

CONSTRUCTION ORGANISATION STRUCTURE AND INNOVATION ADOPTION

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Innovation adoption in construction is widely considered by both academics and industrialists as a key factor to driving efficiency through the industry yet something which is by and large not a priority for the majority of main contractors. The contemporary business landscape is in the middle of the 4th industrial revolution. This research explores the impact of organisational structure on innovation adoption in construction. The aim of this research was to identify the key themes of impact when considering innovation adoption in the UK's main contracting construction arena. 4 interviews were conducted and a thematic approach to data analysis was conducted engaging a thematic approach using Nvivo. The research moves from a deductive to an inductive approach to theory development utilising a review of literature and qualitative semi-structured interviews respectively. The main findings are that organisational structure has the most impact upon innovation adoption. A consolidated workforce/organisational structure was found to have a positive impact in converse to a fragmented structure. In addition, a collective decision making approach with innovation at the core of the organisation is considered of significance.

Keywords: innovation adoption, fragmentation, collective decision making

INTRODUCTION

The construction sector alongside society at large is at a pivotal stage in the development of implementing innovative advancements (technological and non-technological) which promise, if utilised correctly to have an overwhelming effect on productivity of work, efficiency and consequently improving both profit margins and overall outcomes for all stakeholders. Innovative advancement has the potential to solve many of the issues highlighted in past and present research. Latham (1994), Egan (1998) and Constructing 2025; Strategy (2013) highlighted the inefficiencies in the construction industry and recommended the areas for improvement such as integrated project processes, improved management, supervisory skills and adoption of innovations.

The International Council for Research and Innovation in Building and Construction (CIB) Task Group 76 (2015) defines innovation broadly as: "Humanly created changes in established ways of creating value".

The construction industry is historically blamed for slow adoption of innovative practices (Morledge, 2011) and a majority of construction organisations, constructors and professionals alike may be classed as "Laggards" Rogers *et al.*, (1957). With

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industries such as the automotive industry actively embracing innovations, it has been vastly revolutionized and is constantly pushing the envelope on what is achievable. This poses the question of why is the construction industry seemingly falling behind (Blayse, 2004)?

Literature reveals the role of innovation in construction at an increasing rate of interest (Aouad, 2010), primarily due to its ability to secure a sustainable competitive advantage, improving one's project performance and profitability (in the case of the private organization) or by adding value for money (in case of public sector client) (Davidson, 2013). In addition to this primary objective, innovation also promotes stakeholders to become "challengers" by penetrating new markets and pitting themselves against less successful "incumbents" in niche markets. Stakeholders within the construction industry seeking to gain competitive advantage from competitors; may develop and/or adopt what the organization for Economic Co-operation and Development (OECD, 2005) defines as "technical" and "non-technical" innovations which can be further sub-categorized by Slaughter (1998) as "incremental" (small, and based on existing experience and knowledge), "radical" (a breakthrough in science or technology), "modular" (a change in concept or systems), or "system" (multiple, integrated innovations). It is agreed by the CIB TG76 that innovation is not invention but intervention of existing systems, process or products.

In pursuit of innovations, an organization will incur significant issues at an organisational level which are reported widely by the current researchers and industrialists (CIB TG76). Of those issues the most notable include; organisational structure/fragmented nature of the industry, bespoke projects, hidden nature of construction innovation (Barrett, 2007), structure of production, relationships between individuals and firms within the industry and between the industry and external parties and the nature and quality of organisational resources (Blayse, 2004), not to mention capital investment. However, organisational structures (fragmented and consolidated) are not explored in any depth currently and this is where this study attempts to contribute original scope for further exploration. Within Cooper's (1999) 25 years of research on the adoption of innovation generally, "organisational structure" is identified as a key to success or failure. This characteristic is also further identified and compounded by Blayse (2004) as a widely accepted construction industry related issue but not specifically in relation to innovation adoption. This issue has been explored in part but requires further investigation and understanding as the majority of large main contracting organisations utilize a similar fragmented structure which is less dynamic in relation to innovative processes than the alternative.

Recently there has been a move towards a more consolidated structure by a leading firm. It is unclear why some organisations are consistently more successful than others at innovation diffusion (Gledson, 2017). To this end particular reference to fragmentation vs consolidation organisational structure requires further investigation. Of the 180,000 construction firms in the UK, 96% are thought to have less than 8 employees. In terms of the construction sector, over 86% of employees work within SMEs, and are responsible for 75% of the turnover.

The focus of this research is the sociotechnical exploration of administrative process innovation and organisational structure, which are intrinsically linked through management of the construction organisation. The study combines a literature review, which led the author to construct an analytical framework. The method in which the

research was conducted and data analysis follow on, concluding with thematic findings, limitations, implications both in terms of research and practically.

