling of physical and mental well-being

e. "Ability to assert personal control and increased sensitivity to one's own well-being" Elderly people allow physical activity to become a memory rather than a regular exercise. Participating in regular outdoor physical activities can contribute significantly to quality of life.

Similarly, Ulrich (1979) stressed that individuals feel significantly better after exposure to nature scenes. Also Klett 2004 stated that landscaping that includes trees, shrubs, lawns, gardens and flowers improve our quality of life. It enhances and helps the environment by cleaning the air, controlling erosion and providing shelter to wildlife. In addition to nature is the man made elements which also contribute to the quality of life through visually pleasing environment.

Human beings require context with each other and social interactions, one way in which this can be achieved is by Mixing with people in an open and well landscaped environment; this often help in the physical well-being of the individual. As argued by Fitz and LaGory (2008), social ties promote and encourage good health practices by providing health assistance in various form, Furthermore, landscape is one external factor that helps to decide people's preference of where to live or work. Similarly, Skarback (2007) states that, a substantial recreational and landscape development has become a decisive factor in people's choice of where to live and work. Sustainable planning is very important when it comes to the quality of life and living, it does not only help phase out stress as mentioned but also gives a better quality of life and provide attractive environments where people want to live in.

Summarily, it can be said that the benefits and well-being through landscaping are innumerable and the impact on quality of life is overwhelming.

RESEARCH METHOD

This research combined literature review through the use of books, journal articles and internet websites as the secondary source of data collection and quantitative method using the questionnaire survey approach as the primary source of data collection. The literature review provided an overview of tourism, landscaping and the quality of life while the questionnaire survey was used to elicit information from respondents on the likely impact of landscaping on quality of life through tourism.

The quantitative approach was adopted in this research in order to gather enough evidence from a large sample size and ensures that results are statistically robust and can be generalised to all the tourism attractions in Nigeria. As emphasized by Nykiel, 2007; Vanderstoep and Johnston, 2009) results from quantitative approach are statistically reliable, and findings will more accurately reflect the overall population from which the sample was drawn.

Nigeria is divided into six recognised geo-political zones (Ikein et al, 2008), three from the north, that is, North east, Northwest and North central and three from the South made up of South south, Southwest and Southeast. Adopting the probability sampling technique, the simple random sampling which gave equal chance of being picked and free from sampling bias was used to select two zones , the North central made up of Kogi state and the Federal capital and the southwest made up of Ekiti and Ondo states. The tourists' attractions from these zones constitute heterogeneous tourist attractions from which a generalisation can be made. Furthermore, in order to achieve a widespread sample from the population, the stratified random sampling was also used in selecting respondents from across the tourism industry made up of staff of the Nigerian Tourism Board, hotels and travel agents, Government employees, that is, Public Servants, local and state, individuals and tourists.

Closed ended questionnaire was designed such that respondents' opinions were measured on a Likert scale of 4 points, Where 4 denotes strongly agree and 1 denotes strongly disagree. A sample size of two hundred was adopted for each of the state selected and administered as follows: staff of the Nigerian Tourism Board 25(12.5%), hotels and travel agents 25(12.5%), Government employees 25(12.5%), individuals 25(12.5%), and tourists 100(50%) and fifty copies in an academic institution, making a total of eight hundred and fifty. This was chosen because a sample size must be of adequate size, not too small and not too large, but big enough that the effect will be of scientific and statistical significant (Lenth, 2001; Kothari, 2007) furthermore, the larger the sample, the better and gives greater reliability, however a minimum number should be thirty (Cohen et al, 2007). The questionnaires were administered by trained enumerators and at the end of twelve weeks, a total of seven hundred and forty five copies of filled questionnaires were returned, representing eighty seven percent of response rate. Data was analysed using the Statistical Packages for Social Sciences (SPSS).

RESULTS AND DISCUSSION

Descriptive statistics was used to conduct an assessment of all variables, expressing results in simple percentages and using the central tendency of standard deviation. The survey found males (63.4 percent) numbered more than females (36.6 percent). The mode is 1 and shows clearly that more male respondents took part than female respondents and are more interested in tourism activities. Most of the participants were within the age bracket of 20-50 years (83.7 percent) while participants above 50 years of age were 10.7 percent and a balance of 5.6 percent did not respond.

Furthermore, majority of respondents 49.3 percent were government employees and implies that they have regular source of income while 22.1 percent were unemployed. Those who are self employed accounted for 17.4 percent. Also, the private sector employees accounted for 11.0 percent and 0.1 percent did not express any view.

Most participants were also well educated (65.8 percent had tertiary education) and are able to answer the questions and a total of 12.6 and 12.2 percent hold secondary and primary school certificate respectively while 8.9 percent had no formal education and needed a form of assistance of interpreting and filling the questionnaires and 0.5 percent did not respond.

Also, a total of 58.9 percent were married and indicates that the married show more interest than the singles which accounted for 39.1 percent. About 1.6 percent was widowed while 0.4 percent accounted for participants that did not respond.

The range of income level to ascertain whether it is of significance or not showed that about 41.1 percent earn above N100, 000 (N = the Nigeria Naira) and are able to afford some forms of holiday. Further broken down into 48.7 percent earn between N1 – N100,000 monthly, 25.1 percent earn between N100,001 – N500,000 monthly. A total of 16.0 percent earn above N500, 000 monthly while 10.2 percent did not respond.

In a bid to ascertain if respondents attitude will change towards holidaying as a result of landscaping, respondents were asked to rate their responses from strongly agree to strongly disagree. As revealed from the literature, attractive tourism products gear people into making the choice of whether to visit a tourist attraction or not. Results obtained as revealed in Table 1, show that 46.6 percent agree that people's attitude to tourism will change towards holidaying if landscaping is used in the Nigerian tourist attractions. About 38.8 percent strongly agree to this notion, while 7.9 percent disagree, 1.1 percent strongly disagrees and 5.6 percent did not respond. This implies that a total of 85.40 percent are in support that landscaping will change people's attitude towards tourism and are likely to visit. The mean is 3.12 and the standard deviation is 1.002.

Table 1: Attitude towards holidaying

	Frequency	Percent	Valid Percent	Cumulative Percent
No response	42	5.6	5.6	5.6
Strongly disagree	8	1.1	1.1	6.7
Disagree	59	7.9	7.9	14.6
Agree	347	46.6	46.6	61.2
Strongly Agree	286	38.8	38.8	100.0
Total	745	100.0	100.0	

From the literature, aesthetics appearance is important and most people are willing to pay for good looking attractions. As such, respondents were asked if they agree or disagree to this. Table 2 reveals that lack of good landscaping affects people's attitude towards tourism. 44.6 percent agree that the lack of good landscaping explains their negative attitude towards tourism and 32.1 percent strongly agree. Also 16.5 disagree while 1.1 percent strongly disagrees and 5.8 percent did not respond, giving a total of 76.7 percent that are in support. The mean is 2.96 and standard deviation is 1.024

Table 2: lack of good Landscaping as Negative attitude to Tourism

	Frequency	Percent	Valid Percent	Cumulative Percent
No response	43	5.8	5.8	5.8
Strongly disagree	8	1.1	1.1	6.8
Disagree	123	16.5	16.5	23.4
Agree	332	44.6	44.6	67.9
Strongly Agree	239	32.1	32.1	100.0
Total	745	100.0	100.0	

Landscaping apart from being seen as contributing to the quality of life also help the tourism industry to thrive. In this regard, respondents were asked to rate their response on agree or disagree that landscaping is a key element to emerging tourism market. As revealed in Table 3, respondents' opinion show that 56.9 percent agree, 30.3 percent strongly agree implying a total of 87.2 percent. Also, 6.2 percent disagree, while .9 percent strongly disagrees and 5.6 percent did not respond. The mean is 3.05 and the standard deviation is .953.

Table 3: Landscaping is a key Element towards emerging Tourism Market

	Frequency	Percent	Valid Percent	Cumulative Percent
No response	42	5.6	5.6	5.6
Strongly disagree	7	.9	.9	6.6
Disagree	46	6.2	6.2	12.8
Agree	424	56.9	56.9	69.7
Strongly Agree	226	30.3	30.3	100.0
Total	745	100.0	100.0	

Tourism presents avenues for economic opportunities, as such landscaping may be seen as one avenue for job creation and investment prospect for the private sector as well. Respondents' opinion as shown in Table 4, reveal that 48.3 percent agree that landscaping can present various investment opportunities while 39.9 percent strongly agree giving a total of 88.2 percent. Also 5.2 percent disagree while 1.1 percent strongly disagrees and 5.5 percent did not respond. The mean is 3.16 and standard deviation is .982.

Table 4: Investment opportunities in Landscaping

	Frequency	Percent	Valid Percent	Cumulative Percent
No response	41	5.5	5.5	5.5
Strongly disagree	8	1.1	1.1	6.6
Disagree	39	5.2	5.2	11.8
Agree	360	48.3	48.3	60.1
Strongly Agree	296	39.9	39.9	100.0
Total	745	100.0	100.0	

From the findings above, the analysis revealed that there can be a transformation in the tourism industry as well as in the quality of life of the people if good landscaping is employed in many of the Nigerian tourist attractions. The environment as discussed earlier either encourages or discourages a tourist to an attraction. Furthermore, a direct contact with nature gives a regenerating effect. Thus the research revealed that Nigerians do not embark on holiday activities due to lack of landscaping in many of the tourist attractions.

The results show that creating a sustainable landscape by improving on the general aesthetics of the tourist environment will gear people into making out time and looking forward to holidays. Taking out time from daily routine for recreation as discussed earlier reduces stress thereby improving the health of the individual. The survey results reveal that many people are eager for the transformation of many of the existing tourist attractions through landscaping, improving these sites and keeping them sustainable both for now and for future generations will help enhance quality of life and also increase in patronage. Also is the fact that attractive environment improves the air around us, encourages exercises and improves the physical wellbeing.

It was also found out from the analysis that the lack of landscaping has contributed to the negative attitude towards tourism and has kept a lot of people away from tourism activities. Improving these attractions through landscaping and keeping it sustainable will help people discover the various health benefits which in turn will improve their quality of life. Also revealed is the fact that landscaping is the key element for the Nigerian tourism to thrive. It will foster relationships between people and communities at large and increase patronage. Landscaping will encourage the creation of jobs the local community and by extension improve quality of life.

CONCLUSION

Managing and planning the landscape sustainably in the Nigerian tourist attractions will improve the aesthetics, help people interact with one another, as well as contributing to the physical health of the individual. Sustainable landscape contributes to the human wellbeing as well as protecting, enhancing and maintaining the environment for the present and future generations. The study has elaborated on the need for the Nigerian tourism to improve on tourists attractions through landscaping in order to enhance the quality of life of the people. It revealed that if sustainable landscape is embarked upon, the attitude of Nigerians towards domestic tourism will change positively.

REFERENCES

Abraham, A., Sommerhalder, K., and Abel, T. (2010). Landscapes and wellbeing: a Scoping Study on the Health Promoting Impact of Outdoor Environments. *International Journal of Public Health, 4*(1), 59-69.

Adora, C. U. (2010). Managing Tourism in Nigeria: The Security Option. *Management Science and Engineering*, *4*(1), 14-25.

AMSET. (2007). Report of the Tourism Sustainability Group. Action for More Sustainable European Tourism. Available on http://ec.europa.eu/enterprise/newsroom/cf/_getdocument.cfm?doc_id=237 Accessed on 8/2/11

Andereck, K., and Jurowski, C. (2006). Tourism and Quality of life. In J. Gayle and P. N. Norma (Eds.), *Quality Tourism Experience*. Oxford: Butterworth-Heinemann.

Backhaus, N. (2008). Sustainable Development in Contested Landscapes: A landscape Model for Participation Processes. Available from http://iasc2008.glos.ac.uk/conference%20papers/papers/B/Backhaus_102702.pdf. . Accessed on 15/2/11

Bankole, A. S., and Odularu, G. O. (2006). Achieving the Millennium Development Goals: Issues and Options for the Nigeria's Tourism Industry. *PASOS. Revista de Turismo y Patrimonio Cultural, 4*(3), 429-436

Benson, J. F., and Roe, M. H. (2007). *Landscape and Sustainability*. Abingdon, Oxon: Routledge.

Bousselot, J., Badeertscher, K., and Roll, M. (2005). *Sustainable Landscaping*. Colorado: Colorado State University

Buchanan, R. (2000). *Taylor's Master Guide to Landscaping* New York: Houghton Mifflin Harcourt.

Butler, R. W. (1991). Tourism, Environment and Sustainable Development. *Environmental Conservation, 18*, 201-209.

Cohen, L., Marion, L., Morrison, K., and Morrison, K. R. B. (2007). *Research Methods in Education*. Abigdon.Oxon: Routledge.

CPRE. (2010). Landscape Character Assessment. CPRE FYLDE District Group. Available from http://www.cprelanlanshire.org.uk/articles/CPRElandscapecharacterassessment-medlar-with-wesham. Accessed on 1/5/2011.

Dejean-pons, M., and Chaboisseau, F. (2000). *Spatial and Landscape Division*. Paper presented at the European Landscape Convention.

Dudson, R. (2010). *The What and Why of Sustainable Landscape*: An International Sustainability Council Project promoting sustainable landscapes.

Ebohon, O. J., Ayeni, D. A., and Taki, A. H. (2009). *The Need to Explore Sustainable Tourism for Developmental Growth in Nigeria*, Glasgow

Ercan, M. A. (2011). Challenges and Conflicts in achieving Sustainable Communities in Historic Neighbourhood of Istanbul. *Habitat International*, *35*(2), 295-306.

Felce, D., and Perry, J. (1999). Quality of Life: Its Definition and Measurements. *Research in Developmental Disabilities, 16*(1), 51-74.

Figueira, A. P. (2001). *The Role of Planning in Local and Regional Tourism Development.* Paper presented at the Escola Superior Technologia e Gestao/ IPBeja xxvii Reunion deEstudios, Regionates Madrid (Espanna) November, 2001.

Gailing, L. (2008). Land Use and Water Management in Sustainable Network Society *Paper for ERSA Congress. 23-27 August 2008*: Vrije Universiteit Amsterdam.

Ikein, A. A., Alamieseigha, D. S. P., and Azaiki, S. S. (2008). *Oil, Democracy and the Promise of True Federalism*. Maryland: University Press of America.

Inskeep, E. (1987). Environmental Planning for Tourism. *Annals of Tourism Research, 14*(1), 118-135.

Jafari, J. (2003). *Encyclopaedia of Tourism*. Abingdon, Oxon: Routledge.

Jiboku, J. O., and Jiboku, P. A. (2010). Harnessing Tourism Potentials in Nigeria for National Development. *Research in National Development, 8*(1).

Jim, C. Y., and Chen, W. Y. (2009). Value of Scenic Views: Hedonic Assessment of Private Housing in Hong Kong. *Landscape and Urban Planning, 91*(4), 226-234.

Kothari, C. R. (2007). *Research Methodology: Methods and Techniques*. New Delhi: New Age International Ltd.

Kreag, G. (2001). *The Impacts of Tourism*. Minnesota: Sea Grant.

Leitao, A. B. (Ahern, J). Applying Landscape Ecological Concepts and Metrics in Sustainable Landscape Planning. *Landscape and Urban Planning, 59*(2), 65-93.

Lenth, R. V. (2001). Some Practical Guidelines for Effective Sample Size Determination. *American Statistician, 55*(3), 187-193.

Ling, C., and Dale, A. (2011). Nature, Place and Creative Class: Three Canadian Case Studies. *Landscape and Urban Planning, 99*(3-4), 239-247.

Liu, Y. L., Ko, P. F., and Ko, P. F. (2011). A visitor Focused Study of Tourism Attraction in Taiwan: Empirical Evidences from Outbound Chinese Tourists. *Hospitality Management and Tourism, 2*(2), 22-33.

Morais, P., and Camanho, A. S. (2011). Evaluation of Performance of European Cities with the Aim to promote Quality of Life. *Omega, 39*(4), 398-409.

Nohl, W. (2011). Sustainable Landscape use and Aesthetics Perception- Preliminary reflections on Future Landscape. *Landscape and Urban Planning, 54*(1-4), 223-237.

Nykiel, R. A. (2007). *Handbook of Marketing Research Methodologies for Hospitality Research*. New York: The Haworth Hospitality and Tourism Press.

Opdam, P., Steingrover, E., and Rooij, S. (2006). Ecological Networks: A Spatial Concept for Multi-actor Planning of Sustainable Landscape. *Landscape and Urban Planning, 75*(3-4), 322-332.

Pacione, M. (2003). Urban Environmental Quality and Human Wellbeing: a Social Geographical Perspective. *Landscape and Urban Planning, 65*, 19-30.

Scottish Natural Heritage. (2003). Sustainable Development and the Natural Heritage. Available on http://www.snh.org.uk. Accessed on 6/2/11.

Selman, P. (2006). *Planning at the Landscape Scale*. Abigdon, Oxon: Routledge.

