School of Construction Management & Engineering

University of Reading

SMART AND SUSTAINABLE

Using Big Data to improve people's lives in cities

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EXECUTIVE SUMMARY

The University of Reading's desire to create knowledge that will benefit society drives our active and diverse research agenda. Our research is useful, real-world research on issues affecting society both in the present and in the future. Our research strengths in earth systems and environmental science and the built environment place us in a strong position to contribute skills and expertise to the smart and sustainable cities and big data agendas.

In this position paper we argue that although 'big data' and 'smart thinking' both provide powerful potential benefits for cities, they do not, on their own, provide valid solutions for today's urban problems. We need to recognise the key challenges associated with these concepts, and ensure that we use 'smart and sustainable' thinking and innovative big data to improve people's lives in our cities. We argue the case for 'integration', 'innovation' and 'interdisciplinarity' to underpin applied policy and practice and R&D in the 'smart and sustainable cities' and 'big data' nexus.

KEY MESSAGES

- 'Integrated approach': cities need to develop an integrated approach to smart and sustainable thinking which joins up the best elements of smart technologies and sustainable practices. Developing inclusive visions for cities is fundamental to this goal, and putting people at the heart of any future vision for a city is critical to success.
- 'Innovation is vital': cities need to recognise the benefits of using big data to improve the quality of life for its citizens through improved decision-making and better information and customer service. This needs to recognise the challenges around privacy and security. Urban innovation is a critical concept which lies at the heart of the big data revolution.
- 'Interdisciplinary thinking matters': we need to develop better R&D to help provide solutions for today's urban challenges. Developing partnerships between civic society, business and academia is vital and these must also connect through to the SME sector. Interdisciplinarity must be at the heart of our R&D in smart and sustainable cities and big data solutions.

INTRODUCTION: UNDERSTANDING CITIES

We live in the age of the city. More than 50 per cent of the world's population lives in cities – a figure which is set to grow to 66 per cent by 2050. Much of this growth is occurring in developing countries in mega-cities, but also in smaller and medium sized cities in the developed and developing world. This unprecedented urban growth presents us with huge opportunities, because cities can act as vibrant hubs of innovation, enterprise and jobs growth, and as places which create economies of scale in technology deployment. However, this development can also present us with substantial challenges, as more greenhouse gas (GHG) emissions are created, more resources are depleted, more energy is consumed, and larger, dense populations become increasingly vulnerable. The emergence of big data techniques provides us with rich and diverse research opportunities which can help provide solutions to some of our most pressing urban challenges.

Against this backdrop of rapid urbanisation we have seen the emergence of different ways of thinking, or conceptualising how cities could transition to a more sustainable future. During the late 1980s a discourse developed on 'sustainable cities', which focused on the environmental, social and economic sustainability of cities. During the 1990s, attention started to turn to 'smart city' thinking, which provided a technology-based (or ICT) lens to see the future development of cities.

Recently the 'smart city' model has gained further traction, as commercial companies have seen a growing market for the future development of smart city technologies, and the supply of 'big data' (or huge, dynamic datasets) has increased. Proponents argue that technology can be leveraged to enhance economic development and the quality of life, and that the increasing availability and integration of big data, can be used to underpin these goals. Information for decision-making at a range of scales is therefore vital, and further enhanced by the rapid development of pervasive technologies, such as mobile devices and ubiquitous computing, both in cities and people's daily lives.

However, the smart city concept in its purest sense presents substantial challenges, and there is a real danger that by focusing exclusively on the alluring 'smart' technology aspects of cities, that this distracts and deviates us from following a truly sustainable path of urban development.

The University of Reading has a strong track record in urban scale research and brings together expertise in science, social science, engineering, computer science and big data management to provide an innovative and interdisciplinary approach to research in this arena. This position paper therefore outlines our thinking at the University of Reading by addressing the following questions:

- How can we ensure cities are smart and sustainable?
- How can big data help improve people's lives in cities?
- How can we best develop high quality research and development to meet the key urban challenges that we face?

HOW CAN WE ENSURE CITIES ARE SMART AND SUSTAINABLE?

KEY MESSAGE
INTEGRATED APPROACH

Cities need to develop an integrated approach to smart and sustainable thinking which joins up the best elements of smart technologies and sustainable practices. Developing inclusive visions for cities is fundamental to this goal, and putting people at the heart of any future vision for a city is critical to success.

