Design-led procurement: linking the design process with procurement of construction projects

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Abstract

Separation of design from construction has led to serious coordination and communication problems in our industry, which are unlikely to be resolved by BIM without significant changes. Although collaborative design and construction methods have been developed for major projects, over 80% of all construction projects still suffer from a divisive risk management culture, which perpetuates problems of integration between briefing, design and construction. Design-led procurement facilitates the engagement of trade and specialist contractors in the briefing and design process. Designers lead the supervision of work on site, thereby bridging the gaps between briefing, design and construction. Network governance supported by Project Insurance, instead of Professional Indemnity Insurance, facilitates the optimization between briefing, design and construction. A new paradigm has to be established to disentangle long established routines across the design and construction professions.

Keywords

Design-led procurement, network governance, project insurance

Public sector procurement in the UK

In May 2011, the Government's Construction Strategy was published with the intention of reforming the procurement of public sector projects[1] (Cabinet Office, 2011). The strategy sets out principles for new procurement models to allow designers, consultants and contractors to work in a more collaborative and integrated way. A central tenet is the introduction of project-wide insurance covering all parties, enabling the sharing of liabilities, and up to a 20 per cent cost reduction by avoiding contractor charges for bearing risks passed onto them by the client.

This paper explores the underlying reasons why the UK construction industry is not collaborative, and presents alternative procurement models and insurance arrangements that may help overcome this. The first section explores the historical reasons for fragmentation in the construction industry. The second opens up a discussion on the complexity of design and construction processes. A critique of current construction procurement methods is then presented, highlighting their governance shortcomings. The final section sets out design-led

[1] The UK government is the largest client of the construction industry, accounting for about 40% of the industry's workload Cabinet Office. (2011, May 31). *Government Construction Strategy.* Retrieved June 26, 2011 from Cabinet Office: http://www.cabinetoffice.gov.uk/resource-library/government-construction-strategy.

procurement as an alternative, harnessing the benefits of network governance and project insurance arrangements.

Separation of design from construction: a historical perspective

In early seventeenth century England, Master Masons were responsible for building design and construction (Crinson and Lubbock, 1994). During the seventeenth and eighteenth centuries (Wilton-Ely, 1977, the interdisciplinary architectural designer emerged. The establishment of architecture as a profession can be seen as an attempt to distinguish the Architect from the other building trades. In the eighteenth century the development of distinct modes of entry to architecture through pupillage did just this, providing training in drawing and administration, whilst omitting the practical knowledge and skills of the building trades (Crinson and Lubbock, 1994). This was cemented in 1834 with the founding of the Institute of British Architects (later the RIBA)[2] to protect the professional interests of architects (ibid). Subsequently many other professional institutions were set up, further fragmenting the construction industry (ibid).

Discussing problems of institutionalism due to professionalization, Murdoch and Hughes (2008) note that participants of a project team come with predefined conceptions of their and others' roles. Scott (1995) asserts that professions exhibit normative, cognitive and regulative control – three pillars of institutions. Professionals exert normative control by identifying roles and responsibilities of actors. Cognitive control outlines who we are and what we are expected to do in a given situation, thus stressing the importance of social identities. Regulative controls set out rules, monitor actions, sanctions, rewards and punishments. The RIBA outlines the responsibilities of architects – drawing, design and supervision (normative control), monitors architectural education in universities to formalise training (cognitive control) and controlled entry into the profession through registration and protection of title (regulative control). As a result Institutionalization causes inflexibility within the project organization, whilst the project environment demands flexibility due to uncertainty.

Another reason for the formation of the architectural profession was industrialization[3]. Cross (2011) suggests that in craft-based societies, designing is firmly linked to making, whereas in industrialized societies making does not start until design is complete. The general contractor emerged in the UK construction industry around 1870 as a result of increased specialization due to industrial revolution; this relieved architects from the burden of close site supervision, enabling them to spend more time on design (Hughes, 1992). The general contractor

[2] The institute gained its Royal Charter in 1837 to form the Royal Institute of British Architects (RIBA) (Crinson and Lubbock, 1994).