Selman, P. (2008). What do we mean by Sustainable Landscapes? E-Journal of Sustainable Solutions. 4 (2) http://sspp.proquest.com. [Electronic Version],

Shah, M. G., Kale, C. M., and Patki, S. Y. (2002). *Building Drawing: With an Integrated Approach to the Built Environment*. New Delhi: Tata-McGraw-Hill Publishing Company Limited.

Supplementary Planning Guidance. (2004). Landscape. Available on http://www.npt.gov.uk/PDF/Landscape.pdf. Accessed on 5/2/11.

Swarbrooke, J. (1999). *Sustainable Tourism Management*. Wallington, Oxon, UK: CABI Publishing.

Thompson, C. W., Sugiyama, T., Bell, S., Milligton, C., Southwell, K., Roe, J., et al. (2007). Landscape Quality and Quality of Life. Available from http://www.openspace.eca.ac.uk accessed on 5/1/11.

Tzanopoulos, J., Kallimanis, A. S., Bella, I., Labrianidis, L., Sgardelis, S., and Pantis, J. D. (2011). Agricultural Decline and Sustainable Development on Mountain areas in Greece: Sustainability Assessment of Future Scenario. *Land use Policy*, *28*(3), 585-593.

Vanderstoep, S. W., and Johnston, D. D. (2009). *Research Methods for Everyday Life: Blending Qualitative and Quantitative Approaches*: John Wiley and Sons.

VanDerZanden, A. M., and Cook, T. W. (2010). *Sustainable Landscape Management* New Jersey: John Wiley and Sons.

White, D. D. (2006). *Visitor Experiences and Transportation Systems in Yosemite National Park* Arizona School of Community Resources and Development, Arizona State University

World Commission of Environment and Development (WCED, 1987).*Our Common Future* Oxford: Oxford University Press.

World Tourism Organisation Tourism Statistics. (2008). Economy Statistic: Tourist Arrivals. Available from http://www.nationmaster.com/graph/eco_tou_arr_economy_touristarrivals. Accessed on 2/5/22011.

THE PROBLEM OF NON-COMPLETION OF INFRASTRUCTURE PROJECTS IN GHANA

Andrew Oppong-Danquah[1], Noel Painting[2], Kemi Adeyeye[3] and Kassim Gidado[4]

[1] *Estate Management Unit of the Ministry of Health and the Ghana Health Service, Ghana*

[2] *Schools of Environment and Technology, University of Brighton, Cockcroft Building, Lewes Road, Brighton, BN2 4GJ, UK*

Many developing countries have identified the need to improve infrastructure as a key component in meeting their developmental needs. Projects are started with enthusiasm but often do not end in success being under funded, not completed or completed very late – or sometimes remain abandoned for many years. The aim of this study is to identify the causes of failure to satisfactorily delivery infrastructure projects in with particular focus on Ghana. The research concentrates on Ghana because, since showing commitment to parliamentary democracy in 1992, members of parliament and the District Assemblies have all targeted infrastructure provision but often without clear direction in coordinating and synchronizing developments leading to duplication of effort and a waste of resources. This paper includes an identification of practitioners' views regarding the constraints faced and major problems leading to incomplete infrastructure projects. These findings can be used to develop a model which together with effective project planning can be implemented successfully within the constraints faced by Ghana and to a large extent the other countries in West Africa.

Keywords: Ghana, health infrastructure, project non-completion, project planning.

INTRODUCTION

An example of failure in West African infrastructure investments is in the public health sector in Ghana where the issue of uncompleted projects represents wasted time, investment and opportunity.

In an attempt to match the health needs with growth of population governments have felt the need to initiate more health projects such as hospitals, clinics, health centres, and health training institutions such as those for nurses. They have however failed in their commitment of ensuring success many of such projects.

According to the Estate Management Unit of the Ghana Health Service *(EMU/GHS Report 2004)* the Upper West Region, which is the smallest in terms of population and the most deprived, had, at the time of our survey, at least five major public health infrastructural projects mostly at the operational stage which still remain substantially incomplete notwithstanding that construction started in 1999.

[1] andydanq@yahoo.com
[2] N.J.Painting@brighton.ac.uk
[3] O.Adeyeye@brighton.ac.uk
[4] K.I.Gidado@brighton.ac.uk

Oppong-Danquah, A., Painting, N., Adeyeye, K. and Gidado, K. (2011) The problem of non-completion of infrastructure projects in Ghana *In:* Laryea, S., Leiringer, R. and Hughes, W. (Eds) *Procs West Africa Built Environment Research (WABER) Conference,* 19-21 July 2011, Accra, Ghana, 919-927.

Gaining a more complete understanding of the causes of these problems and reasons for projects' failure have long been a focus for both academic researchers and practitioners *(Pinto and Mantel, 1990).*

The issue of uncompleted public health infrastructural projects in Ghana has varied causes including finance and other procurement problems and has therefore attracted the attention of local, national and international stakeholders in the health sector. International institutions such as the World Bank, the African Development Bank and other Donor Agencies have either provided funding or technical support for health infrastructural development in the developing world. The provision of appropriate guidelines for use of funds and the rules of procedure for effective procurement of projects in these countries have also been provided by the governments of these countries and the Banks/Donors for the borrowers or the beneficiary countries in an effort to ensure that projects initiated get completed with enough funding and planning. These guidelines are also intended to ensure that funds earmarked for the project are well spent and that corruption or corrupt practices are either eradicated in the process or at least reduced to their barest minimum in the development of projects and yet in spite of these controls and guidance problems remain. Three case studies were looked at to determine causes of non-completion (projects in the Upper West Region of Ghana). These causes were used to develop the questionnaire.

CASE STUDY 1- REHABILITATION AND EXPANSION OF KOFORIDUA CENTRAL HOSPITAL

The agreement for the rehabilitation and expansion of the Koforidua Central Hospital, a Regional Hospital and therefore a referral hospital, was signed on the 27th of September, 1999 between the Ministry of Health (MOH), Ghana and Spain (IBADESA).

A Turnkey project with a contract sum of $ 30,000.000.00 (Thirty Million US Dollars) was to be financed through a concessional loan from Spanish Government and an export credit on OECD Conditions. Before details of the scope of works were agreed by the parties, the contract sum was reduced to $ 12,000,000 (Amendment No.1 dated 24th, January 1997). The site was handed over to IBADESA in September, 1998. The project involved rehabilitation of and new construction of parts of the hospital, principally the In-Patient Departments and some ancillary services, as well as medical equipment for those departments.

The budgeted cost of $ 12,000,000 consisted of two components: Construction -$ 6.74 million and Equipment 5.26 million. There were complaints from the end users about the design which overlooked or did not provide for sluice room, office for nurses, changing rooms, rest rooms for night officers apart from doctors at some units among others. Though some blocks were rehabilitated and handed over, signs of roof leakages, rotten wooden frames, unserviceable louver frames, defaced and broken wall tiles and seepage of water at the newly constructed mortuary floor are apparent. Complaints have also been made about the poor quality of equipment supplied and installed.

CASE STUDY 2 - CONSTRUCTION OF MATERNITY BLOCK FOR NAMDOM HOSPITAL

The contract was awarded as a Government of Ghana (GoG) Project to a local contractor in June 1999 with the initial contract sum of ¢ 489,621,480.00 or about US $55,000 for completion in September 2000. Consultancy services were to be provided by a government owned firm. The user clients were involved from the inception stage and were part of the discussion on the design, facilities and a number of rooms required. The Regional Tender Board also discussed and reviewed the draft drawings and thence awarded the project to the contractor and copied the Regional Health Directorate.

Work started late and by the end 1999, the contractor could only work to the lintel level. A certificate needed to be raised before the end of the year as it is in the case of GOG Projects to ensure payment to the contractor. The first certificate was front loaded for fear of the funds going to back to the government chest. This was detected by the Ministry of Finance and considered inappropriate and a team was dispatched to the region to inspect the project. The team recommended that a certificate to the tune of works done as at the time totalling ¢84,939,804.90 currently about US $9,000 was be raised to replace the first one. Payment to the second certificate was effected in 2002.

Due to the change in government in 2000, the works did not progress until 2004 when a total amount of ¢600,000,000 was raised under Donor Funded Projects, but because the year was drawing to a close, nothing was done as a new procurement process had to be followed as a result of the change in the funding source. Local political observers attribute the situation to the political standing of the contractor who was initially a staunch member of the previous government but had to 'cross carpet' to join the current government. The project was re-awarded to the same contractor in the early part of 2005 and under the 2005 Capital Investment Plan of the MOH/GHS. The contractor resumed work on site.

CASE STUDY 3 - CONSTRUCTION OF WA DISTRICT HEALTH MANAGEMENT TEAM (DHMT) OFFICE COMPLEX

In 1999, a committee comprising the Regional Director of Health Services, the Regional Estate Manager and all functional unit heads in the district discussed the type and what was required of the project with three consultancy firms. Draft drawings were provided by the firms for vetting by the committee and finally accepted by the user clients (MOH) and the Regional Tender Board.

Firms were then asked to cost the project. The DHMT was to cost 1.3 billion cedis and completed in 9 months (September 1999 – June 2000).

The issues arising from these projects can be summarised as follows:

Table 1: Common problems in uncompleted projects

Problem(s) in projects	Koforidua Hospital	Nandom Maternity Block	Wa DHMT Office
Political Interference		Yes	Yes
Erratic Flow of Funds	Yes	Yes	Yes
Land disputes		Yes	
Project not completed within budget	Yes	Yes	Yes
Apathy on the part of contractors/consultants	Yes		
Over size (floor area) project		Yes	
Project not meeting technical specification	Yes		
Project not completed on time	Yes	Yes	Yes

Note: With the exception of "land issues" all of these reasons were identified by *Baker, Murphy and Fisher (1989)* in '*Factors Affecting Project Success'*.

With the Regional Tender Board as the steering body, the selective method of tendering was used. The DHMT block was awarded as a GOG Project to a local contractor. The site however was encumbered by two structures- a drinking bar and a communication centre. The removal of the structures took 2 months and the contractor finally mobilized to site in November 1999 as a result not much work was done before the end of the year, besides the foundation floor.

The first certificate of ¢53,386,046.10 which was raised before the end of the year was not paid until 2002. Changes in the political situation in Ghana in the year 2000 affected the project as the contractor was believed to be aligned with the previous government. The project remained at the same stage and has been on the Regional Capital Investment Plan for years with no further approval.

The questionnaire was piloted (to targeted health managers in Ghana). This was adapted based on feedback on key issues and adapted questionnaire targeted to respondents from the Ghana Heath Service (GHS) and Ministry of Health (MOH) - officials with construction backgrounds as well as professionals in the construction sector from both private and public institutions with a reasonable number of years of practical experience. The questionnaire was circulated to forty potential respondents were and twenty returned; a completion rate of 50%.

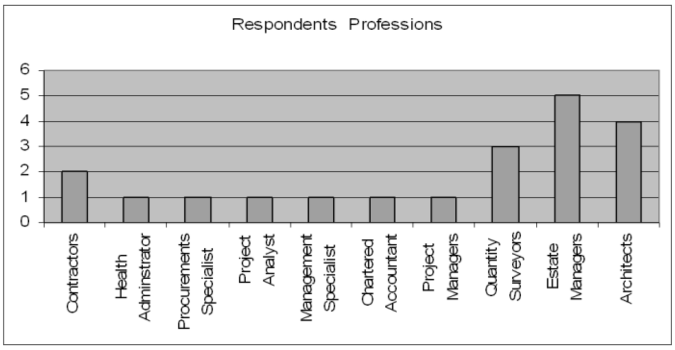


Figure 1. the number of respondents and their various professions

Twenty professionals responded of which 12 came from the GHS/MOH whilst the rest came from other public/private organizations involved in the construction of health projects. (15 of the respondents came from the public sector whilst 5 came from private consortia and contracting companies).

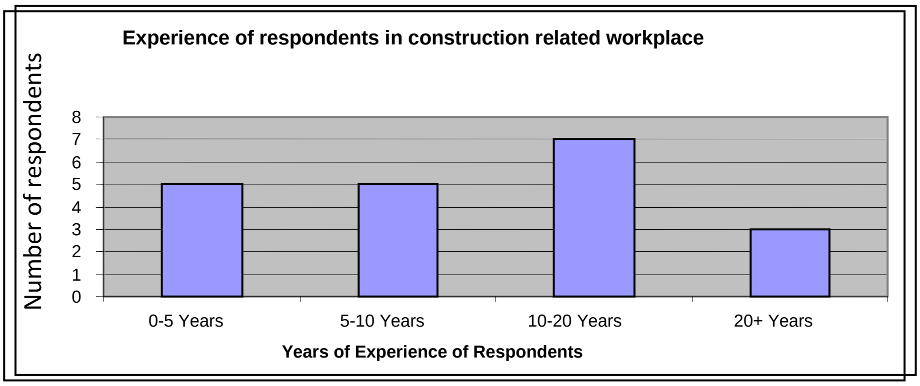


Figure 2. Respondents' years of experience

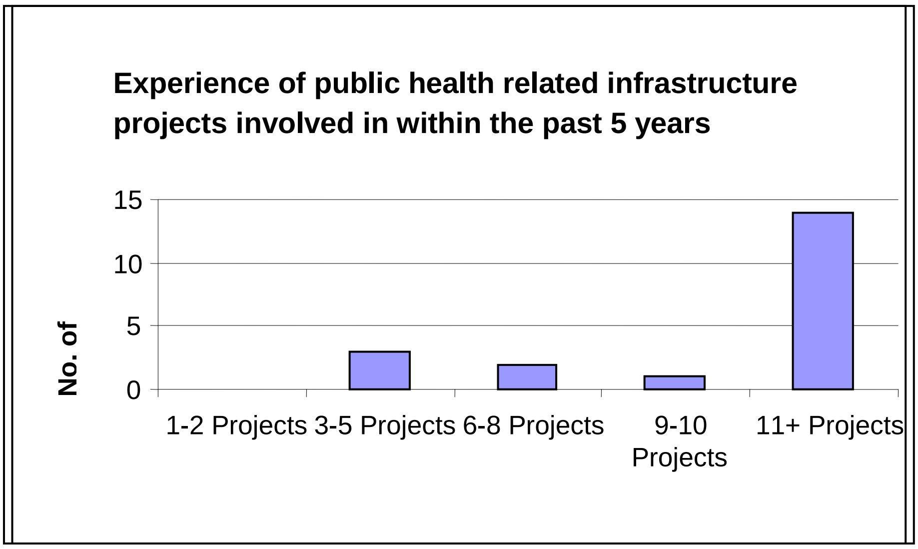


Fig 3. Data on respondents experience in public health projects in the past 5 years

The majority of the respondents (14) had been involved in eleven or more public health related infrastructure projects. The indication is that their richer experience will result in a reliable data as they should be able to offer good reason for the causes of the problem of uncompleted public health infrastructure in Ghana. Figure 4 reveals that most of the GOG Projects are completed late or between two to five years behind schedule. Only 10% of projects funded by the Government of Ghana met project deadlines or are completed at the agreed date of completion. Similarly, 10% of GOG projects are completed 6 months behind schedule. About 4.5% of government funded project never get completed, in order words they are abandoned for good.

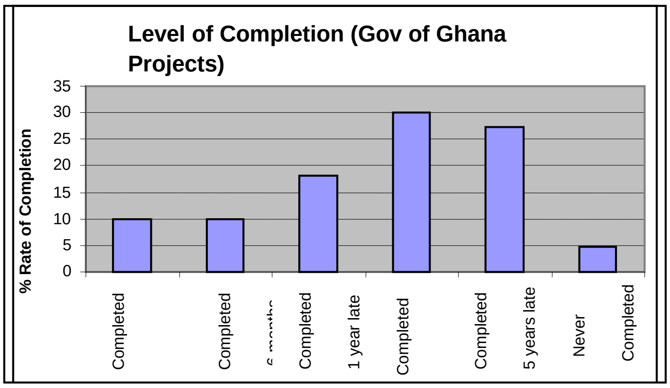


Fig 4. The rates of completion & period within which projects are completed.

The questionnaire also revealed that 42% of the public health projects are abandoned at the construction stage. Although least frequent some respondents mention “equipping” as a stage at which a project is abandoned - for health projects such as hospitals, equipment is crucial if the project is to be commissioned. Within the construction phase it is revealing to note that, the highest levels of abandonment of projects is at the roofing stage (30%), foundation (28%) and external wall / frame (23%). Respondents were asked about reasons for uncompleted projects – table 1 gives a summary of the results.

Table 1. Reasons for uncompleted projects

Reasons for uncompleted projects	Never	Sometimes	Frequently	V Frequently	Always	TOTAL	Don't know
SCORE	0	1	2	3	4		
Poor brief by client	2	8				8	2
Poor site investigation	3	8				8	1
Complex design	3	6				6	1
Land disputes	3	9	2	1		16	1
Cash flow		5	3	7	5	52	
Unsuitable procurement method	4	8	1			10	
Conflicts among parties	3	8				8	
Termination of contract	3	9	1			11	
Political interference	2	10	2	1		17	2
Poor performance by contractors		12	3	2		24	
Technical commissioning	3	7				7	
Poor monitoring and supervision	1	10	2	4		26	
Other-Delayed payment of interim claims				3		9	

The most pronounced causes are cash flow, poor monitoring and supervision, poor performance by contractors, political interference and land disputes. As expected cash flow problems occur mostly during construction in the form of delayed payment of interim claims and erratic flow among others as suggested by some respondents.