When we talk about a 'city' this refers not only to spatial form, but also to the multi-faceted way in which we live in a city, which includes ecological, cultural, technological, spiritual or socio-economic dimensions and their inter-relationships. The way in which we see cities has changed: more than 50 years ago cities were still very much viewed as closed systems, but today many researchers see cities as complex, adaptive systems characterised by dynamic changes, external interactions, and complex interactions. Furthermore, a 'science of cities' is now also recognised as being important to our understanding of a city's characteristics and dynamics[1].

The emergence of 'sustainable urbanism' during the 1960s and 1970s helped us realise that cities are vital in regulating environmental and ecological impacts and social welfare, and, unchecked, that cities could themselves lead to catastrophic socio-environmental impacts. Practitioners of disciplines ranging from the disciplines of planning, economics, ecology and architecture also all came to recognise that understanding and recalibrating the urban form and functioning of cities was essential to developing a more sustainable future.

As our ideas about cities have evolved, 'smart city' thinking has also emerged. This conceptualisation of cities sees them, in its purest form, as being responsive to the beneficial impacts from technology deployment, and linked primarily (but not exclusively) to ICT. Although there is no single agreed definition of a smart city[3], smart city thinking typically sees pervasive technologies (including, for example, telecom networks, transport and infrastructure systems, sensors, meters and other networked systems) as offering the ability to connect, integrate and analyse data to enhance the efficiency and effectiveness of cities. The powerful drive for smart cities is understandable, as there is an estimated substantial market potential of $400b by 2020, of which 10% could be reaped by the UK[4].

Data, however, does not exist in a vacuum, and people use technologies and react and behave in the context of their social practices and learning, so placing citizens centre-stage in a smart city view of the future is vital. This means not only understanding the context of the data generated, but also understanding how governance systems can be framed to protect privacy and confidentiality, as well as ensuring people across a city have access to appropriate technologies, and making sure that we recognise there is 'no one size fits all' for cities.

A model which recognises these challenges needs to join up thinking around both sustainable and smart cities therefore. A 'smart and sustainable' city therefore needs to leverage ICT infrastructure to:

- Improve the quality of life of its citizens.
- Ensure tangible economic growth for its citizens.
- Improve the well-being of its citizens.
- Establish an environmentally responsible and sustainable approach to development.
- Streamline and improve physical infrastructure.
- Reinforce resilience to natural and human-made disasters.
- Underpin effective and well-balanced regulatory, compliance and governance mechanisms[5].

This means that to understand how cities respond to urban challenges we need to create an integrated approach to thinking about four key themes (Figure 1):

- Society;
- Economy;
- Environment; and,
- Governance.

ECONOMY

- Employment
- GDP
- Market – GLocal
- Viability
- Investment
- PPP
- Value Chain
- Risk
- Productivity
- Innovation
- Compensation

GOVERNANCE

- Regulatory
- Compliance
- Processes
- Structure
- Authority
- Transparency
- Communication
- Dialog
- Policies
- Standards
- Citizen Services

ENVIRONMENT

- Sustainable
- Renewable
- Land Use
- Bio-Diversity
- Water/Air
- Waste
- Workplace

SOCIETY

- People
- Culture
- Social Networks
- Tech Savvy
- Demographics
- Quality of Life
- User Experiences
- Equal Access
- End Consumers
- Community Needs
- The City as a Database

Figure 1: Four key themes in a smart and sustainable city[6]

In practice this means developing long-term visions for cities which can not only help overcome the disconnection between short term planning horizons and long term environmental change, but also open up a space to think beyond the short term to a plausible future. Many cities in the UK and internationally are therefore building visions of how they see their future to 2020, 2050 and beyond. Part of the drive for this comes from the existing experience of devolved city powers (for example, Europe and USA), but also stems from a real desire for cities to think ahead and develop strategies which will help them transition to a more sustainable future. These visions (or shared expectations about a plausible and desirable future) differ in their shape and form, but they are a powerful way of promoting discussion and debate, providing a sense of purpose and mobilising resources so that a city can plan and transition for a sustainable future[2].

In the UK, for example, Bristol's 2020 vision, and its smart city vision, are based on 'people, place and prosperity', a desire to be a 'Global Green Capital', and an aspiration to be a centre for smart city thinking. In Canada, Vancouver aims to be the world's greenest city by 2020, with tough targets set for greenhouse gas emissions and a desire to create a city which is resilient to climate change. In Denmark, Copenhagen's vision is based on a target to be carbon neutral by 2025, underpinned by a highly successful walking/cycling policy agenda and a strong focus on renewables. Looking further ahead into the future, Glasgow has developed a vision for 2061, which is now also underpinned by its aspiration to be a leading 'future city' with smart technology at its core.