[3] Crinson and Lubbock (1994) record that there were individuals who resisted the split between design and construction. For example, William Lethaby emphasized that the building craft has to be learnt through direct handling of tools and materials. He saw architecture not only as a form of training in the arts and design, but encompassing the crafts.

developed a financial relationship with design and remodelled the tripartite relationship of client, designer and craftsmen (Wilton-Ely, 1977). Furthermore, Hughes (1992) suggests that, unlike the Master Mason, very few people can grasp the variety and complexity of technologies in modern construction. Hence, there is a need for coordination and management between different specializations as well as between design and construction. A recent survey by the RIBA (2016) highlights that collaboration and efficient administration remain priority issues for architects' today.

The design process

It is imperative for designers to work with specialist trades to gain technical know-how of components while formulating building-designs. Through various case studies, Cross (2011) has demonstrated that good designers operate seamlessly across different levels of detail – from high-level goals to low-level physical principles. Furthermore, in his experiment of redesigning a bathroom, Eastman (1970, cited in Lawson, 1983, p. 33) concluded that experienced designers learnt the nature of the design problem simultaneously while identifying a range of possible solutions. Similarly, Cross (2011) suggests that in the process of designing, the problem and the solution develop together. Thus the design evolves as more understanding of the problem is developed.

Hughes and Murdoch (2001) undertook detailed analyses of nine plans of work, including the RIBA Plan of Work, and carried out consultations with focus groups representing all aspects of the construction industry. They concluded that most plans of work are targeted at producing sufficient information to enable decision making at a particular stage. Hence, plans of work are output focused. These findings are concurrent with Lawson's (1983) analysis of the RIBA Plan of Work. He suggests that it does not map the design process, as it does not allow for iteration between work stages. Even the simplest map of the design process must allow for a return loop to all preceding functions. Thus, a tension exists between working in accordance with a plan of work, which is often linked to fee stages, and the iterative nature of the design process.

Lawson (1983), using the analogy of a team game, suggests that co-operation is crucial in the design process, as the needs of many stakeholders must be satisfied. Design should not be seen as a personal, cognitive process of the individual designer, but rather a social process of interaction with other participants. As Bucciarelli (1994, cited in Cross, 2011, p.20) argues, design involves negotiation involving different participants, each with their specific knowledge and understanding of the object that is being designed. Thus, governance structures should allow coordination through social interaction, even if the parties are not bound by contractual obligations.

Complexity in construction projects

Construction projects involve many actors during different phases, including clients, designers, consultants, contractors and specialist trades. Cherns and Bryant (1984) propose that a temporary multi-organization (TMO) is established through which representatives from

different organizations come together for a particular project and disperse after its completion. The temporary nature of construction projects calls for differentiation in two dimensions: horizontal differentiation between various organizations and vertical differentiation between structural levels (Baccarini, 1996). Construction projects face organizational complexity through horizontal (professions) and vertical differentiation (tiers of supply chain). The governance mechanism needs to coordinate and control interdependencies amongst these differentiations. Interdependence of operations across organizational boundaries gives rise to organizational complexity.

Complexity results in interdependencies between the constituent parts. Thompson (2003) discusses three types of interdependency in ascending order of complexity: pooled, sequential or reciprocal. Pooled interdependence relies on the contribution of each part to the whole. When output of one part becomes input of another, they are sequentially interdependent. Reciprocal interdependence exists when the output of each part becomes input for other parts; architect, structural engineer, services engineer and cost consultants would use each other's outputs to produce their work. Reciprocal interdependencies are most complex and highly evident in the design and construction process (Walker, 2007). Thompson (2003) further suggests that reciprocal interdependence needs coordination by mutual adjustment and involves transmission of new information during the process. This increases the burden on decision-making and communication. Thus, organizational complexity in construction projects will prove challenging for the governance of construction projects.