The majority of respondents are involved in donor sponsored projects. It is noteworthy that 38% of Ghana's public health infrastructures are donor funded. The Government of Ghana provides a further 27%, Loans and Grants 19%, District Assembly 10% and Community Initiated Projects 8% however, the total government contribution could be substantial if the Local Government (District Assembly) is considered as part of it. Most of Community Initiated Projects in Ghana eventually become government funded. These projects are generally poorly planned and the enthusiasm of the community wanes as a result of apathy on the part of people or the prominent citizens who normally are the project funders.

Seventy to eighty percent of Donor Funded projects were considered successful with a considerable number of respondents thinking that they record 90% success. Mission/NGO Funders also record high rate of success (Very Frequently) like the Donors with four of the respondents thinking as much as 90% success rate is attainable. The high rate of success can perhaps be attributed to implementation of rules and procedures by these funders. The effective implementation of sponsors' checks seems to be far higher than in the case of Government Funded projects which recorded a rate of only 50%.

The opinion of the respondents is that there had been involvement of staff and end user(s) participation in the post evaluation of completed projects. However, the majority of the respondents answered "Sometimes" which is not a firm answer and an indication of the fact that it is not a routine or something consistent with health projects. The preferred answer to make the situation on the ground more certain and firm would have been "Yes". Credit may be given to the Estate Management Unit for the awareness created for staff in project management and contract administration as indicated in the Procedure Manuals for Capital Projects Investments.

Performance of the local contractors was generally not good. In meeting project deadlines or completion dates, they were rated as poor. Staff accommodation was identified as the part most often abandoned indicating that it was not been a priority of stakeholders as compared to wards and service area, health training institutions and office accommodation.

The most favoured procurement route was the Turnkey/Package deal followed by the traditional method of procurement.

Respondents were asked about procurement routes used. Reasons for their choice of procurement are given below;

TURNKEY /PACKAGE DEAL

- Funding acquisition is easy and funds were deemed readily available during implementation thus avoidance of erratic flow of funds informed the decision in favour of Turnkey method.
- Management and monitoring was considered easier since the client had little role to play in the project implementation.
- Turnkey projects often do not, however, fulfil user requirements, users most often do not have “much say” unlike the traditional method which allows for their inputs
- Turnkey is usually adopted by the donor agencies who always cut their “coat according to the budget”. Even though higher in cost (design and execution) they are almost always completed for use. Cash flow is not normally a constraint.
- Due to timely flow of funds, it avoids delays and cost overruns.

TRADITIONAL

- The traditional method is less expensive compared to the others. Cost is very important to the sector and the nation as a whole, therefore a method that provides planned stages in terms of design and cost is recommended. The other procurement methods tend to be more expensive and may not yield a commensurate advantage.
- It was considered important that the Traditional method is used to offer the local contractors the opportunity to compete as they often cannot financially compete for Turnkey projects.
- The traditional method also allows for keener competition and recognises the employer/client/user throughout the project.
- The traditional method is popular and well understood by Ghanaian construction professionals.
- Selective tendering which is a key character of the traditional method allows for competitive pricing from a selection of contractors and consultants of equal standing.

Donors preferred open tendering arrangement as it “allows a greater number of firms to compete”. Respondents were asked (for projects completed on time) if there was there any post completion evaluation involving staff and end users? They considered that there had been little involvement of staff or end user(s) participation in the post evaluation of completed projects. Finally respondents were asked to suggest solutions to alleviate the problem of uncompleted public health infrastructure projects. Most of their suggestions centred on an effective completion date, sufficient budgetary allocation/funds for projects, projects devoid of political interference and enforcement of contractual obligations among others. Their proposals can be summarized under broad headings as follows:

PROJECT INITIATION/ PLANNING

- proper needs assessment. Appropriate and acceptable design
- government to synchronize all development projects and allocate money to complete few selected projects at a time. District Assemblies to be brought in the picture for effective coordination of development projects among stakeholders from inception of projects through to implementation and completion.
- adequate consensus building with all stakeholders
- scope of works should be clearly defined at the inception stage
- Improved budgeting system and encourage long range planning.
- ensure a robust project delivery strategy is in place.
- phasing out projects with insufficient budget provision
- until on-going projects are completed no new ones should be started.
- in situations where the planning period overlaps with the execution period, the necessary adjustments must be made. It must however be ensured that the unrealistic completion times are not fixed for contracts.
- all major projects with a life span of more than two years be reviewed every year, with a report published providing details of progress for further action.

FUNDING

- 100% Funding must be acquired /secured or assured before projects start and advance payments to contractors must be guaranteed by their Bankers.
- accurate cost of projects required for realistic budgets.

SELECTION OF CONTRACTORS/CONSULTANTS

- only proven contractors and consultants to be engaged, (not on the basis of political affiliation)
- Supervision of works by consultants must be on site and payment of supervision fees must be based on work done on site by the contractor
- Retention of contract sum to be applied and damages for delays must also be applied (contract terms must be enforced when parties default).
- In specialized areas, award of contract should be on the basis of contractor’s speciality in the area concerned.
- Selective tendering for bigger jobs and open tendering for smaller jobs

PROJECT SUPERVISION/EVALUATION

- minimal interference from user clients
- effective monitoring of consultants and contractors by user agency as well as effective supervision by managing consultants.
- project approval teams at the national level should visit the regions before the approval of project estimates

- management of projects should be lodged at the Regional Health Directorate to facilitate processing and payment to contractors for work done.
- The analyses of the results show the following among others; reasons for uncompleted public health infrastructure projects, preferred choice of procurement, and suggestions to improve the situation.

CONCLUSION

Five major reasons for non-completion were identified by practitioners in the construction of public health infrastructure projects in Ghana:-

1. Cash flow problems
2. Poor monitoring and supervision
3. Poor performance by contractors
4. Political Interference
5. Land disputes.

Efforts to improve the situation should include focusing on the whole project and note changes as they occur; keeping sight of project objectives throughout the procurement; ensuring good leadership and accountability ensuring effective communication and interaction with service providers and other stakeholders and finally a good understanding of the implications of providers' plans for implementation.

REFERENCES

Baker B.N., Murphy D.C., Fisher D.(1989) ' *Factors Affecting Projects Success*' in Cleland D.J. & King W.D. Ed. Project Management Handbook. New York. Van Nostrand 1988: 902-919.

Eastern Regional Health Administration(Regional Report 1999),

EMU/GHS (2004), Estate Management Unit, Upper West – Draft Annual Report, Ghana

Pinto J.K. & Mantel S.J. (1990) *The Causes of Project Failure.* IEEE Transactions on Engineering Management 1990: EM – 37 (4): 269-76.

THE THERMAL PERFORMANCE OF AN EDUCATIONAL OFFICE BUILDING IN GHANA

Jimmy Nkrumah[1], Christian Koranteng[2] and Kojo Safo-Kantanka[3]
[1, 3] Development Office, Kwame Nkrumah University of Science and Technology, Kumasi, Ghana
[2]Department of Architecture, Kwame Nkrumah University of Science and Technology, Kumasi, Ghana

The thermal performance of an educational office building which exhibits sustainable design principles of passive architecture (emphasis on the use of natural ventilation) was studied. The building has individual cell and open-plan office spaces with different orientation and ventilation possibilities (cross, one-sided and borrowed ventilation). Data loggers were installed to monitor the environmental conditions existing in the building during the rainy season. The evaluated data showed that the indoor temperatures were comfortable (mean of 25°C), the relative humidity values were mostly high (80 - 85%) and the dew point temperature (22°C) was found to be close to the recommended minimum comfort temperature. Moreover, the enclosed corridor space was found to be warmer than the adjacent office spaces during the day time. The use of cool night air as a passive cooling strategy is recommended. Preference for office types with ventilation possibilities could not be statistically recommended since all the evaluated thermal values showed insignificant deviations.

Keywords: environment, Ghana, natural ventilation, relative humidity, thermal performance.

INTRODUCTION

A building which is able to provide comfort and satisfaction to its occupants with minimum use of energy is said to be efficient. The prime aim of current research has centred on energy efficiency, user behaviour and thermal comfort (Szokolay, 2004).

The human body has a constant temperature of about 37°C and through the processes of physiological and behavioural strategies, tolerance to a range of thermal conditions is improved (Taylor, 2006). A variation of the body temperature by less than or more than 2°C leads to either hypothermia (35°C) or hyperthermia (39°C) with the possibility of death at a reduction of about 10°C or an elevation of 5°C (Bessoudo, 2008). In Ghana, where outdoor temperatures can reach as high as 37°C, designers must make sure that buildings are comfortable, especially in naturally ventilated types, where the indoor and outdoor temperatures tend to balance each other. With the adoption of sustainable design recommendations for passive architecture, a good indoor thermal condition and air quality can be achieved (Alamdari, 1994). Generally, naturally ventilated and mixed-mode thermal control buildings have a high user acceptance and use less energy, but their effectiveness depends on prevailing outdoor conditions (wind velocity and temperature). In favorable climates, the application of

[1] jimmynkrumah@yahoo.co.uk
[2] rcbpd.ghana@yahoo.com
[3]

Nkrumah, J., Koranteng, C. and Safo-Kantanka, K. (2011) The thermal performance of an educational office building in Ghana *In:* Laryea, S., Leiringer, R. and Hughes, W. (Eds) *Procs West Africa Built Environment Research (WABER) Conference,* 19-21 July 2011, Accra, Ghana, 929-938.

natural ventilation has led to a low total energy use of 10 – 30% when compared to air-conditioned buildings (Walker, 2010).

Ghana is characterized by a favorable climate during the rainy season (June – September). During this period, the mean outdoor temperature is about 26°C but relative humidity values are rather high (above 80%). Generally, for thermal comfort in spaces, an acceptable range of temperature and relative humidity values needs to be achieved. Ferstl (2005) suggests 22 – 26°C and 30 - 80% relative humidity values. The standard of building biology testing methods (SBM, 2008) suggests 30 to 70% relative humidity to be comfortable. Koranteng and Mahdavi (2010) advocate 23 – 29°C for 90% acceptability based on calculations of a long term study on thermal comfort and an approach after Szokolay (2004). Further, a relative humidity of 30 – 80% is recommended. Fischer *et al.* (2008) suggest a range of 50 – 70% of relative humidity to be comfortable. The danger of higher humidities in Ghana is the condensation on and in building materials which serves as a source of germs and odour. Generally, the growth of mould is accelerated when humidity increases (Fischer *et al.,* 2008). According to Klein and Schlenger (2008), high humidities restrict evaporation from the skin and in respiration, and thus kerb the dissipation mechanism as experienced in Ghana, especially during the rainy season where humidity values of above 90% are recorded.

The human perception with regard to air velocity has been summarized by Szokolay (2004). An air velocity of less than 0.1 $m.s^{-1}$ is perceived as stuffy, 0.1 – 0.2 $m.s^{-1}$ as unnoticed, 0.2 – 0.5 $m.s^{-1}$ as pleasant, 0.5 – 1.0 $m.s^{-1}$ as awareness, 1 – 1.5 $m.s^{-1}$ as draughty and over 1.5 $m.s^{-1}$ as annoying. The influence of high air velocities in humid conditions can be welcoming since it plays an important role in the evaporative cooling potential of the skin. Moreover, sustainable design principles of orientation, building form, window sizes, air change rates and shading cannot be over-emphasised, especially in naturally ventilated buildings.

The present paper investigates the temperature, dew point and relative humidity values in an educational office building during the moderate period (rainy season) of the year in Ghana. Here, lessons on preference, based on the thermal conditions of the different office spaces (individual cell, open-plan) and on the ventilation possibilities (cross, one-sided and borrowed) are the focus of the study. Indoor sensors were used to record the thermal conditions and an evaluation exercise was conducted afterwards.

RESEARCH METHOD

To effectively study the thermal performance of naturally ventilated office buildings during the rainy season, the thermal conditions existing in an educational office building with characteristics of sustainable design principles were observed. The chosen building is the newly constructed studio (architectural students drawing spaces and offices) block of the College of Architecture and Planning, KNUST, Kumasi, capital of the Ashanti Region in Ghana. It is representative of low-rise educational buildings being constructed in Ghana (see Fig. 1 and 2). Moreover, aspects of sustainable design principles (which are often neglected) of orientation, form, ventilation and shading have been employed, which makes the building worthy of studying.

The naturally ventilated building with an area of 2500m² is oriented towards the north, has three floors and a sub basement. The offices are mostly of a single occupancy type with few open plan and multiple occupancy spaces on the third and fourth floors. The ground floor and sub basement are used by students as studio spaces. The windows have been recessed on the main facades whereas only few are located on the east and west sides, serving the utility spaces. The corridor type of arrangement of the single cell offices means that the corridor needs artificial lighting and cross ventilation cannot be fully utilised (see Fig. 3). High level louvre blade windows are used on both sides of the office walls to support privacy and comfort.

Fig.1: View of the building at CAP, KNUST

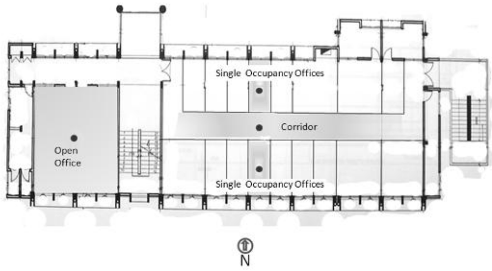


Fig.2: Schematic floor plan of the building with monitored spaces

The window to wall ratio on the main facade is 0.40 and the rectangular building form has an aspect ratio of 1:3.20.

Indoor temperature, relative humidity and dew point sensors (hobos) were installed in a number of offices (single and open plan, see Fig. 2). Further, outdoor data loggers with a cover protecting them from rain were used to record the external environmental conditions (temperature, relative humidity and dew point). Since the building is naturally ventilated, the need to monitor the prevailing outdoor conditions was paramount. The data was recorded every 10 minutes during the rainy season (July to September).

Fig.3: Corridor showing high level windows of the building

Table 1 shows the accuracy of the sensors. The measured data were analysed in spread sheets and the various mean monthly values evaluated and graphed.

Table 1: Accuracy of the hobo sensors

Sensor	Range	Error
Air temperature	-20 to 70 ^oC	± 0.4 ^oC
Relative humidity	5 to 95 %	± 3%

Furthermore, to evaluate the window to wall ratios, air velocities and volumetric flow rates, recommended values and equations were used. Equation 1 shows the calculation of the air change rates (ACH) with minimum recommendations of 30m³/h. person and 50m³/h. person for individual cell and open-plan office spaces (Klein and Schlenger, 2008). The estimation of the air velocities for cross ventilated spaces was based on Proeglhof (2004), (Equation 2). The assessment of the room depth for naturally ventilated buildings (for one-sided ventilation, Equation 3 and for cross ventilated spaces, Equation 4) was based on Klein and Schlenger (2008). Recommendation on the form aspect ratio (rectangular buildings to be 1:1.75) was based on previous work of Koranteng and Abaitey (2010). Finally, a general value for window to wall ratio (0.5) for appreciable ventilation was applied. The employed equations are general recommendations without correction factors for the Ghanaian context. There is the need for research in Ghana to proof the relevance and effectiveness of architectural design recommendations.

$ACH = Ų/V\ [h^{-1}]$ Equation 1

Where *ACH* is number of air change rates, *Ų* is volumetric air flow rate [m³/h. person] and *V* is volume of space in m³.

$V = (ACH + 3.43)/63.1\ [ms.^{-1}]$ Equation 2

Where *V* is air velocity and *ACH* is air change rate.

$D = 2.50.\ h\ [m]$ Equation 3 (one-sided ventilation)
$D = 5.0.\ h\ [m]$ Equation 4 (cross ventilation)
Here, *D* implies the room depth and *h* is the floor height.

The air change rates, air velocities in the spaces, assessment of room depth and form aspect ratios of the buildings were tabulated and compared with the design recommendations.

RESULTS

The mean monthly hourly values recorded from the offices, namely, individual cells oriented towards the north and south (named north or south), the corridor, the open-plan (named open) spaces and the outdoor values are illustrated.

Fig. 4 shows the mean monthly hourly temperature values during the working hours (8-17 hours) and Fig. 5 illustrates the mean monthly temperature values for the evening and night time. The mean monthly hourly relative humidity values during and after the working time is demonstrated in Fig. 6 and 7. Furthermore, Fig. 8 and 9 show the dew point values (mean monthly) during the working hours and for the evening and night time. The mean monthly thermal values (temperature, relative humidity and dew point) for the individual cell offices oriented towards the north are illustrated in Fig. 10. The same thermal values for the corridor, individual cells oriented towards the south, and the open-plan offices are shown in Fig. 11, 12 and 13. Table 2 shows the results of the evaluation of air flow rates and window area per office space.