The best city visions therefore link vision, strategy and action (including climate change, energy, economy and people) and are:

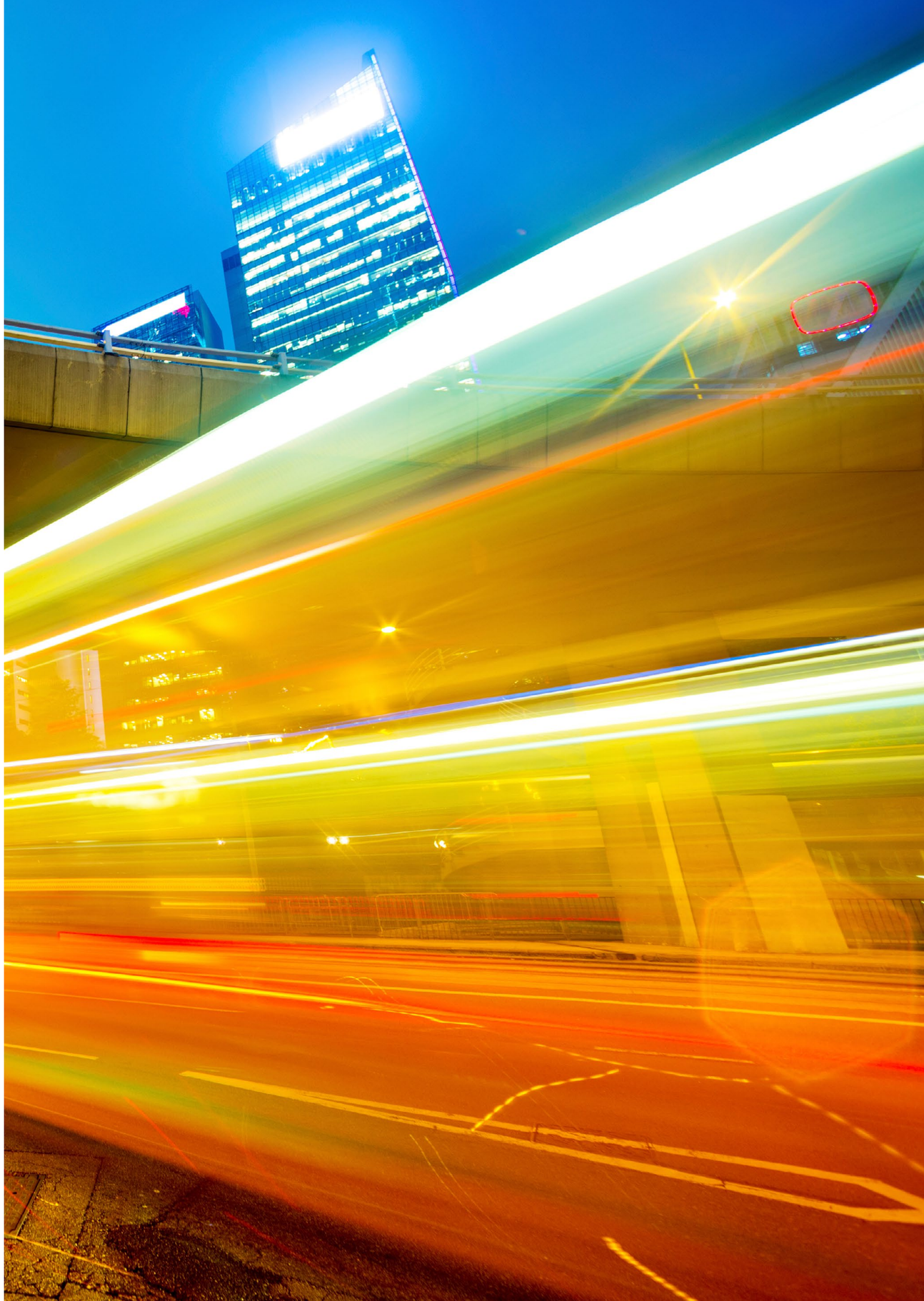
- Participatory and inclusive;
- Based on a robust empirical evidence base; and,
- Politically viable.