Current procurement methods - a critique

Eccles (1981), through his interviews of house builders in Massachusetts, has noted the existence of a "quasi-firm" in the construction industry. In general contracting, the main contractor works with a small number of specialist sub-contractors, in an"inside" contracting system. This form of governance balances advantages of market and bilateral structures as close coordination and control is achieved along with some degree of competition. He further asserts that a decision taken within the "inside" contracting mode is a trade-off between the criticality of the sub-contractors' works within the main programme and lower construction costs resulting from a scale of economies. Thus, internal contracting induces process innovation. However, lack of product and material innovation due to bias for process innovations is identified as a defective incentive of the "inside" contracting system (Williamson, 1975). Assurance of continuous relationships is essential for suppliers to make transaction specific investments in equipment, systems and employee skills. Internal contracting limits the number of sub-contractors. However, it does not pose incentives for product innovation as there is no guarantee of continuous work over long periods of time to recoup investments. In response, Eccles (1981) argues that as plans and specifications are prepared by the architect, product innovation is not in the hands of the main contractor or the sub-contractor.

The main contractor may foster product innovation through design-build procurement who has 'single point responsibility for delivering the required building and associated services in accordance with defined standards and conditions' (Bennet et al. 1996: 3). The single point responsibility ensures integration of design and construction, enhancing buildability and increased certainty of product delivery. However, design-build projects still suffer from poor design quality and lack flexibility to incorporate client changes (Anumba and Evbuomwan, 1997). Through a survey of 330 construction projects Bennett et al. (1996) argue that design quality is not undermined by a contractor's commercial interests alone, but by discontinuity in design responsibility which sees partly developed designs handed over to the contractor. In their survey, the best performance of quality expectations were in those design-build projects where Employers' Requirements were minimal. Hence, it is not just the discontinuity between design and construction that affects quality, the discontinuity in design responsibility also has its effects.

Latham (1994) argues that trust is essential to the improvement of performance in the construction industry. Citing a survey of 180 major construction companies, Lathem (1994) shows that there is a clear appetite across the industry to develop a partnership approach to risk management (ibid). Only 15% of respondents were in favour of apportioning risk to single parties. If the performance of the supply chain is to be enhanced, the governance mechanism needs to be reconsidered. The governance structure should promote coordination through social interaction amongst parties, not be legally bound.

Network Governance

Williamson (1979) describes governance as an institutional framework within which transactions are decided. This framework refers to the regulative lens of institutional theory proposed by Scott (1995) where control is exerted through rules and regulations. Eriksson (2006) refers to governance mechanisms as alternative ways to influence organizations involved to establish control and co-ordination. Thus the governance mechanism integrates differentiation and interdependencies through control and co-ordination.

Powell (1990) proposes comparative models of market, hierarchy and network. He substantiates his model of a network through examples of various industries ranging from traditional craft to technologically advanced. He asserts that the network is a viable form of economic organization and is characterized by reciprocal patterns of communication and exchanges. He argues against the idea of hybrid forms occurring along the continuum of the market and hierarchies, and suggests that there are distinct alternative forms of governance demonstrated through collaboration and reciprocity. He concludes three critical components of a network:

1. Know-how – Tacit knowledge is an important incentive for craft based industries.
2. Demand for speed – Flexibility and fast access to information in a dynamic world. Information exchanged in the network is "freer" than hierarchy and

"thicker" than market. Information is open for interpretation and thus can generate new insights.

3. Trust – High probability of future association motivates network participants to cooperate. Need for hierarchical supervision is limited as opportunism is discouraged. Quality is emphasized over quantity.