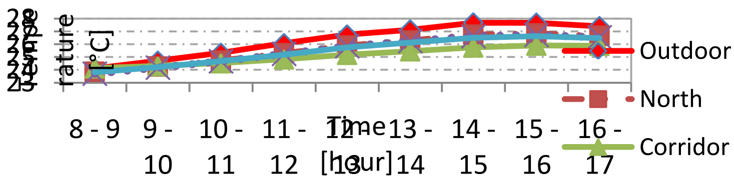


Fig.4: Mean monthly hourly temperature values during the working hours of individual cells (north and south orientation) and open-plan offices

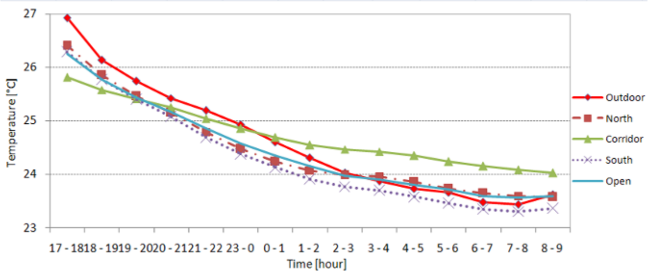


Fig.5: Mean monthly hourly temperature values during the evening and night hours of individual cells (north and south orientation) and open-plan offices

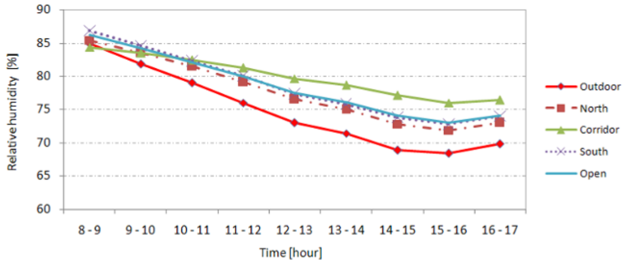


Fig.6: Mean monthly hourly relative humidity values during the working hours of individual cells (north and south orientation) and open-plan offices

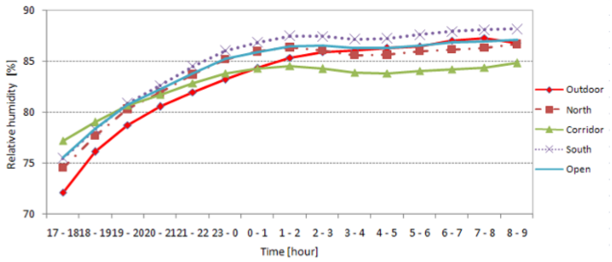


Fig.7: Mean monthly hourly relative humidity values during the evening and night hours of individual cells (north and south orientation) and open-plan offices

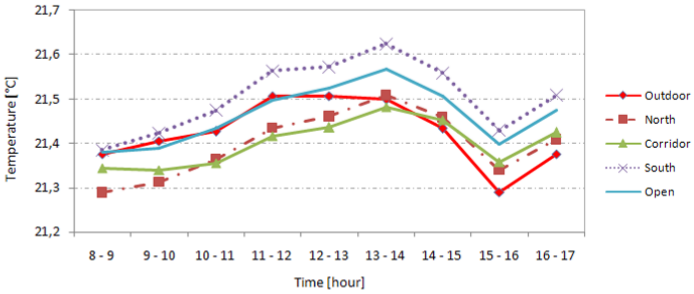


Fig.8: Mean monthly hourly dew point values during the working hours of individual cells (north and south orientation) and open-plan offices

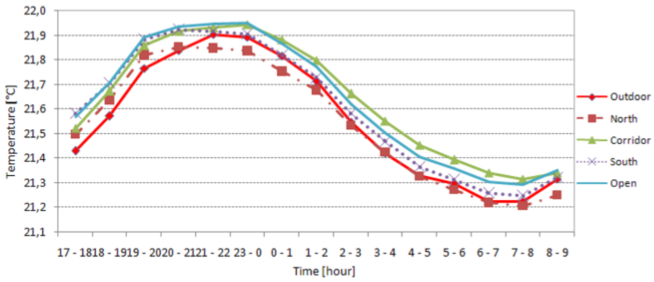


Fig.9: Mean monthly hourly dew point values during the evening and night hours of individual cells (north and south orientation) and open-plan offices

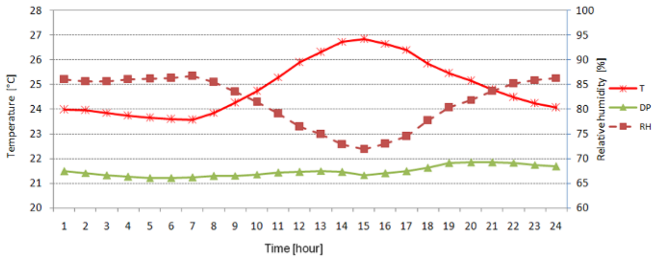


Fig.10: Mean monthly hourly thermal values of an individual cell office oriented towards the north (T: Temperature, DP: Dew point and RH: Relative humidity)

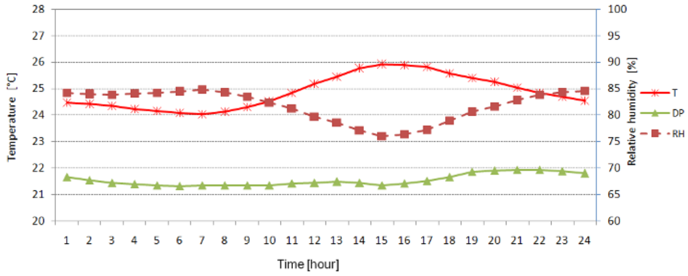


Fig.11: Mean monthly hourly thermal values of the corridor (T: Temperature, DP: Dew point and RH: Relative humidity)

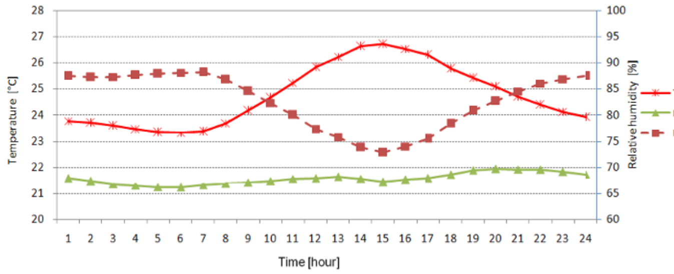


Fig.12: Mean monthly hourly thermal values of an individual cell office oriented towards the south (T: Temperature, DP: Dew point and RH: Relative humidity)

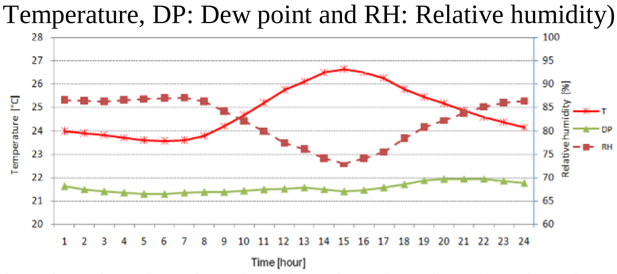


Fig.13: Mean monthly hourly thermal values of the open-plan office (T: Temperature, DP: Dew point and RH: Relative humidity)

Table 2: Output data on air flow rates and window area

Parameter	Individual cell office (area = 5 m²)	Open-plan office (area = 80 m²)
Air change rate, ACH [h^{-1}]	2.40	2.50
Air velocity, V [m.s^{-1}]	0.10	0.10
Air velocity, V (pleasant) [m.s^{-1}]	0.50	0.50
Air change rate, ACH (pleasant) [h^{-1}]	0.4	4
Volumetric air flow rate, Ų [m³.h. person^{-1}]	30.0	50.0
Occupancy	1.00	10.0
Window area, north façade [m²]	2.20	8.00
Window area per façade required [m²]	2.75	10.0
Window area, corridor-walls [m²]	1.10	8.00

The building depth of 12.50m and depth of individual cell offices (2.50m) fulfils the recommended values for cross and one-sided ventilation buildings (Equations 3 and

4). However, the aspect ratio of 1:3.20 is more than the recommended value of 1:1.75 for rectangular buildings (Koranteng and Abaitey, 2010).

DISCUSSION

The outdoor mean monthly hourly temperature value rises from 24°C in the morning to a peak of about 28°C during the working hours (Fig. 4). At 8 in the morning, all the temperature values of the monitored spaces are nearly the same (24°C). As the outdoor temperature rises with increasing solar radiation, the indoor temperature also increases. The individual office cells show a slightly higher temperature (northern and southern oriented) than the open-plan space (Fig. 2) but with a standard deviation of 0.07. Here, preference of office and ventilation type over each other cannot be recommended. The maximum indoor temperature of about 27°C could be said to be comfortable for all the spaces (Koranteng and Mahdavi (2010, studies based on Fanger's percentage of dissatisfied persons)). Interestingly, the corridor shows a lower temperature value between the hours of 10 am and 5 pm. The cool air at the enclosed corridor resulted from the low air change rates. This characteristic has also been observed in compact buildings by Lechner (2001). The advantage in compact building forms is that they gain less heat during the day but loose less heat at night. To make good use of the cool air in the corridor, workspace could be located away from the external facades. However, corridors could be noisy and impair concentration of workers in office buildings.

In Fig. 5, a fall in all the temperature values (evening and night hours) is demonstrated. The outdoor temperature reduces, reaching the corridor levels around midnight and continues to fall to about 23.5°C. At this level, the outdoor air is cooler than that of the corridor (ca. 1°C temperature difference), northern and open office spaces, but slightly warmer than the individual cell offices oriented towards the south. The high temperature in the southern individual cells could be linked to the exposed external walls, absorbing much solar radiation during the day. The standard deviation of the cool to the warm offices is low (0.02) and the prevailing indoor temperatures are all in the recommended thermal comfort range. The cooler outdoor air from 2 am onwards has a passive cooling potential when effectively used. This could be combined with thermal mass to improve the thermal performance and energy use of buildings (Mahdavi and Orehounig (2009) and Koranteng (2010)).

The plotted relative humidity values during the working hours (8 am to 5 pm) showed lower outdoor values than the indoor spaces (Fig. 6). During the mornings, the relative humidity difference was about 2%, which increased to about 7% at 3 pm. High values (above 70%) are recorded for the corridor, followed by the open-plan and the individual cells (southern and northern) but with a difference of less than 3%. Moreover, the values exceed 80% from 8 am to 12 noon. These values raise severe concerns, since high humidity levels result in inefficient evaporative cooling of the skin which leads to discomfort. In addition, odours and ill-health symptoms are part of the concern with high humidity values (SBM, 2008). However, values of 70 to 80% fall within the recommendations on relative humidity (Ferstl (2005), and Koranteng and Mahdavi (2010)). Furthermore, monitoring of high humidity values above 75% is recommended, since latent loads of occupants could result in an increase in relative humidity (58 – 85 $g.h^{-1}$ per person at temperatures of 24 to 28°C), (Fischer *et al.* (2008)).

The demonstration of the relative humidity values during the evening and night hours (Fig. 7) raises extreme concern. The degree of the concern (humidity and temperature discomfort) is based on the standard of building biology (SBM, 2008). After 19 hours, the recorded relative humidity data exceed the boundary of the recommendation value of 80%. From midnight to 9 am, values of 85 to 88% were recorded (mean corridor value of 84%). The most important factor accompanying high relative humidity values is the dew point temperature. Moisture will be visible when indoor temperature falls below the dew point. In Fig. 8, the highest dew point temperature was recorded in the individual cell office towards the south, which was followed by the open-plan space and the individual cell towards the north, and the corridor space. The standard deviation ranges from 0.05 to 0.08 which illustrates the closeness of the values. Besides, the mean dew point temperature of 21.4°C is just below the minimum recommended temperature for comfort (23°C) (Koranteng and Mahdavi (2010). The pattern of the dew point temperature was similar during the evening and the night hours (Fig. 9). A mean temperature value of 21.5°C and a standard deviation of 0.20 to 0.21was recorded.

This clearly shows the difficulty involved (moisture control) in designing healthy and efficient buildings in warm and humid environments. Further, at a temperature range of 0 to 50°C, an accelerated growth rate of 15 to 30% of fungal spores (weekly growth rate of 10^3 - 10^6 of spores/m³ air) has been observed (Fischer *et al.*, 2008). The proliferation of microorganisms in buildings affects indoor air quality, creates hazardous health conditions for the occupants and contributes to the deterioration of building components (Morse, 2009).

In Fig. 10 – 13, the thermal conditions in the spaces have been demonstrated. The mean temperature (24.7 to 24.9°C), relative humidity (81.5 to 82.2%) and dew point (21.5 to 21.6°C) values calculated showed insignificant differences and therefore no preference of office space and ventilation type over the other was given. The maximum temperature values recorded ranged from 25.9 to 26.8°C. Also, the maximum relative humidity values ranged from 85 to 88%. The dew point temperature had a peak of 21.9°C. The maximum temperatures were recorded at 3 pm, this time of day also showed the minimum relative humidity values (Fig. 10 – 13). The main concern are definitely the high relative humidity levels and the dew points leading to problems associated with mould. Persistent moisture leads to rot, corrosion, and other forms of deterioration. Also, the reduction of thermal resistance and a decrease in the strength and or stiffness of materials have been observed. Furthermore, insect infestation through invisible mites, cockroaches and ants are a result of moisture related issues (Morse, 2009).

The evaluation of the air flow rates (Table 2) showed that due to the high relative humidity values, a high air change rate would be needed to achieve a pleasant (air velocity of 0.5 $m.s^{-1}$) indoor climate. Whilst the window area required per office space was 0.55 m² and 2 m² less on the main facades for the individual cell and open-plan office spaces, that of the corridor would need to be increased by 1.65 m² (individual cell offices), (Table 2). A minimum window to wall ratio of 0.5 is recommended in passive designs to assist in the effective use of natural ventilation, which would help to avoid mildew.

To control and avoid mildew, the use of non-porous building materials and sustainable design principles are recommended. The installation and use of fans would help to promote evaporative cooling of the skin and should be a priority in all office buildings, especially in naturally ventilated types, since the effect would be thermal sensation reduction of air temperature values of 2 – 3°C (Hyde, 2000).

CONCLUSION

To effectively study the building performance of naturally ventilated office buildings during the rainy season, the thermal environment prevailing in an educational office building with attributes of sustainable design was monitored. The results pertaining to the different office types, ventilation possibilities and orientation showed that whilst the temperature values (mean of ca. 25°C) were in the recommended comfort range, the relative humidity levels were rather high (above 80%). The associated dew point temperatures were also high (very close to the minimum comfort temperature of 23°C). The danger is the growth of mildew, damage to building construction and health problems. Further, the thermal conditions could not justify one office type over the other since the recorded values showed minor deviations. However, the corridor space was found to be cooler during the day time hours but warmer at night. The consequent use of sustainable building design principles could lead to a better thermal environment.

REFERENCES

Alamdari, F. (1994) "Applications of CFD in the Built Environment" Microclimate Centre, BSRIA, Bracknell, England.

Bessoudo, M. (2008) Building Facades and Thermal Comfort: The Impact of Climate, Solar Radiation, and Glazing on the Indoor Thermal Environment, Verlag Dr. Mueller, U.K.2

Ferstl, K. (2005) Fundamentals of Climatically Appropriate Building and Relevant Design Principles, In: Tropical Architecture by Lauber W., First Edition, Prestel Verlag, Munich, Germany.

Fischer, H., Freymuth, H., Haeupl, P., Homann, M., Jeninsch, R., Richter, E., and Stoehrer, M. (2008) Theory of Building Physics, Vieweg and Taubner Verlag, Germany.

Hyde, R. (2000) Climate Responsive Design, First Edition, E & FN Spon, United Kingdom.

Klein, O. and Schlenger, J. (2008) Basics: Room Conditioning, Birkhaeuser Verlag, Berlin.

Koranteng, C. and Abaitey, G. E. (2010) "The Effects of Form and Orientation on Energy Performance of Residential Buildings in Ghana", Journal of Science and Technology, Ghana.

Koranteng, C. (2010) "The Energy Performance of Office Buildings in Ghana", Journal of Science and Technology, Ghana.

Koranteng, C. and Mahdavi, A. (2010) "An inquiry into the thermal performance of five office buildings in Ghana", 10th Rehva World Congress, Sustainable Energy Use in Buildings, CLIMA 2010, Antalya, Turkey, May 9 – 12, 2010.

Lechner, N. (2001) Heating, Cooling, Lighting: Design Methods for Architects, Second Edition, John Wiley & Sons, Inc., New York, USA.

Mahdavi, A. and Orehounig, K. (2009) "Building Energy Use via Intelligent Passive Cooling", 6te Internationale Energiewirtschaft, TU Wien, IEWT 2009.