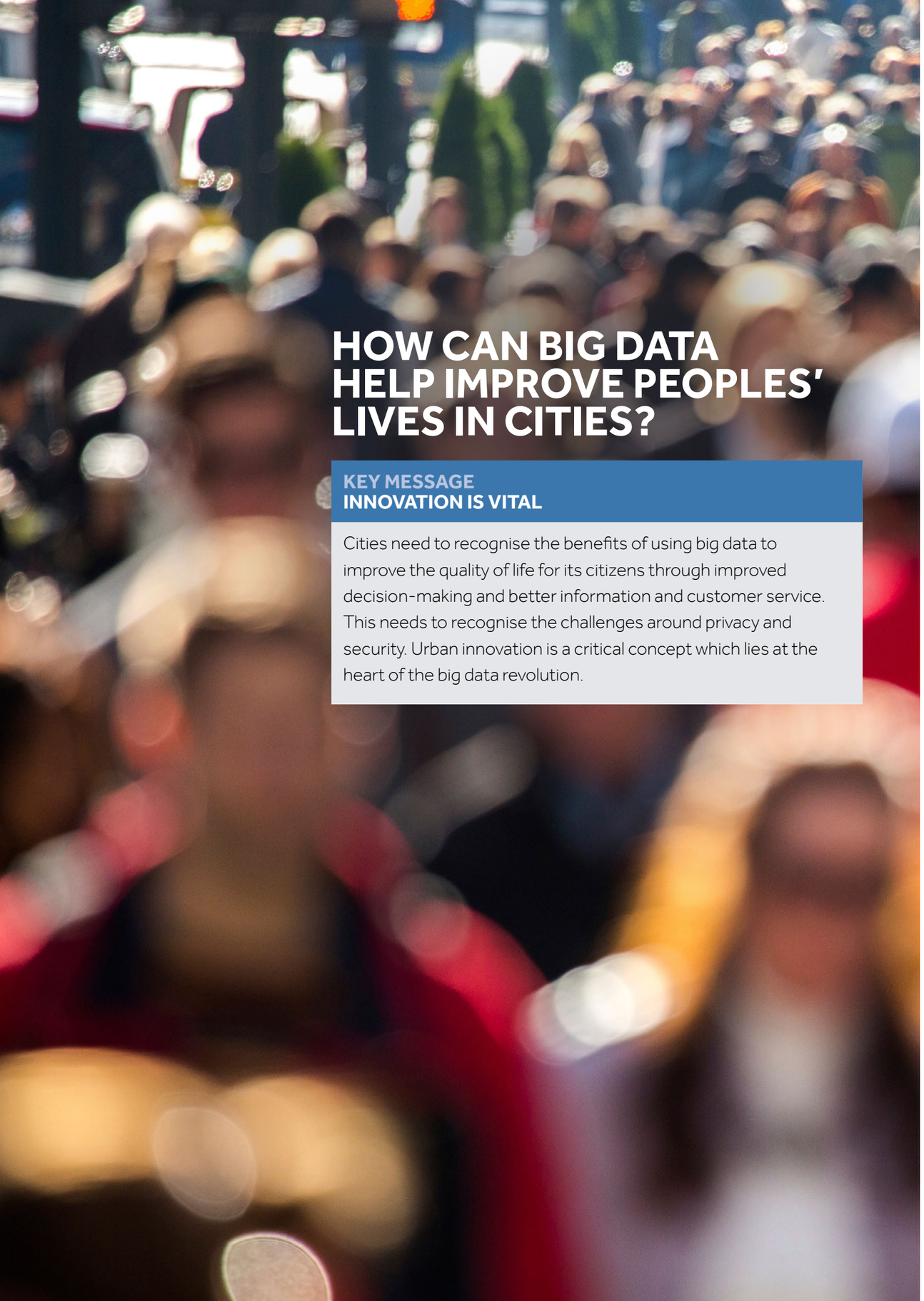
Bringing together key stakeholders, including citizens, the public sector, business and academia in the vision for a city is also vital to help underpin and embed smart and sustainable thinking. This is also important to understand when we know that 70% of our buildings in cities in the UK, for example, will still be standing in 2050. Scaling up the response to this urban retrofit challenge requires integrated thinking and a clear vision to bring key stakeholders together, and this also opens up a potential market for smart and sustainable solutions for cities which are suffering from technological lock-in and outdated infrastructure systems.

READING 2050

This project is a partnership between University of Reading, Barton Willmore and Reading UK CIC to develop a smart and sustainable vision for Reading through to 2050. Building on previous research , the project is based on Foresight techniques, and is focused on engaging with a range of key stakeholders to develop a coherent and credible vision for Greater Reading. The vision has produced three urban design scenarios around 'green tech'; 'festivals and culture'; and 'rivers and parks', and the work has also connected with the UK GOS/BIS Future Cities Foresight programme.

www.bartonwillmore.co.uk/reading2050





HOW CAN BIG DATA HELP IMPROVE PEOPLES' LIVES IN CITIES?