Fenton and Pettigrew (2000) applied network theory of governance by Jones et al. (1997) to study the organization of Arup. They found that some employees were very active within the network and others were not. The former came in frequent contact with each other and formed closed ties leading to over-embeddedness. It was difficult to integrate the latter due to under-embeddedness. Thus, in order to optimize embeddedness, the social mechanism should be modified to restrict as well as extend access. They also argue that leadership and incentive systems can be useful alongside social control mechanisms. Incentives can motivate employees within a network to cooperate. Leadership can aid to balance strong and weak ties. Leaders at the hub of strong ties can influence diffusion of information within a network.

Network governance exerts control through social mechanisms and can influence development of trust among network members. Lack of trust is considered one of the key reasons for adversarial attitudes within the construction industry. Network governance proposes benefits of coordination through effective communication. However, network governance is not widely used within the construction project environment (Rose & Manley, 2012).

Design-led procurement method (proposal)

Design-led procurement aims to harness the potential of design by bridging the separation between design and construction through network governance. In this procurement method, designers work directly with specialist/trade contractors without intermediation of a main contractor. Trade/specialist contractors hold direct contracts with the client and their work on site is supervised by the designers. Hiley and Khaidzir (1999) report that architect-led construction management procurement method in Germany has proved successful. Hans Haenlein Architects have employed design-led procurement in various projects (Haenlein, 2007a). Architects deal directly with trade/specialist contractors and hold separate contracts with these contractors, consultants and the client.

The School projects – an example

Patel (2011) analysed two projects for a school client to refurbish chemistry laboratories: C Block 1 (phase 1) and C Block 2 (phase 2). The project details of both cases are given in Table 1 (at the end of paper). These projects were selected as they offer polarity as described by Voss et al. (2002). The architect, consultants and trade/specialist contractors were the same in both the cases except for the laboratory equipment contractor. The works involved in both projects were largely similar, key difference being in the quantity of work. While C Block 1 was procured through the traditional procurement route, C Block 2 was procured through the design-led procurement route.

C Block 2 was 22% cheaper and finished within less time as compared to C Block 1. Cost certainty existed in C Block 2 by the use of an 'open book' change management system. Design-led procurement gave rise to conditions necessary for emergence and survival of network governance. Social control of project culture, reputation and inclusive restricted access induced cooperation amongst network members. Communication analysis provides evidence of enhanced coordination between design and construction in the design-led project. Defects were attended promptly by trade contractors; their commitment increased due to proximity of the client through site meetings. It is noteworthy that no explicit financial incentives were offered to contractors for cooperative behaviour.

Lead organization network governance

While undertaking design-led procurement for C Block 2, the client insisted that the project should be managed by the architect. Inputs from network members like structural consultant, electrical and mechanical trade contractor were disparate. Also, each member did not possess requisite skills to coordinate their work with others. Hence, network governance had to be brokered. Lead organization network governance (Provan and Kenis, 2007) was employed to facilitate network level coordination. The architect acted as lead organization and undertook the coordination of network level activities and decisions. Disintermediation of the main contractor increased interaction between designers and trade/specialist contractors, as well as between trade/specialist contractors

Along with design leadership, this form of network governance ensured continuity of design responsibility as well as integration of design and construction. Design remained the sole responsibility of the architect throughout the project. Buildability knowledge and specifications were developed by the architect through discussion and coordination with trade/specialist contractors.

The client placed the competence of the architect at the forefront for the design-led procurement. While outlining current difficulties faced by the profession and possibilities of future development, Hiley and Khaidzir (1999) acknowledge the need for a change in attitude, knowledge, education and training. Architectural education should emphasize the need for appreciating technical knowledge of other disciplines. The attitude of passing technical risks onto the main contractor should be discouraged. Capabilities to manage the interfaces should be developed through education and practical training. The medical Teaching Hospital model could provide the necessary education, research and practice metaphors for the future professional practices in the built environment (Hans Haenlein Architects, 2009). Such a facility would aim to explore the interfaces between practice, research and postgraduate education in Design and Construction and facilitate their development in a multidisciplinary context.