Morse, R. (2009) Indoor Air Quality and Mold Prevention of the Building Envelope, (available at www.wbdg.org/resources/env_iaq.php).

Pröglhof, C. (2004). „Aspekte der natürlichen Fensterlüftung – eine Fallstudie", Department of Building Physics and Building Ecology, TU Wien.

Standard of Building Biology Testing Methods (SBM) (2008) Evaluation Guidelines, (available at www.baubiologie.ca).

Szokolay, S. (2004) Introduction to Architectural Science: The Basis of Sustainable Design, First Edition, Architectural Press, Oxford, UK.

Taylor, N. (2006) "Challenges to Temperature Regulation When Working in Hot Environments", Industrial Health 2006, 44: 331 - 344.

Walker, A. (2010) Natural Ventilation, (available www.wbdg.org/resources/naturalventilation.php).

URBAN LAND USE PLANNING IN GHANA: A POLICY INPUT DISCUSSION

Kwasi Gyau Baffour Awuah[1], Felix Hammond[2], Colin Booth[3] and Jessica Lamond[4]

School of Technology, University of Wolverhampton, Wolverhampton, WV1 1LY, UK

While the weakness of extant urban land use planning system in Ghana is not in doubt it is uncertain whether current planning reforms could address the fundamental issues that underpin the ailing planning system. This work as part of an ongoing study on evaluation of the economic justification of sub-Saharan Africa urban land use planning systems interrogates the planning regime in Ghana and the outlined reform package through a critique of the relevant literature. The primary aim is to provide input into current efforts in the country to devise effective and efficient urban land use planning model. The work establishes that while some of the causes of the problem such as high cost of compliance of planning regulations and inadequate knowledge of relevance of planning and its regulations appear obvious, their magnitude and conceptual explanations of the problem remain unresolved. To achieve a befitting planning model, conceptual understanding of the problem and knowledge of the magnitude of the causes such as planning regulation compliance cost are imperative. The work, therefore, outlines a conceptual explanation to the problem based on insights of the human action theory and identifies that the planning regime appears to lack incentives. Consequently, it is concluded that a quantitative cost and benefits of the extant planning regime is vital to the success of the planning reforms.

Keywords: Ghana, human action, urban land use planning system.

INTRODUCTION

The significance of urban land use planning (ULUP) as a central tool for addressing development imperatives such as rapid urbanisation, climate change and resource depletion in the world today is widely recognised (cf. Watson, 2009; Seto and Shephard, 2009). Despite this recognition, scepticism has been expressed over planning regimes particularly those of the developing world regarding their capability to deal with these imperatives and promote socio-economic development due to their underlying weakness (Payne and Majale, 2004; Kironde, 2006; UN-Habitat, 2009).

In Ghana the urban land use planning system in operation has come under severe criticism regarding its weakness and ineffectiveness (Government of Ghana, 2007; GIA, 2009). This weakness of the planning regime is manifested in the country's deplorable urban environment which is characterised by massive disregard of planning laws, co-location of first class settlements and shanties, traffic congestion and poor infrastructure among others. Hammond (2006), for example, estimates that 80% of

[1] K.G.BaffourAwuah@wlv.ac.uk
[2] F.Hammond@wlv.ac.uk
[3] C.Booth@wlv.ac.uk
[4] J.Lamond@wlv.ac.uk

Baffour Awuah *et al* ((2011) Urban land use planning in Ghana: a policy input discussion *In:* Laryea, S., Leiringer, R. and Hughes, W. (Eds) *Procs West Africa Built Environment Research (WABER) Conference*, 19-21 July 2011, Accra, Ghana, 939-952.

developments in Ghana are not covered by requisite building permits. Findings from surveys of government residential areas in Accra by Ghana's Lands Commission in 2006 also established that unauthorised land use conversions in prime areas like East Legon, Airport West and Achimota Forest residential areas were 20%, 24% and 20% respectively (cf. Baffour Awuah, 2007, 2010).

Following the emergence of land policy and development, and resource access and management in development dialogue among governments and the donor community (Toulmin et al., 2002; Hammond and Adarkwa, 2010), Government of Ghana in 2003 embarked on land tenure reforms (cf. Larbi et al., 2004). As part of this land tenure reform known as the Land Administration Project (LAP), a Land Use Planning and Management Project (LUMP) was initiated in 2007 to also revise the planning regime in the country. The envisaged outcome of the revision which is currently ongoing is to devise an appropriate planning model to support meaningful socio-economic development of the country (Government of Ghana, 2007, 2009). However, it appears doubtful whether the urban land use planning and management reform package will address the fundamental issues that confront the extant planning regime. This work, therefore, as part of ongoing study on evaluation of economic justification of sub Saharan Africa urban land use planning systems (SSA-ULUPS) interrogates through a critique of the relevant literature the extant planning regime and the reform package.

The primary aim is to contribute to the design of an appropriate planning model for Ghana in its quest for socio-economic development. It is argued that the ongoing reforms must be guided by conceptual understanding of the problem that confronts the existing planning regime to ensure the desired outcome. The work is thus organised in six sections. Section one gives an introduction to the work and how it has been organised and approached. Sections two to four critique the relevant literature on the country's planning regime. Section two examines evolution and nature of ULUP overtime and to date in the country while Section three details the manifestations of the extant planning regime and causes of its weakness. In Section four the work critiques the on-going planning reform package to rescue the ailing planning regime. Based on critique of the literature, Section five devises a conceptual view/framework based on insights from the human action theory to analyse and provide a conceptual understanding of the state of the planning regime dwelling on developers/property owners as unit of analysis and factors such as knowledge of planning regulations and its costs and benefits for the analysis. To the foregoing, the work then draws a conclusion in Section six.

EVOLUTION AND NATURE OF ULUP IN GHANA

The nature and practice of urban land use planning in Ghana have evolved overtime to their current status. Prior to the advent of colonialism, there existed some form of planning which was used to manage settlements by traditional authorities (Domfeh, 2001). Findings from archaeological and others studies, for example, show that settlement planning among the Akans, the largest tribe in Ghana dates back to 3, 500 years or more ago (Meyerowitz, 1951; Wilks, 1959; Effah-Gyamfi,1975; Farrar, 1996; see further Baffour Awuah et al., 2010).

The nature of planning during this period, though it may have differed among the various communities, was such that it was undertaken by traditional leaders on behalf of their people as political and spiritual leaders. However, this was undertaken in consultation with community members and in recognition of their socio-economic needs. Barbot (1732), describing the seventeenth century coastal Akan settlements disclosed that developments were in the form of many crooked and irregular lanes, which ended up at a wide open space at the centres of the settlements. The open spaces were used as market places. The developments which comprised of sub-divided dense compounds and occupied by related lineages were also clustered with small lanes and streets in between them. The rationale for such spatial configuration was to protect the inhabitants from external aggression and ensure expeditious organisation against such aggressions. Besides, the open spaces which were at the centres of the settlements were used as market places and meeting grounds for deliberation on community issues. This ensured equal commuting distance among community members. Related spatial configuration also pertained among the Bonos and Asantes of the Akan tribe (cf. Meyerowitz, 1951; Wilks, 1959; Effah-Gyamfi, 1975; Farrar, 1996).

It has been argued particularly by evolutionary land tenure theorists that this system of settlement management regime would have evolved into an appropriate design capable of dealing with the ongoing development imperatives (cf. Hammond, 2006; Hammond and Adarkwa, 2010). However, this perceived evolutionary arrangement did not materialise due to colonial intervention. Therefore, following colonialism at the turn of the nineteenth century, planning arrangement based on Western European requirements was cobbled onto the country by Western Europeans in particular the British (cf. Afrane, 1993; Gambrah, 1994; Konadu-Agyemang, 1998).

This new planning arrangement begun as a limited colonial government activity devoted to the passage of legislations, preparation of planning schemes and building of infrastructure (Afrane, 1993; Domfeh, 2001; Baffour Awuah et al., 2010). Perhaps the first of such legislations is the Towns Ordinance (1892) which is described as the genesis of formal planning in Ghana (Gambrah, 1994). Subsequently, in the 1900s and 1920s a number of regulations on creation of good sanitary conditions, prevention of diseases, minimum plot sizes and alignment and regulation of streets and so on were enacted (Konadu Agyemang, 1998). The Town Planning Ordinance (1925), for instance, was passed and health boards established to ensure healthy environments (Gambrah, 1994; Domfeh, 2001). Similarly, records at Ghana's Town and Country Planning Department indicate that in 1920 and 1927 during Governor Gordon Guggisberg's era some planning schemes were prepared and implemented in the two largest cities in Ghana; Accra and Kumasi.

Similar to other sub-Saharan African countries, and unlike planning that predated colonialism, the motive of the colonial planning apparatus was to secure the health of colonial administrators and promote the rationale for colonialism of exploiting the resources of Africa (Konadu-Agyemang, 1998; Njoh, 2009; Baffour Awuah et al., 2010). This was reinforced with the enactment of the Town and Country Planning Ordinance No. 13 of (1945) which was based on the UK Town and Country Planning Act (1932) (Amissah, 1979) and considered planning for the first time as a comprehensive activity of the colonial government (Afrane, 1993; Acquaah-Harrison, 2003). This Ordinance provided for the creation of town and country planning boards with the responsibility among others to secure the orderly and progressive development of land. However, Ordinance No.13 was replaced by Cap 84 in 1954 which was also amended in 1959 resulting in the taking on of the functions of the planning board by the minister responsible for town and country planning. Earlier in 1944, the Town and country Planning Department was set up for preparation of draft planning schemes and report. Consequently, the Department became the secretariat of the planning board and subsequently the minister responsible for town and country planning albeit not provided for in the Ordinance (Domfeh, 2001).

The ethos of the Town and Country Planning Ordinance No.13 (1945) and its subsequent amendments is that it prescribed rational comprehensive approach to ULUP and the use of master plans (Afrane, 1993; Gambrah, 1994). Underlying this planning philosophy is the land use segregation concept which sets out four cardinal principles. These are: unifunctional land use focusing on specialisation in land use; discreet zoning indicating legal manifestation of unifunctional land use; regulation prescribing regulatory process for desirable developments; and consensus, signifying that government actions are in the interest of communities (Afrane, 1993; Lai, 1994; Baffour Awuah et al., 2010).

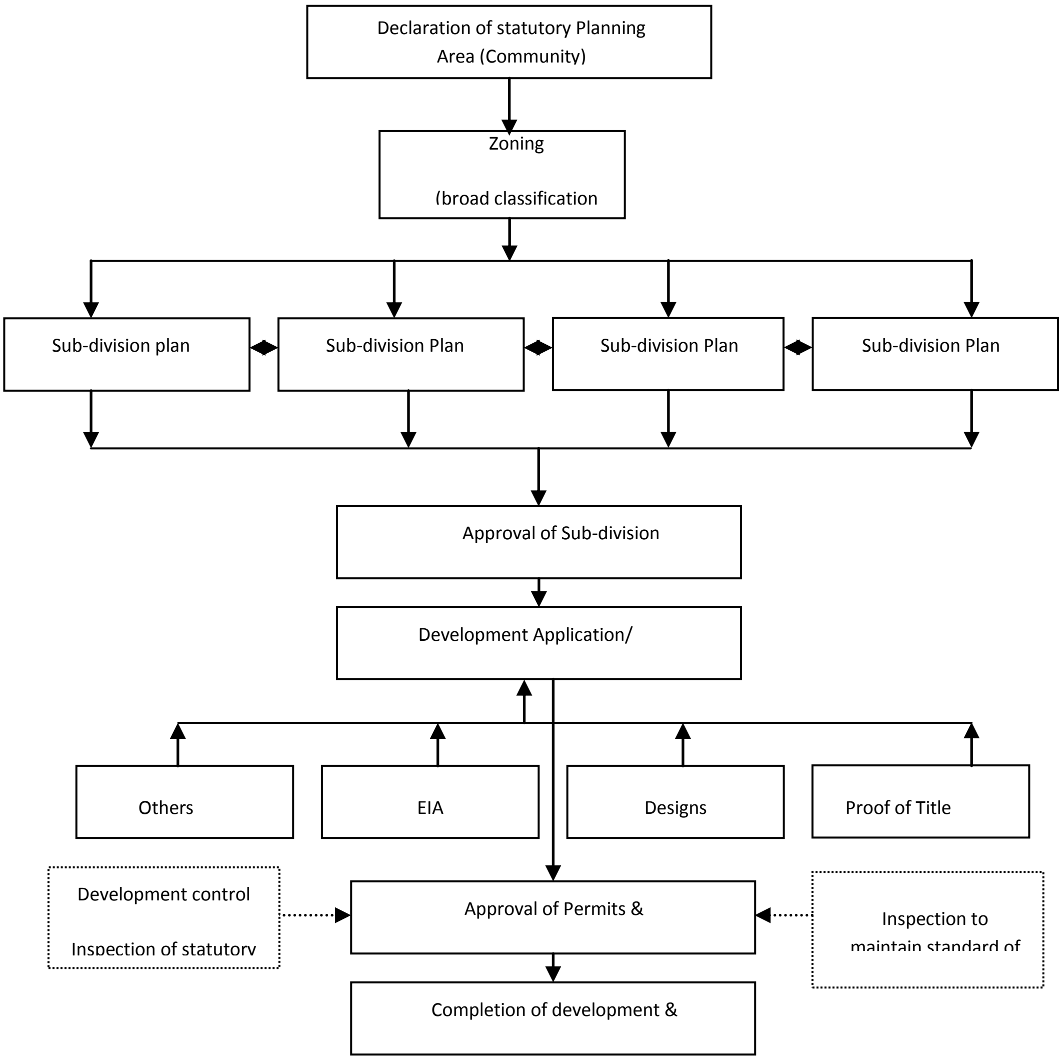


Figure 1 simplified version of the ULUP Model under 1945 planning Ordinance

The dictates of the 1945 Planning Ordinance and as illustrated by Figure 1, therefore, were such that upon declaration of any area as a statutory planning area all developments were to cease pending the preparation and approval of a planning scheme. Further to that proposed projects were screened to ensure that they met the necessary requirements for grant of building permits to commence developments and then certificate of occupancy upon completion of projects. Given its rationale for planning, the colonial government on the basis of the foregoing pursued racial and spatial segregation especially in the area of residential accommodation. Example of such segregation was the occupation of large bungalows with luxurious compound on large tracts of lands in Cantonments and Airport and Ridge Residential Areas whilst the indigenes lived in deplorable areas like James Town and Chorkor (Konadu-Agyemang, 1998; see further Baffour Awuah et al., 2010).

After independence and following global criticism of rational comprehensive approach to planning in the 1960s, attempts were made to change the orientation of planning to incorporate social and economic issues albeit with little success (Acquaah-Harrison, 2003). However, in 1993 after a long period of central government control, planning was decentralised pursuant to the promulgation of a number of legislations. These include: Local Government Act (1993) Act 462; National Development Planning Commission Act, (1994) Act 479; and National Development Planning (Systems) Act (1994) Act 480. Under this arrangement the Town and Country Planning Department hitherto a central government line agency which had regional and district branches throughout the country has also been decentralised in accordance with provisions of the Civil Service Law (PNDCL 327). This means that the former regional and district branches of the Department have become establishments of the regional and district coordinating councils respectively and the metropolitan/municipal/district assemblies planning authorities (Government of Ghana, 1996).

That said, the current planning arrangement did not abolish Cap 84 and Act 462 which made the assemblies planning authorities did come with a legislative instrument to guide ULUP practice. Consequently, though the assemblies are planning authorities, current ULUP practice follow the dictates of Cap 84 and supported by related legislations such as the National Building Regulations (1996) LI 1630 (cf. Herrle and Nkum and Associates, 2001; Domfe, 2001; LUMP, 2009). This planning arrangement has, however, come under severe criticisms for its adverse manifestations on the country's urban environment.

ULUP MANIFESTATIONS AND CAUSES

Generally, the aim of the extant ULUP regime in Ghana is to ensure orderly and progressive development of lands in urban areas, preserve amenities and promote environmental control among others (Konadu-Agyemang, 1998). However, several studies and reports have criticised the planning regime as being weak, ineffective and serving as a platform for public officials to undertake corrupt practices (Government of Ghana, 2007). The location of Nima, a shanty settlement which is only separated by a road from Roman Ridge and Airport Residential Areas, prime government residential areas in Accra is an epitome of the problem. Indeed the draft report on the strategic plan of Accra Vol. I (1991) aptly outline Accra's urban terrain as characterised by high traffic congestion especially in the central areas, poor housing and infrastructure conditions, urban sprawl with disregard for planning laws.