KEY MESSAGE
INNOVATION IS VITAL

Cities need to recognise the benefits of using big data to improve the quality of life for its citizens through improved decision-making and better information and customer service. This needs to recognise the challenges around privacy and security. Urban innovation is a critical concept which lies at the heart of the big data revolution.

City governments and businesses require data and information to be able to provide appropriate and timely services and products to their citizens and customers. Data on cities have often been sourced through a combination of official government surveys and small, non-continuous data sets, created by local government, business and academia. Often data on cities have been scarce and fragmented therefore. But the creation of big datasets, generated primarily by the decentralised nature of computing, and the ability to connect and join up and analyse the huge amounts of data created through pervasive and ubiquitous ICT networks and mobile devices, has created powerful possibilities and challenges for cities.

As with smart cities, although there is no agreed definition for 'big data', the OED describes it as 'data of a very large size, typically to the extent that its manipulation and management present significant logistical challenges'. Big data may also be:

- Huge in volume;
- High resolution;
- Diverse in variety; and
- Rapidly growing or changing.

Big data 'consists of massive, dynamic, varied, detailed, inter-related, low cost datasets that can be connected and utilised in diverse ways'[11], and there has been an explosion in the quantity of big data produced: for example, there are more data being produced every two days than in all of the period prior to 2003[12]. These data are generated through directed legislative means (e.g. passport control and pollution measurements) or automated (e.g. retail scans) or volunteered (e.g. social media). By 2020 sensor data will be created through the connection of some 50b globally connected devices[13]. This growing market will create 58,000 new jobs in the UK through to 2017, and the public sector data market is worth £6.8b pa[14].

Traditionally cities have operated on the basis of functionally oriented service providers which have not been citizen-focused and often inefficient, without the ability to connect across services. In the world of big data and the related internet of things, data on energy, water, waste, telecommunications, health, education, transport, housing and so on, can be brought more closely together so that citizens, SMEs and the public sector can co-create public services and create new value with city level data.

In the world of cities, automated big data therefore presents us with the ability to use sensors and meters to monitor and track a range of data, including climatic and environmental data; transport data; and energy, water and waste data, with much of this data based on the functioning of the built environment and infrastructure of cities. Such data can also be spatially referenced, and open data legislation is also enabling cities to make their data available (including land use and planning data) which, in turn, creates the possibility of joining up datasets within cities, and breaking down the silos of data sets (which can also help us develop interdisciplinary thinking).

Much of the big data gathered within cities is also 'real time' data and so also gives us the opportunity to carry out longitudinal analysis over time. This big data can be useful not only to local governments in cities and their citizens, but also businesses seeking to improve their organisational efficiency and effectiveness. For example, some businesses are using big data to reduce their carbon footprint and manage their resource use more effectively[15].

ESRC URBAN BIG DATA CENTRE

Cities are complex, dynamic structures; difficult to predict and manage. But through the analysis of big data – huge amounts of information created and stored by organisations detailing social, environmental, or economic activities – we can yield new trends and patterns, impossible to see from single sources alone. This intelligence helps us better understand the challenges facing our cities and allows policymakers, businesses and communities to develop effective solutions. The Urban Big Data Centre (UBDC) was established by the UK Economic and Social Research Council to address social, economic and environmental challenges facing cities. The UBDC brings together interdisciplinary expertise of urban social scientists and data scientists from the University of Glasgow and six partner universities of Edinburgh, Bristol, Cambridge, Reading, Sheffield and Illinois-Chicago to seek solutions in addressing such challenges.

ubdc.ac.uk/about/overview

The use of big data does also, of course, raise some key concerns over the privacy, security and value of big data. For example, health data is often cited as a major area for big data benefits and privacy issues remain a challenging (though not insurmountable) barrier to opening up NHS data in the UK. Also the techniques to analyse big data, communicate it, and use it are still in development, and its monetary value is yet to be fully analysed and understood[16].

Often cities also lack the skills and resources to think about big data projects and may also find it difficult to join up their thinking across departments and also across local authority boundaries. There are also issues over the extent to which citizens have full access to appropriate technologies, especially amongst low income groups and older people, leading to potential digital exclusion in cities.