This example is not aimed at promoting one particular profession to lead construction projects. The main argument is to achieve integration of design and construction through design leadership. Network governance is not attributed to design-led procurement only.

Future research should examine the compatibility of network governance with other procurement routes.

Professional Indemnity Insurance (PII) versus Project Insurance

On their appointment on C Block 2, one of the contractors raised concerns over the need for a general insurance policy to cover claims against the client for accidents, or the inability to establish blame regarding a fault with any of the trade/specialist contractors. The client's insurer confirmed that their insurance policy covers all these risks.

Project Insurance, taken out by the client for everyone involved in a project, as is the norm in Germany, provides much more cost effective insurance cover for everyone than separate insurance arrangements for each professional and trade organization. At a stroke it overcomes the litigious basis of the construction industry. If the UK construction industry were to move from practice-based Pll to project based insurance, small practices would be able to network much more easily and be appointed for larger projects (Haenlein, 2007b). RIBA Small Practices Group position paper for public sector procurement highlighted the insurance requirement as one of the barriers to access public sector market and suggested adopting project-based insurance (RIBA, 2011) .

Conclusion

The purpose of this paper is to explore a procurement route, which aims to integrate design and construction. The literature review demonstrates constraints of the various procurement routes for being able to deal satisfactorily with the organizational complexity of construction projects. Product innovation is biased against process optimization. However, the potential of 'design' to improve efficiency is understated. Designers work simultaneously at different levels of detail. In light of technological advancements in building systems, input of specialist contractors is necessary during the early design stages. Designers need to manage the interfaces between these systems and ensure the buildability of their design. Designing is a social process of achieving consensus of different interests. Professionalization creates boundaries for roles and further increases the separation of design from construction. Design-led procurement offers the opportunity for designers and trade/specialist contractors to work together from inception through to construction. The effectiveness of this procurement route is complemented by network governance. Network governance balances the conflicting demands of specialization and integration posed by construction projects. Structural embeddedness of network members enables social control of their behaviour. Leadership addresses problems of over-embeddedness and under-embeddedness by managing strong ties and bridging weak ties for cross-fertilization. Designers can assume leadership of the network to coordinate inputs of various members even at the construction stage. Design evolves over time. Hence, continuity of design responsibility is paramount to ensure quality. Cooperation of trade/specialist contractors is vital for product innovation and efficiency. Design-led procurement and network governance are synchronous to the design process.

Acknowledgements

We are grateful to Will Hughes for his guidance in exploring the ideas presented in the paper.

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Table 1

Project	Procurement method	Budget cost (GBP)	Final building cost (GBP)	Floor area (Sqm)	Unit cost per area (GBP/Sqm)	Contract period[1] (Weeks)	Actual completion[2] (Weeks)	Defects cleared[3] (Weeks)	Professionals appointed during the project	Fees[4] (% of cost)	Cost index[5]
C Block 1	Traditional	289,000	283,580	289	981	18 (09/04/1990-17/08/1990)	25 (02/10/1990)	69 (30/01/1992)	Architect Structural Engineer Bldg. Services Engineer Quantity Surveyor	11 05 04 06	100%
C Block 2	Design-led procurement	500,000	468,626 (incl. Architect's 6% management fee)	609	770	21 (01/04/1991-26/08/1991)	21 (23/08/1991)	31 (06/04/1992) (General Building works cleared - 61 weeks– 21/10/1992)	Architect Structural Engineer	11 05	78%

1. Contract period is as mentioned in the contract document

2. Actual completion is calculated from start on site to the issue of Practical Completion.

3. Defects cleared period is calculated from issue of practical completion certificate to the issue of Making Good Defects

4. Fees are the professional fees. They are calculated as percentage of construction costs

5. Cost index is calculated by assuming C Block 1 as 100% and taking ratio of cumulative costs of construction and professional fees.