Afrane (1993) in a study on integration of housing and economic activities in four low- income settlements in Kumasi, the second largest city in Ghana established among other findings that property owners and residents would like to integrate housing and economic activities. However, most of the integration was carried out without regard to planning regulations. In a study on spatial and urban fragmentation in Accra, Larbi (1996) also established that 76% of developments on customary lands in Accra are unauthorised. However, Asabere (1981) in his study on determinants of land values in an African city: case of Accra found out that government zoning increases land values in Accra. That said, more recent studies (cf. Hammond, 2006; Baffour Awuah, 2007, 2010; Government of Ghana, 2009) have established adverse effects of the extant planning regime in Ghana on the country's urban environment. Baffour Awuah (2007) in a study on socio-economic impact of unauthorised land use conversions in state residential areas in Accra: case study of Ofankor Sector One Residential established that 48% of plots of land studied had their uses converted without requisite authorisation from the concerned planning authority. The study also revealed that this state of affairs had serious economic consequences for Ghana's Lands Commission with respect to ground rent revenue. In fact the study identified that the Commission lost ground rent revenue in 2006 which was estimated at 52% of ground rent charged in the same year for the area due to the phenomenon. In addition, the study established from the records of the Commission that unauthorised land use conversions in prime state residential areas such as East Legon, Airport West and Achimota Forest residential areas in 2006 were estimated at 20%, 24% and 20% respectively. Again, the recent human settlement and land use policy and planning study on Ghana (see Government of Ghana, 2009) reiterated the foregoing adverse manifestations and in particular sprawl, of the country's planning regime in virtually all the major urban centres.

Several causes are identified in the literature as responsible for the weak and ineffective ULUP regime in Ghana. Firstly, it has been argued that the planning regime continues to respond to colonial demands. Indeed the underpinning laws of the planning regime which is a relic of colonialism are outmoded, complex and their requirements restrictive taking into account the socio-economic realities in the country (Afrane, 1993; Baffour Awuah et al., 2010). For example, Cap 84 and LI 1630 specify stringent procedure and requirements for applying development and building permits, type of construction and construction materials allowable which are in the main based on British standards. These requirements for building permit include architectural designs, proof of title to land and environmental impact assessment report among others. Quite apart from that these planning laws are couched in such a technical language that they are difficult to be understood by even the uninitiated educated elites let alone majority of the people who are not well informed of planning policies and are also excluded from participating in the planning process (Afrane, 1993; Herrle and Nkum and Associates, 2001; see further UN-Habitat, 2009). This thus creates a platform for developers to disregard planning laws resulting in unauthorised developments and shanty settlements. In fact Baffour Awuah (2007, 2010) in his study on unauthorised land use conversions in Ofankor Sector One, for example, established that property owners who lacked knowledge of planning laws and their requirements are seven times more likely to convert their approved land uses without authorisation.

To the above point are the bureaucratic delays associated with the procedures for making formal planned urban lands available for development and of granting development rights. It is, for example, estimated that it takes a period of two years for a building permit to be granted (Farvacque and McAuslan, 1992) and in extreme cases six years (Kassanga, 1991). In a workshop organised in Kumasi, Ghana for Ghanaian professional planners and planning researcher by Peter Herrle and Nkum and Associates, participants pointed out that ULUP in Ghana is limited to re-zoning. Besides, planning processes are associated with delays and that majority of the built up areas in the country are not covered by approved planning scheme due to lack of base maps (cf. Herrle and Nkum and Associates, 2001). Further to this, is the huge cost involved in enforcing and complying with planning and urban development regulations. Findings from relevant studies indicate that huge cost in terms of time, monetary resources for meeting planning law requirements and making extra out of pocket payments to sort out planning documentation, and planning administration running cost are incurred for the purpose of complying and enforcing planning laws (Farvacque and McAuslan, 1992; Government of Ghana, 2007, 2009; UN-Habitat, 2009; GIA, 2009; see further Baffour Awuah et al., 2010).

In addition, planning institutions in Ghana are said to be weak, fragmented, under resourced and manipulated by politicians (LUMP, 2009). Indeed, the Town and Country Planning Department, the main professional ULUP agency has had a very chequered history and in a period of ten years (1999-2009) the Department was moved eight times between different ministries (LUMP, 2009). It is also observed that in 1995 there were two hundred and fifty professional planners in the country and only sixty-two were engaged by the then one hundred and ten metropolitan/municipal/district assemblies, the planning authorities. This means that forty-eight of the planning authorities were without planners. Even so, most of these planners had no varied training in areas like sociology, land economics and political economy among others to bring on board emerging planning models (Acquaah-Harrisson, 2003). To this point is the blurring nature of where the planning mandate actually resides due to the concurrent operation of Cap 84 and Act 462. Compounding the problem is the tripartite issue of rapid urbanisation, rise of the informal sector and urban poverty. This has resulted in inordinate demand for urban land and land based developments with the effect that planning continuous chase of developments has exacerbated and hence the deplorable urban environments (cf. Obeng-Odoom, 2010).

REFORM PACKAGE

Over the last decade land policy and development and resource access and management began to emerge in development dialogue among governments and the donor community (cf. Toulmin et al., 2002; Larbi et al., 2004). In Ghana this culminated into the development of a land policy (in 1999). Subsequently, a 25-year land tenure reform programme that began with the Land Administration Project (LAP) which seeks to put in place an effective and efficient land administration system for socio-economic development got under way in 2003 (Larbi et al., 2004; Government of Ghana, 2007, 2009). As part of the Land Administration Project, a sub-project, Land Use Planning and Management (LUPMP) commenced in 2007.

The aim of LUPMP is to develop a coherent, streamlined and sustainable land use planning and management system which is decentralised and based on consultative and participatory approaches to effectively manage human settlement developments. Flowing from this aim are seven objectives namely:

1. To develop and test models and processes of land use planning and development controls in partnership and with the active participation of communities and customary land owners;
2. To develop and test simplified and operational procedures of the inter-linkage between land tenure clarification and land use management at the local level as an integral part of the development management process and land administration system;
3. To develop and draft a coherent and modernised legal framework for town and country planning including model guidelines and regulations;

4. To prepare and implement institutional reform and strengthening including capacity building;
5. To implement an information system including integration of new and existing data (maps and other data) to support integrated planning at all levels
6. To develop an information/public awareness campaign strategies and materials to support the implementation of the reformed planning system; and
7. To support implementation of land use planning and development controls in Greater Accra Region and selected pilot areas in other regions (cf. Government of Ghana, 2007, 2009).

The outlined objectives were earmarked to be achieved through four main activities. These are: development and testing of decentralised land use models in selected high priority areas; policy studies and reform of legal and institutional framework for land use planning and management; implementation of information system for land use planning and management; and implementation of planning at the regional, district and local levels (Government of Ghana, 2009). The main policy study which is to underpin a reformed planning regime was completed in 2009. This was complimented by five discussion papers; a report on land use planning and management in Ghana's regions and selected settlements, review of town and country planning and other connected legislations, institutional review of agencies and bodies involved in planning, and a report on the extant planning system (Government of Ghana, 2009).

Whilst findings from the study and the discussion papers confirmed the manifestation of weakness of the planning regime and also identified the causes as discussed in the preceding section, they failed to provide a conceptual explanation of the planning problem in the country, a necessary input for far reaching policy formulation. Besides, like existing studies relative to the planning regime these policy studies were largely qualitative. For example, the main policy study dwelt significantly on descriptive administrative reports on land use planning and management in Ghana's regions and selected settlements. In fact the entire planning reform package though worthy and long overdue, according to its terms of reference, it is supposed to be based only on the problems identified by Ghana's Land Policy (1999) (cf. Government of Ghana, 2009: p.4), a policy whose basis appears not to be supported by in-depth research. Consequently, the extent and magnitude of compliance cost of planning regulation described as high and one of the causes of the ineffective planning regime, for example, is not known. This raises the question as to: how high is the cost of compliance of planning regulation? What is the acceptable cost of compliance of planning regulation to ensure adherence?

To guide policy formulation regarding devising an effective and efficient planning model for Ghana, a conceptual understanding of the underlying problem of the planning regime is imperative. A discussion of a proposed conceptual view of the problem is thus set forth in the next section.

INPUT FOR REFORM – CONCEPTUAL VIEW OF ULUP PROBLEM

Since the 1980s, there has been proliferation of planning theories dwelling on theories from political economy and other social science disciplines (Allmendinger, 2002). From the economics standpoint, the planning question has in the main been examined from the neo-classical, welfare and in recent times public choice economics (Adams et al., 2005). However, these theories have been formulated based on developed economies experiences (Watson, 2002) and in the case of the economic theories have resulted in disagreement over outcomes from relevant studies (Adams et al., 2005). Consequently, in providing conceptual explanation of Ghana's planning regime problem it is imperative that the underlying theory takes into account the socio-economic conditions of the people and the institutions that prosecute the planning agenda in Ghana. Such a suitable theory is the human action theory.

Human action theory emerged from a branch of political economy (Mises, 1949) currently known as Austrian Economics and became an integrated theory following the work of Mises (1949) despite its long period of existence. The theory constitutes the central axiom of Austrian Economics (Bratland, 2000) and has also been used in several fields such as legal theorising (Kinsella and Tinsley, 2004) and political ethics (cf. Hoppe, 1989). The theory as applied to urban land use planning in Ghana is illustrated by Figure 2.

The theory posits that every human being acts, and acts instinctively in a cheapest way possible to achieve their ends (Mises, 1949; Rothbard, 2004). For example, a person who wants to construct a house will do so using the cheapest means possible. Therefore, from the theory economic propositions should focus on individuals and not groups, as groups such as organisations and companies, do not have independent existence of their own and act through individuals (Mises, 1949; Rothbard, 2004). Thus human action is a purposive behaviour of using means to achieve ends; the substitution of a more satisfactory state of affairs for a less satisfactory one (Mises, 1949; Kinsella and Tinsley, 2004).

From Figure 2, developers/property owners expect to have good living environment and suitable arrangement of land uses to ensure health, safety, amenity and convenience; the rationale for planning (Adams, 2008; Gurran et al., 2008). These expectations are, however, manifested in property values appreciation. Therefore, for developers/property owners, property values appreciation constitutes ends known as benefits (cf. Fischel, 1990; Lai et al., 2007) and urban land use planning means also known as cost (cf. Mises, 1949). However, planning is undertaken through adhering to the requirements of planning regulations such as undertaking of zoning and preparation of sub-division schemes, building of infrastructure, acquisition of development permits among others (cf. Cheshire and Sheppard, 2004; Lai, 2005). Human action in this context, therefore, refers to compliance of planning regulations and occurs within ends and means framework (cf. Baird, 1998).

The theory further states that individuals act on the basis of incentives, that which impels human beings to act. This is intuitively conceived as the positive difference between the values of ends of action and means or resources used up in action (cf. Mises, 1949; Baird, 1998). Therefore, as depicted in Figure 2, for compliance of planning regulation to be worthwhile property values appreciation must be more than the value or resources used up in meeting planning requirements or cost of compliance of regulation.

What is noteworthy is that human beings speculate and makes speculation critical in the determination of existence of incentives (Mises, 1949; Rothbard, 2004). Thus in Figure 2, developers/property owners in arriving at whether or not planning provides incentives speculate either by perception or actual calculation. However, means in actual sense exist in the universe as elements and it is only when human beings are able to discover relevant relationship between them and the achievement of their ends that they become means (Mises, 1949; Rothbard, 2004).

Consequently, developers/property owners must first of all have knowledge as of the relevance of planning or compliance to planning regulation prior to speculating its costs and benefits. From the foregoing, human action is contingent on incentives determined by speculation of the values of ends and means of or resources used up in action subsequent to conception of means to ends. Therefore, for compliance of planning regulation, planning regimes must provide incentives signifying that developers/property owners should for a start conceive the relevance of planning to their end of property values appreciation and then, on the basis of their speculation come to a conclusion that benefits of compliance outweighs the costs. This implies that where there is lack of conception of relevance of planning to appreciation of property values, there will be lack of incentives and then lack of compliance with planning regulation. Similarly, where there is lack of resources or means even though conceived, there will be lack of incentives and hence lack of compliance (Baffour Awuah et al., 2011).

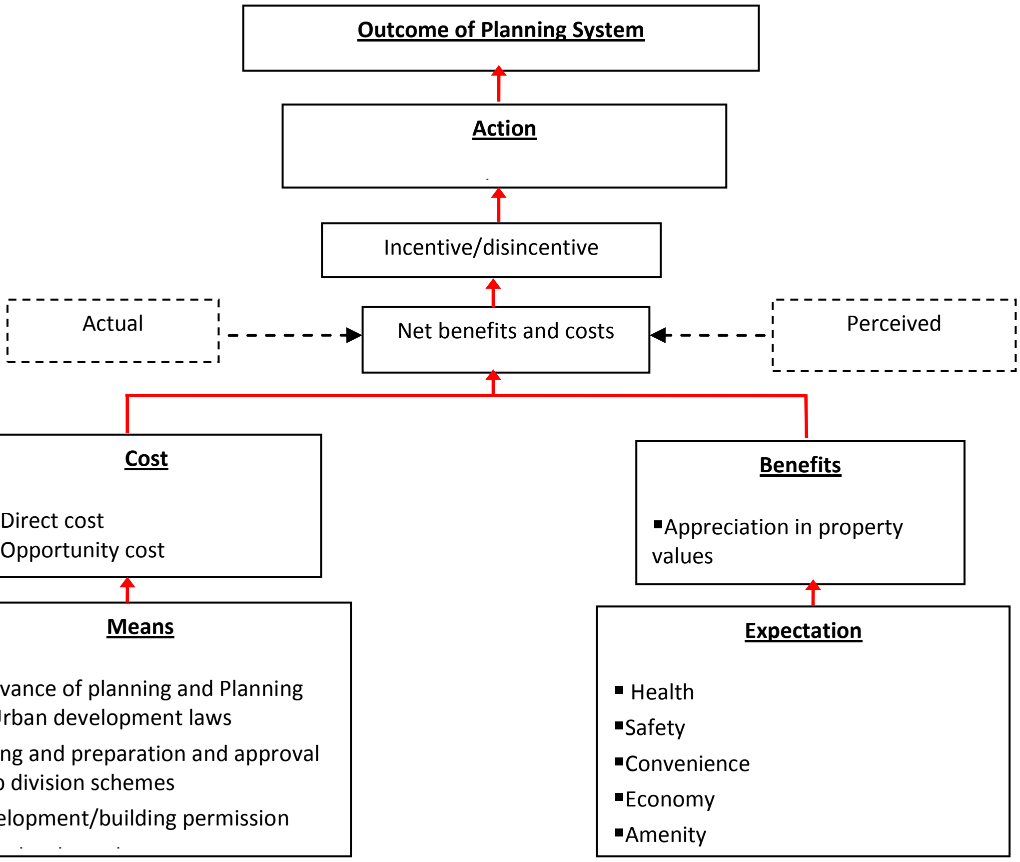


Figure 2 Source: Baffour Awuah et al. (2011)

The logic of the framework as depicted by Figure 2, therefore, is that where a planning regime provides incentives developers/property owners will comply with planning regulations which will result in orderly developments with infrastructure among others and vice-versa (Baffour Awuah et al., 2011).

However, from the earlier literature review it is evident that the relevance of planning, and knowledge and requirements of planning regulation are not known by majority of the people due to prevention of the public from participation in the planning process and the technical language by which planning legislations are couched (Herrle and Nkum and Associates, 2001). Besides, whilst the majority of the people particularly those of the low income bracket want to put their space into compatible multiple uses as, for example, integrating housing and economic activities (Afrane, 1993; Baffour Awuah, 2007, 2010) the planning regime continues to operate a strict land use segregation concept with huge cost for developers in terms of meeting compliance requirements (Government of Ghana, 2007, 2010). Compounding the situation has been the growing levels of poverty meaning the majority of the people simply do not have the resources to meet the planning regulation requirements. Given this situation and from the standpoint of human action theory, compliance of planning regulation under the Ghanaian ULUP regime will be low as it appears to lack incentives and hence the country's deplorable urban environment. Consequently, any policy to address the problems of the extant planning regime must of necessity be guided by quantitative determination of cost and benefits imposed by the regime.

CONCLUSION

This work set out to examine ULUP in Ghana through a critique of the extant literature. The primary aim was to contribute to ongoing planning reform efforts aimed at devising an effective and efficient ULUP model for the socio-economic development of the country. The literature critique established that although planning existed prior to colonialism, with the advent of colonialism the colonial master (the British) cobbled their colonial planning apparatus onto the country and up to date the country's planning regime continues to respond that colonial demands. This has resulted in lack of knowledge of relevance of planning and planning regulations among majority of the people, high cost of compliance of planning regulation compounded by weak planning institutions, poverty, urbanisation etc. and rendered the planning regime weak and ineffective manifested in deplorable urban environments. However, relevant studies to date have been silent on conceptual explanation of the underlying problem of the extant planning regime and the extent and magnitude of the causes such as high compliance cost of planning regulation. Using insights from the human action theory, the work outlines a conceptual explanation of the underlying problem of the planning regime and identifies that the planning regime appears to lack incentives. The work, therefore, concludes that determination of quantitative costs and benefits of the extant planning regime is vital to the success of the planning reforms.

REFERENCES

Accra Planning and Development Programme, United Nations Development Programme and United Nations Centre for Human Settlements (1991) "Strategic Plan for Greater Accra Metropolitan Area, Vols. I. Ministry of Local Government, Accra-Ghana.