DATASIFT

DataSift started in 2007 on the University of Reading's Whiteknights Campus and is now the leader in Human Data Intelligence. Processing more than 2 billion interactions a day, DataSift analyses 'big data' from people's activities, turning it into useful information. The company employs 130 people across offices five offices worldwide and work for companies such as Bloomberg and CBS Interactive. The University intends attracting other companies like Datasift to its new Thames Valley Science Park[17].

www.datasift.com

Also there is an inherent danger that we end up analysing big data as an end in itself rather than trying to use big data as a really important opportunity to develop 'big theory' about how the city works, and how we can tackle key urban challenges. Understanding how we can integrate and analyse structured and unstructured data is also a challenge. Data no longer comes in pre-packaged form: it can be messy, complicated and fragmented and based around a variety of sources, including tweets, texts, click streams, GPS, and CCTV footage[18]. Ensuring we enable the location of data to be sourced accurately is also fundamental to adding value to data, and in cities this may relate to the effective range of influence, relative distance or spatial features[19].

In this respect the concept of 'urban innovation' is important. Innovation in the urban context refers to any new method, business model, policy, institutional design or regulation that meets the needs of urban populations in a more efficient, effective and sustainable (environmental, economic and social) way. It may refer to improved rules or legislation as well as improved institutions, models of stakeholder participation or new means of delivering services. Big data is a key focal point of urban innovation and also lies at the heart of a range of InnovateUK Future Cities Catapult activities[20]. Cities are hubs of innovation so there is a virtuous circle in the way that successful innovation in big data aggregation and analysis can potentially improve peoples' lives through better information, more effective transport and infrastructure and real time data on the environment.

HOW CAN WE BEST DEVELOP HIGH QUALITY RESEARCH AND DEVELOPMENT TO MEET THE KEY URBAN CHALLENGES THAT WE FACE?

KEY MESSAGE
INTERDISCIPLINARY THINKING MATTERS

We need to develop better R&D to help provide solutions for today's urban challenges. Developing partnerships between civic society, business and academia is vital and these must also connect through to the SME sector. Interdisciplinary thinking must be at the heart of our R&D in smart and sustainable cities and big data solutions.

Given the importance of integrated thinking and innovation in the smart and sustainable cities agenda, we also need to create interdisciplinary thinking which underpins the way in which we develop appropriate R&D in this space.

The critical urban challenges we face today are complex and multi-faceted. These revolve around[21]:

- Population growth and stressed infrastructure – cities need to be able to cope with a rapid growth of population and associated stresses to the built environment and infrastructure.
- Resource efficiency and low carbon growth – cities need to decouple economic and physical growth from resource consumption.
- Resilient systems – cities need to develop adaptive systems which are able to bounce back from a range of environmental and socio-economic events.
- Income inequality – cities need to develop an inclusive approach to economic growth that bridges the gap in terms of inequality and deprivation
- Demographic change and disease – cities need to cope with an ageing population and mitigate the risk of disease and bad health to help maximise wellbeing.

To help tackle these challenges we need to create urban innovation 'ecosystems' which combine the expertise of civic society (including people and local government), business and academia (Figure 2)[22]. This links very closely with the idea of creating urban innovation in cities, and has also led to the development of 'urban transition laboratories' or 'urban living laboratories', which are centres of reflexive learning and social innovation co-created by cities, business and academia[23].

Figure 2 Urban Innovation Ecosystems[24]

The role of business in this ecosystem is vital, and physical centres of innovation provide the space for universities, business and cities to collide and create new ideas. In the Thames Valley region, for example, Reading is a hub of enterprise and growth. Reading's economy, which is highly connected nationally and internationally, is one of the strongest in the UK, and is based on high-tech industry, innovation and inward investment. Reading is also one of the top five 'city' economies in the UK, with a strong track record in inward investment and economic growth. The University of Reading is also a key player in this ecosystem, contributing £650m to the local economy each year[25], and with world-leading expertise across a range of disciplines in climate and environmental sciences and the built environment, and a strong emphasis on applied research and policy/practice impact. Our research in this space is covering a range of topics including, for example, urban meteorology; urban retrofitting; smart grids; and urban housing datasets[26].

THE NEW THAMES VALLEY VISION PROJECT

The UK government aims to reduce carbon emissions by encouraging and supporting the uptake of low carbon technologies (LCTs) such as electric vehicles and photovoltaics. The increased uptake of LCTs is expected to increase the electrical energy usage in the UK which may threaten the security of the network and disrupt the supply to customers. As part of the project the University of Reading is modelling household and low-voltage (LV) substation level data in order to better understand current and future network demand behaviour as well as look at how smart control can be combined with network storage to reduce peak demand and balance the networks. In particular this project focuses on the LV Network in Bracknell and the surrounding Thames Valley area. Bracknell and the Thames Valley is home to many large companies and the local network is typical of much of Britain's network, and therefore the lessons learned can quickly be applied nationwide.