Acquaah-Harrison, R. (2003) "The Restructuring of the Town and Country Planning Department". Paper presented at a Town and Country Planning Department Seminar held at Little Acre Hotel, Aburi, Ghana from February 12 – 13, 2003.

Adams, D. (2008) "Mapping out the regulatory environment and its interaction with land and property markets". Energy Policy, 36, 4570 – 4574.

Adams, D., Watkins, C. and White, M. (2005) "Examining public policy and property markets', in Adams, D., Watkins, C. and White, M. (Eds) Planning, Public Policy and Property Markets". Oxford, Blackwell Publishing Ltd, 3-9.

Afrane, S.K. (1993) "The Integration of Housing and Economic Activities: a Case study of Low Income Settlements in Kumasi, Ghana". PhD Thesis, University of British Columbia, Canada.

Allmendinger P. (2002) "Towards a Post-Positivist Typology of Planning Theory". Planning Theory 1:1, 77-99.

Amissah, S.B. (1979) "Guidelines for the Formulation of Land Policies and Title Registration in Ghana: A Documentation". Kumasi Land Administration Research Centre, University of Science and Technology.

Asabere P. K. (1981) "The Determinants of Land Values in an African City: The Case of Accra, Ghana". Land Economics, 57:3, 385-397.

Baffour Awuah, K.G. (2007) "The Socio-Economic Impact of Unauthorized Land Use Conversions in State Residential Areas of Accra: A Case Study of Ofankor Sector One Residential Area, Accra". MA Thesis, ISSER- University of Ghana, Ghana.

Baffour Awuah, K.G. (2010) "Land Use Planning In Ghana – Recent Salient Findings from a State Residential Area". The Journal of Business and Estate Management Research, 2:1, 18-35.

Baffour Awuah, K.G., Hammond, F., Bloch, R., Proverbs, D., Booth, C., Lamond, J. (2010) "Sub Saharan Urban Land Use Planning Systems: The Need For An Economic Appraisal". Paper presented at RICS-COBRA Conference held at Dauphine University- Paris, France from September 2 -3, 2010.

Baffour Awuah, K.G., Hammond, F., Booth, C., Lamond, J. (2011) "Improving the performance of the Construction Industry: The Urban Land Use Planning Factor". Paper submitted at the ARCOM and LCI, UK Doctoral Workshop held at the School of the Built and Natural Environment, University of Northumbria, UK on March 2, 2011.

Baird, C.W. (1998) "Profit and Loss, in Boettke, J. (Ed.) The Elgar Companion to Austrian Economics". Cheltenham, Edward Elgar Publishing Inc.

Barbot, J. (1732) "A description of the Coasts of North and South Guinea". London, Churchill's Collection of Voyages and Travels.

Bratland, J. (2000) "Human Action and Socially Optimal Conservation: A Mises Inquiry into the Hotelling Principle". The Quarterly Journal of Austrian Economics, 3, 3-26.

Cheshire P. and Sheppard, S. (2004) "Land markets and land market regulation: progress towards understanding". Regional Science and Urban Economics, 34, 619-637.

Cotula, L., Toulmin, C. and Hesse, C. (2004) "Land Tenure and Administration in Africa: Lessons of Experience and Emerging issues". London, International Institute for Environment and Development.

Domfeh, S. N. (2001) "Town and Country Planning in Brief, Ghana". (Unpublished).

Effah-Gyamfi, K. (1975) "Traditional History of the Bono State: An Archaeological Approach". Legon, Institute of African Studies, University of Ghana, Legon.

Farrar, T. (1996) "Building Technology and Settlement Planning in West Africa Civilization: Precolonial Akan Cities". Cambridge, Edwin Mellen Press.

Farvacque, C. and McAuslan, P. (1992) "Urban Management Programme: Reforming urban land policies and institutions in developing countries". The International Bank for Reconstruction and Development (World Bank), Washington DC, USA.

Fischel, W.A. (1990) Introduction: Four Maxims for Research on Land-Use Controls, Land Economics, 66:3, 229- 236.

Gambrah, A. (1994) “Regulation of Housing and Services for the Urban Poor: A case study of Accra, Ghana”. MSc Thesis, University of British Columbia, Canada

Ghana Institute of Architects (GIA) (2009) “Addressing the adverse impact of non-enforcement of building and development controls in Ghana: Summary of findings of research”. GIA (Unpublished).

Government of Ghana (2007) “Draft Inception Report on Land Use Planning and Management Project”. Accra, Land Administration Project, Ministry of Lands, Forestry and Mines.

Government of Ghana (2009) “Human settlements and land use policy and planning in Ghana: A policy study”. Land Use Planning and Management Project, Town and Country Planning Department, Ghana

Gurran, N., Ruming, K., Randolph, B. and Quintal, D. (2008) “Planning, government charges, and the costs of land and housing”. AHURI Positioning Paper No. 109, Australian Housing and Urban Research Institute, UNSW – UWS Research Centre, Sydney Research Centre.

Hammond, F.N. (2006) “The Economic Impacts of Sub-Saharan Africa Urban Real Estate Policies”. PhD Thesis, University of Wolverhampton, UK.

Hammond, F.N. and Antwi, Y.A. (2010) “Analysis of sub-Saharan Africa Real Estate Policies”. London, Palgrave Macmillan.

Herrle, P. and Nkum and Associates (2001) “Towards a Concept for Participatory Urban Planning in District Towns, Final Report for Promotion of District Capitals II submitted to Programme Co-ordination Office PRODICAP II”. Accra, GTZ and Ministry of Local Government and Rural Development, Ghana.

Hoppe, H. (1989) “The Theory of Socialism and Capitalism”. Boston, Kluwer Academic Publishers.

Kasanga, K.R. (1991) “Institutional/Lagal Regimes and Urban Land Management: A case study of Ghana”. Kumasi, Land administration Research Centre, University of Science and Technology, Ghana.

Kironde J.M.L. (2006) “The regulatory framework, unplanned development and urban poverty: Findings from Dar es Salaam, Tanzania”. Land Use Policy, 23, 460 – 472.

Kinsella, N.S. and Tinsley, P. (2004) “Causation and Aggression”. The Quarterly Journal of Austrian Economics, 7:4, 97-112

Konadu-Agyemang (1998) “The Political Economy of Housing and Urban Development in Africa: Ghana’s Experience from Colonial Times to 1998”. Westport, Praeger Publishers.

Land Use Planning and Management Project (LUMP) (2009) “Town and Country Planning Authority”. LUMP-Dialogue, 2:1, 1-9.

Lai, W.L. (1994) “The economics of land – use – zoning”. Town Planning Review, 65: 1, 77-98.

Lai, W. L., Yung, P., Li, R. Y., and Ho, D. C. (2007) “The private supply of and public demand for planning conditions in the absence of direct statutory enforcement measures”. Planning Practice and Research, 22:4, 535-557.

Larbi, W. O., Antwi, A., Olomolaiye, P. (2004) “Compulsory land acquisition in Ghana – Policy and praxis”. Land Use Policy, 21, 115 – 127.

Larbi, W.O. (1996) “Spatial planning and urban fragmentation in Accra”. Third World Planning Review, 18, 193-215.

Meyerowitz, E.L.R. (1951) “The Sacred State of the Akan”. London, Farber and Farber.

Mises, L.V. (1949) "Human Action: A Treatise on Economics". Scholar's Edition. Auburn, Ala.: Ludwig von Mises Institute.

Njoh A.J. (2009) "Urban Planning as a tool of power and social control in colonial Africa". Planning Perspectives, 24: 3, 301 – 317.

Obeng-Odoom, F. (2010) "An urban twist to politics in Ghana". Habitat International. 34, 392 – 399.

Payne, G. and Majale, M. (2004) "The Urban Housing Manual: Making Regulatory Frameworks Work for the poor". London, Earthscan.

Rothbard, M.N. (2004) "Man, Economy and State". Scholar's edition, Alabama, Ludwig Von Mises Institute.

Seto, K. C. and Shepherd, J. M. (2009) "Global land use trends and climate impacts". Current Opinion in Environment Sustainability, 1, 89-95.

UN-Habitat (2009) "Planning Sustainable Cities: Policy Directions. Global Report on Human Settlements, Abridged (Edn.)". London, Earthscan.

Watson, V. (2002) "The Usefulness of Normative Planning Theories in the context of Sub – Saharan Africa". Planning Theory, 1:1, 27-52.

Watson V. (2009a) "The Planned City Sweeps the poor away: Urban Planning and 21st century urbanization". Progress in Planning, 72, 151-193.

Wilks, I. (1959) "Akwamu (1650 – 1750). Rise and Fall of a West African Empire". Legon, Institute of African Studies, University of Ghana, Legon.

URBANISATION AND THE MARKETPLACE IN WEST AFRICAN COUNTRIES: IMPACT ON THE HEALTH AND SAFETY OF CHILDREN OF FEMALE TRADERS

Enitan Oloto[1] and Kayode Adebayo[2]

Department of Architecture, University of Lagos, Akoka, Lagos State, Nigeria

Female traders work in the informal sector, a large segment of the economy about which there is limited information. As such, their enormous contribution to the economy has yet to be fully recognized by economists, urban planners, and policymakers. As Urbanization continues, both the volume of demand and the number of female traders and street vendors are expected to grow. Economic reforms and downsizing in the public and private sectors over the years have driven many new entrants into this competitive market, affecting women greatly and causing downward pressure on earnings. Majority of these women have their children accompany them to the marketplace, exposing them to health and safety hazards. These pressures explain the need for women to be provided with facilities such as the on-site childcare centre which will assist them in taking care of their children on site while at work. The purpose of this research is to see how Urbanisation has affected the health and safety of children in the marketplace and ultimately the positive effect of introducing childcare facilities in marketplaces. It has actually been observed that public toilets have been the predominant features springing up in market places recently, but another important facility, salient and of major importance are the on-site childcare facilities.

Keywords: female traders, marketplace, on-site childcare facility, urbanisation.

INTRODUCTION

In regard to future trends, it is estimated 93% of urban growth will occur in Asia and Africa, and to a lesser extent in Latin America and the Caribbean. By 2050 over 6 billion people, two thirds of humanity, will be living in towns and cities. (Webster's online dictionary, 2011). What is historically unprecedented is the absolute rate of urban growth in Africa—averaging almost 5 percent per year1, implying close to a doubling of the urban population in 15 years. On average the population of the Africa Region is now one-third urbanized, higher than South Asia's 28 percent. Africa is approaching a demographic inflection point as the numbers of new urban residents are projected to rise sharply by over 300 million between 2000-2030—more than twice the rural population increments. (Kessides, 2005, p.x). By 2025, it is estimated that 58.9% of West Africans will be living in urban areas. (Aniah, .n.d., p.265).

While it is clear that West African countries are experiencing unprecedented rates of urbanization, debate over the causes and effects of urbanization in the region remains heated and often rancorous. African urbanization is taking place in a context of severe

[1] enylegacy@yahoo.com
[2] Akay.adebayo@yahoo.com

Oloto, E. and Adebayo, K. ((2011) Urbanisation and the marketplace in West African countries: Impact on the health and safety of children of female traders *In:* Laryea, S., Leiringer, R. and Hughes, W. (Eds) *Procs West Africa Built Environment Research (WABER) Conference,* 19-21 July 2011, Accra, Ghana, 953-962.

constraints that did not face other country groups in other periods--such as full exposure to pressures of global competition; very limited outlets for external migration; and depredation of the productive workforce and of family security. (Kessides, et al.,2005, p.ix). The study reported in this research is concerned not with the causes, but rather the effects, of urbanization in the region. Particularly, the study was designed to explore the impact of urbanization within the informal sector in West African countries.

Economic reforms and downsizing in the public and private sectors has brought new influx into the informal sector of most West African countries resulting in a daily influx of women into the informal sector of trading. The challenges of urbanisation have made more women venture out to look for alternative means of providing for their family, while juggling between household chores and trading in the marketplace, and trying to raise their children. Over 80% of these women bring their children between the ages of 6-36 months to their workplace (the market).Women have developed strategies that allow them to be productive while coping with the demands of childbearing and child care. These include dependence on traditional support systems, such as choosing flexible working time, and obtaining the help of surrogate mothers, including older siblings. Sometimes, these other caretakers are unable to properly look after young children, thus leaving especially infants vulnerable to poor diet and infections. Another strategy is to take the child to work. (Ene-Obong, Uwaegbute, Iroegbu, and Amazigo, 1998, p.173) Many informal jobs like trading, are not only “flexible, precarious and insecure,” but are also hazardous and take place in settings which are both unhealthy and unsafe. Such work environments can include waste dumps, informal market areas, roadsides and homes, all of which can expose the workers who work in them to environmental disease, traffic accidents, fire hazards, crime and assault, weather related discomfort, and musculo-skeletal injuries. (Alfers, n.d., p.4.)

A large proportion of lower socioeconomic status women in West African countries are petty traders, with many selling their products in markets with poor environmental conditions. Therefore, the children who often accompany their mothers to the market are constantly at the risk of inadequate immunization and constantly exposed to health hazards like child diarrhoea, through contaminated food and water, which is an important cause of morbidity and mortality in this environment. It was observed after conducting a survey of the market women in Balogun market in Lagos state, that on average, women trades are 27 years old and have up to three children under the age of four.

For the purpose of this research, reports will be limited to three West African countries-Nigeria, Ghana, and Liberia. Comparison to other francophone neighbouring counties will be researched in the near future. There is however, very little empirical evidence showing the direct impact of urbanisation on the health and safety of the market women and its indirect effect on children that accompany their mothers in the informal sector urban enterprises within West African countries. The research will contribute to the existing documented researches on this agenda and will alert policy makers and planners in West African countries to the problems and coping mechanism which undermines the business performance of female traders in the informal economy and the health and safety risk of children who accompany them to the market. It identifies briefly, some of the major institutional obstacles which currently limit the ability of most West African countries to institute effective health and safety mechanisms in markets and other trading areas in the region. The research thus makes only tentative suggestions about possible ways forward in terms of interventions to address the current situation.

The introduction of on-site childcare facilities in every market locations will be a catalyst for rapid alienation of challenges faced by female traders who bring their children to the marketplace. The research proceeds in the following order. Initially, it examines the theoretical and intuitive link between urbanization and marketplace, and then the Profile of the 3 selected West African markets will be discussed. Next, it discusses the data and methodological issues of the study. A subsequent section presents the study results .The research ends with concluding remarks and articulated future intentions.

THEORETICAL FRAMEWORKS AND CONCEPTUAL TOOLS

The rapid inflow of people from rural settlements to urban cities and the Urbanisation affects the growth of markets within the informal sector. This can be seen as more people migrate daily into the West African urban cities for better opportunities. Even the economic meltdown has witnessed the gradual transition of people from the formal sector of the economy to the informal sector. The informal sector in Africa is dominated by trade-related activities. According to Verick (nd.), this sector is characterised by a high proportion of women.

Skinner (2005) who argued that trends in petty trading over time are integrally linked to urbanisation, migration and economic development processes. In their research, George, Gordon, Mark and Rogelio (2008) argued convincingly that urbanisation is the most important issue of the twenty-first century – even more important than economic growth, poverty, and the environment. In their study they agreed that Urbanisation is critical for economic growth, for reduction of poverty, for stabilisation of population growth, and for long-term sustainability. George et al. (2008) also mentioned that informal activities in many developing countries accounts for as much as two-thirds of urban employment, providing a main source of employment and income for poor urban women who predominantly engage in trading in the market place. According to Verick (nd.), the informal sector has not only persisted but actually grown in many developing countries, particularly in Africa where it dominates the economy both in terms of output and employment. We can see from George et al. (2008) and Verick (nd.), that more women fend for their families and contribute to the economic growth of West African countries. One can only deduce from these literatures that more attention should be given to the well being of the female traders who according to Chen, (2008) make up 60% of women's labour force participation in West Africa. It is therefore apparent that the need to provide policies and facilities that will focus on this group. For instance, in the paper *"The role of the market woman in the Nigerian Economy"* (par.2*)*, women, including girls, make up 49 percent of Nigeria's population (2006) and constitute 37.14 percent of Nigerians in gainful employment (3). The paper also mentioned that with only 7 percent presence in the industrial work force and 26 percent in the service sector, it is apparent that women are highly concentrated in the informal sector of the economy and for most of them, life revolves around the family, the farm and the market place. In the case of Ghana, Tsikata (2007) stated that a distinct characteristic of the informal economy in Ghana and everywhere in sub-Saharan Africa is the predominant location of women's productive activities. He went on to state that the numerical composition of the informal sector in Ghana is predominantly female and its official characteristics, the nature of many enterprises and its labor relations are all associated with the features of women's work. Tsikata (2007) also observed that though the expansion of the informal economy has created new work opportunities for women in Ghana, women have become entrenched in the survivalist sections of the informal economy making a living in conditions which do not conform to the ILO standards for decent work. Thus it can be argued that women's special relationship with the informal is not a happy one. Chen, (2008) argued that compared to other regions of the world, Africa is known for its large numbers of women street vendors and market traders. Verick (nd) observed that because many African countries either don't collect data on the informal sector or they use different definitions, it was difficult to make strict comparisons within and between countries. Nonetheless, Verick (nd) stated that the gross national income (GNI), which ranges from under 30 percent in South Africa, the continent's largest economy, to almost 60 percent in Nigeria,and with an average of 42.3 percent in sub-Saharan Africa (SSA), indicates the size of the informal economy. According to Skinner, (2008) in most African countries, other than North African countries, women represent at least half, if not more, of the total number of traders However, the empirical findings and documentations on the apparent dominance of the informal trade by women have not been used as a factor to encourage these women. If true, then this is evidence that female traders are been neglected and not enough is being done on their conditions at work. Alfers (nd.) in her paper "Occupational Health and Safety for Informal Workers in Ghana -A case study of market and street traders in Accra", stated that female market and street traders were exposed to a number of health and safety hazards – with fire, and diseases related to poor environmental health ranking prominently. It was also discovered that it is at the level of local government where the institutions exist which are most likely to be able to provide protection against these risks. Unfortunately, despite the potential of these institutions to provide preventive social health protection to traders, it was found that they have been largely unable to fulfil this role.