www.thamesvalleyvision.co.uk

If we are to create the right mix of R&D that will address the key urban challenges described above we will need to be truly 'interdisciplinary' in our thinking. In a truly interdisciplinary approach, a common model is developed, based on a dialogue between disciplines and the transfer of tools or models for working, which, in concert, can overcomes the silo approach of disciplinary thinking. This approach is especially appropriate to the development of urban big data solutions. Indeed the worlds of meteorology and Geographic Information Systems (GIS) would also seem to be very closely related, as both focus on geospatial data. However, they have grown up with totally different technology bases, and only now are they coming together to allow meteorology and geographic data to be brought together more easily.

Furthermore, spatial design skills are need to help develop sustainable and cost-effective buildings and public spaces; construction and engineering skills are needed to analyse and develop new tools which use big data such as Building Information Modelling (BIM); digital design is needed to provide fresh views of the city; and social science skills needed to help understand how to bridge the gaps that may exist city governance structure. Similarly we need real estate and finance skills to help us understand the impact of big data in urban development projects, and skills in understanding social innovation, learning and practice, as citizens and other stakeholders engage with the emerging technologies which are designed to add value to big data.

Here at Reading our research in the smart and sustainable cities/ big data arena recognises the importance of interdisciplinary thinking (Appendix 1). For example, scientific understanding of city climates can support decision making around overheating, air quality, flooding and urban greening[27].

This interdisciplinarity is true of academic R&D teams operating in the urban innovation space, but it is also true of the many emerging 'urban teams' based in major consulting practices. Understanding how the SME sector can be part of this new R&D space is also critical to recognise, however. For example, Reading has the second highest concentration of Small and Medium Sized businesses (SMEs) in the UK, and Reading is behind only London in terms of the number of SMEs per 10,000 population, with a growth of 5.2% between 2011 and 2013[28]. SMEs are vital parts of the urban solutions ecosystem because they are critical to jobs growth and are often technology-focused so they can provide entrepreneurial skills and expertise to develop smart and sustainable solutions to urban challenges.

CONCLUDING COMMENTS

Although 'big data' and 'smart thinking' both provide powerful potential benefits for cities, they do not, on their own, provide valid solutions for today's urban problems. We need to recognise the key challenges associated with these concepts, and ensure that we use 'smart and sustainable' thinking and innovative big data to improve peoples' lives in our cities. This means understanding how we apply 'integration', 'innovation' and 'interdisciplinarity' to underpin applied policy and practice and R&D in the 'smart and sustainable cities' and 'big data' nexus.

APPENDIX 1

The University of Reading's desire to create knowledge that will benefit society drives our active and diverse research agenda. Our research is useful, real-world research on issues affecting society both in the present and in the future.

The results from the Research Excellence Framework (REF) 2014 confirm the University of Reading's place as a world-leading research-intensive university. 98% of our research is internationally recognised, and 78% of our research is classed as internationally excellent. 27% of our research is world leading.

The REF places the University of Reading 27th in the UK by research power (out of 154 submitted institutions). Research power recognises both the quality and quantity of research submitted into the exercise.

We can offer a range of skills and research excellence in earth systems and environmental science and the built environment (including a new School of Architecture) which are directly relevant to the smart and sustainable cities and big data agenda.

For further information, please contact Professor Tim Dixon **t.j.dixon@reading.ac.uk)**

UNIVERSITY OF READING INSTITUTES AND CENTRES

Institute for Environmental Analytics

The Institute for Environmental Analytics is a newly-formed partnership of 12 organisations, including partners from academia, industry and the public sector. The Institute will work at the boundary between world-class academic research and cutting-edge innovation to translate the latest environmental science into commercial enterprises and public services, addressing some of the most pressing problems facing society today.

www.the-iea.org

Walker Institute

The Walker Institute for Climate System Research is improving understanding of future climate and its impacts and consequences. We are working with business, governments and research organisations across the world to provide advice on the risks and opportunities from climate change. The Institute brings together the unique breadth and depth of climate related research that takes place at the University of Reading.

Within the Institute, experts in weather and climate, water, the built environment, energy, ecosystems, agriculture and socio-economics work together to provide a unique integrated approach to understanding climate change and what it means for our future. As well as innovative research, training in climate change and its impacts is also a priority – for researchers, policymakers and businesses alike.

www.walker-institute.ac.uk

Intelligent Systems Research

The Intelligent Systems Research (ISR) Laboratory is a multi-disciplinary research unit with a track record of key contributions to over 30 large scale international collaborative research projects, and with funding from a variety of sources, including EPSRC, InnovateUK, The European Community, MoD and industry.

The ISR research capabilities span the spectrum of socio-ethical system-of-systems, pervasive systems software as well as real-time systems, comprising software, heterogeneous embedded systems, hardware acceleration and high performance computation. These also include cloud-enabled service-oriented architectures, Big Data Driven and Crowd-Sourced integrated models of urban dynamics, analytics, simulations and visualisations for strategic, operational and tactical decision support to serve city managers, planners, policy makers and emergency services as well as citizens.

This is underpinned by Future Cities technology enablers such as smart Wireless Sensor and Actor Networks (WSANs), Secure Semantic Middleware and Trust Modelling.

www.isr.reading.ac.uk

Design Innovation Research Centre

With a vision of a new mode of design in the digital economy, the research team works with engineers and managers on major projects, including London 2012 Olympics and Crossrail, developing new knowledge about digital practice and bringing learning back into the laboratory to develop the next generation of technologies. Recent work had examined visualization and management of change in an era of big data.

www.reading.ac.uk/designinnovation

The Reading Centre for Real Estate and Planning Research

The Reading Centre for Real Estate and Planning Research (CREPR) is a major interdisciplinary research centre within the School of Real Estate & Planning. Research has been key to the success of the School, which was established in 1968, and is ranked the leading centre for real estate in Europe by the US Urban Land Institute. CREPR researchers collaborate with universities, governments, industry, professional and third sector organisations, engaging with diverse data, econometric modelling and forecasting needs, and informing public policy and private practice worldwide.

www.henley.ac.uk/school/page/rep:-research

UNIVERSITY OF READING PROGRAMMES AND NETWORKS

Technologies for Sustainable Built Environments

The Technologies for Sustainable Built Environments (TSBE) Centre was established with EPSRC funding, and is part of the School of Construction Management and Engineering at the University of Reading. The school is a world leader in teaching and research and Ranked 8th in UK by overall grade point average, with 83% of research rated world-leading (4*) or internationally excellent (3*). TSBE has a global reputation for innovation, focused on real-world problems facing the management of the built environment, attracting academics, students and industry professionals of the highest calibre. The TSBE Centre is an Industrial Doctorate Centre specialising in the Engineering Doctorate (EngD) programme. We offer the expertise of internationally renowned academics to UK industry to develop their research. Through our academic experience and the research of the EngD students, industry will be better equipped to respond to the challenges of sustainability and climate change by reducing the environmental impact of construction and its carbon footprint.

www.reading.ac.uk/tsbe-about.aspx

Sustainability in the Built Environment

The Sustainability in the Built Environment (SustBE) network draws together a multi-disciplinary team of experts from across the University. Working on six key research clusters relating to sustainability within the built environment, SustBE is able to combine the knowledge and expertise from internationally recognised centres at the University, including those above but also drawing on expertise from real estate and planning expertise, psychology, mathematics, agriculture and social science. There are a number of projects which have a focus on cities and big data in this network

www.reading.ac.uk/sustainability-in-the-built-environment

OTHER EXAMPLES OF RECENT AND RELEVANT RESEARCH PROJECTS

EPSRC Demand

The DEMAND Centre (Dynamics of Energy, Mobility and Demand) takes a distinctive approach to end use energy demand, recognising that energy is not used for its own sake but as part of accomplishing social practices at home, at work and in moving around. In essence the Centre focuses on what energy is for. Part of the work explores trends and patterns in energy demand, and draws on big data sets.

www.demand.ac.uk

EPSRC Retrofit 2050

Four year programme of work examining how we can retrofit and re-engineer cities at scale. The project focused on energy, water and waste and used Foresight-based techniques to develop visions for cities.

www.retrofit2050.org.uk

Advanced Climate Technology Urban Atmospheric Laboratory

A virtual urban environment (City-VUE) to engage engineers, meteorologists, policy makers and the public, on the urban climate and specifically, the adaptation of buildings to a warmer London climate. Data is used to assess the effect of building layout on city ventilation, and develop tools to optimise urban renewable energy generation.

www.actual.ac.uk

SustBE Smart and Sustainable Cities

A range of smart and sustainable city projects

www.reading.ac.uk/sbe-special-projects.aspx

Intelligent Systems Research ISR) Laboratory Projects

A range of smart city and smart technology projects

www.smartsantander.eu
www.elliot-project.eu
www.hydramiddleware.eu
www.videosense.eu
www.inter-trust.eu

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SMART AND SUSTAINABLE

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