In the same paper, Alfer (n. d.) argued that despite the abundance of health and safety risks in the large and growing informal economy, little attention has been paid to the subject of occupational health and safety in the literature on risk and social protection. She also stated that although there is a wealth of information on both informal and formal health protection mechanisms in Africa, the focus tends to be on protection that is curative rather than preventive in nature and that while such curative protection is of course important.

Ene-Obong,Uwaegbute, Iroegbu and Amazigbo (1998) focused on the salient but integral part of the market-the children. According to Ene-Obong et al. (1998) the market environment, with its prevailing unsanitary conditions and overcrowding could be dangerous for the child. In addition, women engaging in buying and selling may not be able to give close attention or supervision to their children. They further went to say that depending on the number of hours spent in the market, infant foods may be poorly prepared, obtained, or handled. All these were potential hazards to children in the market. Oladokun, Lawoyin and Adedokun (2009) did not fail to mention that traders who form a large percentage of the female work force in Nigeria and spend long hours at work, put their children at risk of inadequate immunization. They observed that the immunization coverage rate among children of female traders was low and that routine immunization sites should be made available in the markets. These immunization activities could be carried out in childcare centres built within the markets for easy access. Also in the research, "Women and Children Getting by in Urban, Accra", compiled by the International Food Policy Research Institute [IFPRI], (n.d.), many young children of the traders in Accra, were not adequately nourished. About 18 percent were stunted in grow and about 15 percent were underweight for their age. According to Ene-Obong et al (1998), taking a child to the market could be seen as advantageous in the sense that it gives mothers the opportunity to continue to breastfeed and look after the child while at work. Though this argument is acceptable, until certain parameters are put into place, the children will still be exposed to unfavourable conditions regarding to safety and health. The hygienic conditions of most markets are appalling and certain facilities need to be put in place to validate their argument. (IFPRI), (n.d.), also argued that malnutrition of the children of market women in Accra appeared to be more closely associated with the quality of care than with the extent of poverty or food insecurity. In order to avoid an epidemic catastrophe, it is of paramount importance that more preventive than curative measures should be adopted regarding the sanitary and safety conditions of our markets. Markets will continue to expand and grow, as urbanisation persists and women will continue to dominate this sector of the economy. Verick (nd.), Skinner (2005), George et al. (2008) and Chen, (2008) all clearly agree that not only does urbanisation have a dynamic impact on the growth rate of markets in West African cities, but that one major characteristics of trading is the predominate presence of women in this informal sector of the economy. Though Ene-Obong et al. (1998) and Oladokun's et al. (2009) focus were on the needs and challenges of the children exposed to health hazards and poor environmental sanitation, little research has been made on the health and safety of children who make up a salient part of the market. This was reflected by non-existence of on-site childcare centres, in almost all the major markets in Nigeria, Ghana and Liberia. Childcare centres were alien features of markets in theses three researched countries.

MARKETS AND THEIR FEATURES

Markets in Nigeria

The most common features of Nigerian markets are lock- up shops (permanent structures), make-shift structures made of wood and old zinc roofing sheets (temporary structures) or simply tables made of wood arrangement disorderly in open areas with no superstructures. In markets like Idumota in Lagos State, The distinct feature about this market is that it is made up of very many multiple storey buildings some measuring 5 or even more floors. Most of the shops are actually apartment rooms converted into shops. (Onwueme, 2009).Figure 1 and 2 show pictures of lock-up stores and open stalls in Balogun Market.

Fig.1 A woman with her children at Balogun Market

Fig.2 Open shed market at Balogun

Markets in Ghana

Fig. 3 Makola Market

Open-air markets are an integral part of society in Ghana. Accra's markets are the centre of the city's economic activity; it is here where most people buy their basic goods. The majority of traders are women who source and carry their own goods to the market at great expense and effort. Makola market is a whole neighbourhood packed full of stalls, multi-storey shops shown in figure 3, and winding streets predominately with women selling wares.

Markets in Liberia

Market places occur either in enclosed or covered structures or in open space. Market structures are of several types. Some are roofed buildings with concrete floors and walls, while others lack walls. Market areas often lack concrete floors and are poorly drained. Many of the market structures were damaged during the war and have required major renovation. Urban daily markets often operate in unsanitary, unhealthy, and congested conditions. **(**Republic of Liberia: Liberia Market Review [LMR], 2007, p.xi). Based on the report compiled by "*Liberian Markets and Marketers Survey*", (2007, p.12), Over one-thirds (36.4 percent) of marketers surveyed have their children accompanying them to the market. Marketers' justification for taking their children along with them to marketplaces included: the lack of someone to care for them at home (54 percent), the need for helping hands in selling (37 percent), and the need to take care of the very young ones who are either still breastfeeding or require primary parental care (2.2 percent). Over 50 percent of the women who bring their children to the market use them to sell. Approximately 18.8 percent of the children, however, spend the day playing (with friends). Surprisingly, only 0.2 percent of the market women enrol their children into day care programs. (Liberian Markets and Marketers Survey, 2007, p.18). Only two (2) markets, the Nancy Doe Market in Monrovia and the Logan Town Market, have learning and child development services for market women. (Liberian Markets and Marketers Survey, 2007, p.18).

Fig.3 Multi-storey Nancy Doe Market

Fig.4 Example of open shed market

RESEARCH METHOD

The research was not designed to produce statistically representative results but to provide a description of the conditions of markets in three selected West African Countries, (Nigeria, Ghana, and Liberia) based on qualitative analysis. Generally, data were scarce and not readily available for theses three countries, although the Liberian government made efforts to compile information on the female market women, despite their challenges of lose of data due to the civil war. Recent relevant literature on Liberian markets and the marketing system is scanty.

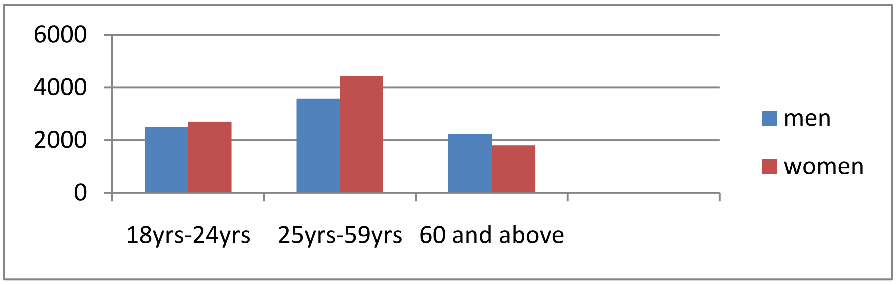
However, the findings of this research were obtained through a data collection methodology that combined a sample survey among marketers with desk study, direct observation, focus group discussions, and key informant interviews. The main data sources included the marketers, the Market's Association leaders, and local community leaders of Balogun market in Nigeria .Reviews of available literature were used for this research from articles, journals, books and the websites. Key informants interviews were held at local level within selected markets in Lagos, Nigeria. In total, 100 interviews were conducted. The review was conducted in 2 markets (Balogun and Oyingbo market). Given logistic and time constraints, markets were selected based on their frequency (daily, weekly), geographic location (urban) and the type of market (wholesale, retail or combined). A structured questionnaire was designed to collect primary data. Given the time constraint and the expected output, the questions were designed to collect mostly qualitative information. Information was gathered using a mix of methodologies including observations, interviews with individual traders, and focus group discussions with the market women.

The principal research methodology challenge was the lack of literature and data on the informal sector in West Africa. Data were often fragmented and based upon estimates. There were no current, reliable production data available. Statistical information quoted by international institutions was often based on regional averages rather than empirical local data. There was very little data on the Nigerian Market women. Literatures focused more on the structure of the market system and the demolition of illegal markets than the working conditions of the female trader and effects on their children. The findings however suggest that female traders are burdened with the responsibilities of child care which limits the extent of their trading and equally leaving the children victims to health and safety hazards.

CONCLUSIONS

Recognizing the fact that the informal economy is here to stay and that market women are permanent players in the economy is an important step that needs to be taken in reformulating policy. (Cohen, Bhatt and Horn, 2000, p.11). That women who took their children to the market would rather leave them at home if they had caretakers suggests that having their children with them imposes some constraints on their market activities and, therefore, affects the quality of care they can offer to their children. There is, therefore, a need to empower these women in the areas of quality child-care practices. The establishment of health posts in markets would be used for the promotion of appropriate infant-feeding practices, growth monitoring, distribution of oral rehydration solution and cater for other special needs of the children of market women. (Ene-Obong et al., 1998).

The results of this study show that women's participation in the economy, in these informal working conditions, is not accompanied by domestic and social support that would permit the delegation of other responsibilities, such as the care of the young. The manner in which these women resolve such problems implies a high probability that the child will be with its mother. These children cannot be overlooked not only because they are highly susceptible to diseases and accidents but because they form an integral part of the market place. Accidents and gastrointestinal illnesses are found to be common indicators of damage to health of children in the two market studied in Lagos markets.(Balogun and Onyingbo market). Both illnesses are related to different aspects of care, particularly feeding and stimulation of the psychomotor development in children. Both require an appropriate physical environment for prevention, including hygienic areas for food preparation and disposal of wastes. This observation was deduced from information's collected after interviewing about 100 market women in Balogun Market in Lagos State as regards the health and safety of their children. These women are of the opinion that no one can take care of their children, the way they can. When queried further, it was discovered that a daycare centre actually exists in a part called Enu-owa.Not many of the inhabitants of this site had heard of the place. The few that were aware of the site, where happy to say they had withdrawn their children from that care centre, because of the method these nannies employed in the care of their children.



Population of male and female traders in Balogun Market

The study also shows that simply because a child remains with its mother does not necessarily imply that it will receive 'maternal care', given that the mother has to pay attention simultaneously to her own safety and that of the child against all forms of urban violence, while paying adequate attention to customers and to the merchandise. This situation corresponds to the relatively high rate of accidents among children who spend the day in the street, compared with those children cared for in childcare facility. At the same time, the absence of hygienic installations and safe working conditions would explain the relatively high incidence of gastrointestinal illness among these children, when compared with that among children taken as reference in proper childcare facilities. All these factors point to the presence of particular problems in this informal sector of the urban population. A broader public policy focus is required to incorporate the needs of the female traders and their children.

One of the drawbacks to the improvements of Occupational Health and Safety of women workers is inaccurate statistics. One fifth of the world's women are economically productive but are not counted because of inadequate measurement. Therefore the method of data collection for national statistics on occupational health must be improved, especially the workplace coverage so as to highlight traditional areas of female employment. (Alli,n.d., Improved data collection and statistics,para.1)

The research proposes several alternatives at the policy level for dealing with these hazardous working conditions and the lack of social security provisions. If possible, one measure to develop would be the promotion of on-site child care facilities in whatever form, whether under the auspices of the community, trade associations or public institutions. It was observed that out of the three West African countries used as case studies in the research (Nigeria, Ghana, and Liberia), Nigeria seemed to have very few statistical data and documented literature on female traders in the informal sector. Our review of public policy and survey of female traders reveals that predominant concerns in Nigeria are tax collection, elimination of unfair competition and, in relation to health, protection of consumer health rather than the improvement of the environment to becoming family-friendly and safe for children of the market women.

Specific policy recommendations suggested by our findings are: A childcare centre for vendors' children at the workplace; Maximum reduction of children's exposure to environmental pollution by caring for them in enclosed areas; Health education of female vendors, concerning development, nutrition, hygiene and safety. Municipal authorities must initiate a new and comprehensive program for the development of markets and marketers. These must include standardized market infrastructural development and changes, the provision of basic infrastructural services needed onsite by female marketers. It must also include support for child development that would help children accompanying their parents to the markets daily.

The research concludes that the formation of strong female traders associations, education training and more enforcement of municipal by-laws and policy that will encourage the introduction of childcare facilities like childcare centres and health posts, will alienate some of the challenges affecting the women who unavoidably must bring their children to the marketplace.

ACKNOWLEDGEMENTS

The authors are grateful to the market women and market association leaders of Balogun and Oyingbo market, all in Lagos State, Nigeria, who gave us access to interview them at a short notice despite their tight and busy schedule.

REFRENCES

Alfers, L. (n.d.) Occupational Health and Safety for Informal Workers in Ghana: A case study of market and street traders in Accra.

Alli, B.O. (n.d.).Women at the workplace Occupational Health and Gender Focal point, Retrieved March 16, 2011 miosh.net/articles/Occupational%20Health/Women2.doc

Aniah, E.J., (n.d.) Urbanisation and Development in West Africa: Challenges and Policy Implications, LWATI: A Journal of Contemporary Research, 3, 265-283.

Chen, M., (2008) Women and Employment in Africa: A framework for action.

Chirisa, I. (2008) Population Growth and Rapid Urbanization in Africa: Implications for Sustainability, Journal of Sustainable Development in Africa, 10:2, 361-394.

Cohen, M., Bhatt, M. and Horn, P. (2000) Women Street Vendors: The Road to Recognition. Seeds, 20, 1.

Ene-Obong,H.N., Uwaegbute, A.C., Iroegbu, C.U. and Amazigo, U.V. (1998) The Effect of Two Child-care Practices of Market Women on Diarrhoea Prevalence, Feeding Patterns and Nutritional Status of Children Aged 0-24 Months, Journal Diarrhoeal Diseases Research, 16:3,173-179

George, M., Gordon, M., Mark, M., and Rogelio, F. (2008) Urbanization, Poverty and Environment in the 21st Century, The New Global Frontier [Review by W.D. Thwala] 19:7, 386.

Ghana,accra,transport and trade for market women -2006 present, Retrieved March 19, 2011 from www.transaid.org/.../ghana,-accra,-transport-and-trade-for-market-women,-2006---present.

International Food Policy Research Institute [IFPRI], (n.d.), Women and Children Getting by in Urban Accra. Retrieved March 16, 2011 from www.ifpri.org/sites/default/files/publications/accra.pdf

Kessides, C.,(2005), The Urban Transition in Sub-Saharan Africa: Implications for Economic Growth and Poverty Reduction ,Africa Region Working Paper,97,ix-x.

Ministry of Trade and Industry website, http://www.moti.gov.gh/en/business-opportunities/model-markets-for-districts-assemblies.php

Oladokun, R.E. , Lawoyin, T.O. and Adedokun, B.O. (2009) Immunization status and its determinants among children of female traders in Ibadan, South-Western Nigeria. Afr J Med Med Sci.,.38:1,9-15. Retrieved March 16, 2011 from www.ncbi.nlm.nih.gov/pubmed/19722422

Onwueme, P., (2009), Retrieved March 19, 201http://EzineArticles.com/?expert=Paul_Onwueme

Republic of Liberia: Liberia Market Review (LMR), (2007)

Skinner, C. (2008) Street Trade in Africa: A Review, School of Development Studies Working Paper, 20.

Songsore, J. (n.d.). The Urban Transition in Ghana: Urbanization, National Development and Poverty Reduction.

Subah –Belleh Associates, (2007) Liberian Markets and Marketers' Survey.

The Role of the Market Woman in the Nigerian Economy, (n.d.). Retrieved March 16, 2011 from http://www.gadanigeria.org/THE%20MARKET%20WOMAN%20AND%20THE%20NIGERIAN%20ECONOMY.pdf

Tsikata, D. (2007) Women and the Informal Economy: A Special Relationship? Retrieved May 8, 2011 from http://www.egnghana.org

Verick,S. (n.d.). The Impact of Globalization on the Informal Sector in Africa.

Wahhaj, Z. (2003 September) Women in Ghana, The Executive Times, Retrieved March 16, 2011 from users.ox.ac.uk/~qehs0657/WomenGhana.pdf

Webster's Online Dictionary, Retrieved March 16, 2011 from http://www.websters-online dictionary.org/definitions/Urbanization.

INDEX OF AUTHORS

INDEX OF KEYWORDS