Innovation Background and Theory

Research of innovation across the business sector as a whole has been debated and discussed for decades as such it is critical to define what the current perspectives of researchers are:

Table 1 Eminent Researcher’s Innovation Criteria

Innovation Definition Criteria.	Eminent Researchers					
	Chesbrough, H	Baregheh <i>et al.</i> ,	Davidson	CIB Task Group 76	Holt	Zhu <i>et al.</i> ,
Year	2005	2009	2013	2015	2015	2017
Differentiation for Advancement.		X				
Adoption Across a Range of Businesses/Market/s (not singular).	X		X	X		X
Meaningful, Lasting Impact.	X	X	X	X		X
Creating Value /Economic Impact.		X	X	X		X
Intervention of an Existing Process /Product.		X	X	X	X	X
New Inventions (also included).	X		X			

The etymological definition is specific about existing systems, process or product interventions and does not consider entirely new inventions. The etymological definition is specific about existing systems, process or product interventions and does not consider entirely new inventions. In its simplest of forms, we can elude to the most recent eminent researcher’s agreed definition. Consider as an example that the wheel was invented and not merely an intervention of an existing product that had been modified from a less attractive system/product. It could be argued that the wheel has undergone many iterations of interventions/innovations across the centuries, which is undeniable however; there was also a moment when the original was conceptual. It is necessary to progress with current research to assign invention to completely new concepts/ideas/products and consider innovation as an intervention of an existing process or product. The CIB Task Group (2015) has further compounded this thought in its Construction Innovation publication (2015).

Therefore, innovation in a construction context can be defined as:

An intervention to a process, product or service that has the potential to increase value and efficiency socio-technically and/or socio-economically.

Comparable Industries and Innovation Diffusion

When looking at innovation and other comparable industries, the automotive industry is frequently examined. If we are to follow the ubiquitous comparative approach to construction research against that of the automotive industry, we could expect deep technological changes albeit the pace of change would almost certainly be over a longer period. The construction industry lacks the rapid consumer reaction/critique/expectation that the automotive industry is afforded and the ability and willingness to respond to. Rogers *et al.*, (1957) created the technology adoption lifecycle model or Rogers’ Bell which when we attempt to draw a cross comparison between automotive and construction industries, it is widely accepted that the

automotive industry sits between “Innovators” and “Early Adopters” spending many billions annually, whereas the construction industry is often considered as “Laggards”. Many of the leading construction industry publications over the last 3 decades have commented this on. The Latham report (1994); The Egan Report (1998) and the Her Majesty’s Stationary Office publication more recently in its *Accelerating Change: Consultation Paper* by the strategic Forum of Construction (2002) which underlined the potential importance of information technology in achieving greater integration, and set the tone for future UK government initiatives.

The construction industry would significantly benefit from the introduction of a widespread, standardized method of implementing innovation. However, as Latham discussed, the fragmentation within the construction industry is a significant barrier to this ideology. The hope of developing a sustainable method of improvement within the construction industry remained a key issue within the industry for several years after ‘Constructing the team’ was published.

In July 2013, the Government Published the ‘Construction 2025: Industrial strategy: Government and industry in partnership following various themes underlined in previous reports such as the Construction Strategy 2011, The Latham Report, Egan Report, etc. This report outlined the government’s targets for the construction industry, and highlighted particular issues such as cost, time, emissions and improvements in exports deemed necessary to improve the industry. The report also highlights the Governments industry vision over the course of its delivery underlining key factors for success, which are categorized as; People, Smart, Sustainable, Growth and Leadership. Greater assistance in construction managerial processes will inevitably support the supply chain, which is responsible for delivering these targets making the successful implementation of innovation vital in the view of the public sector. Whilst key factors are stated, it does not address the inherent issues of the industry and how these broad categories will be adopted by a largely fragmented industry with slim profits.

Organisational Structure in Large Main Contracting Firms in the UK

Profit maximisation is the main reason for the majority of (private) businesses and this is no different in the construction sector. Profit maximisation ensures survival, return on investment, growth and the additional performance indicator of economic value added (McKee, Varadarajan and Pride, 1998). The UK construction sector is intrinsically linked to this combination of business goals however their cause is further complicated by a market structure that is considered highly competitive, unpredictable with poor profit margins, a blemished Health and Safety record (Ming, Runeson *et al.*, 1996); and a need to innovate for economic success (Abbot, Jeong *et al.*, 2006). These issues are further compounded by the fact the sector is fragmented by small to medium enterprises (sub-contractors and suppliers) and so when all these challenges are combined it often has a detrimental effect on success and even survival (Thomas Ng, Tang *et al.*, 2009). The tangible benefits from the adoption of innovative practices include efficiency in processes, in some instances differentiation, overall organisational efficiency (Frambach, 1993) and consequential super-normal profits (Levin and Meisel, 1992). However, the internal process within a construction company that innovates regularly across the organisation is obscured and unclear. Damanpour (1991) highlights three elements of regularly occurring innovations namely, administrative and technical, process and product, and radical against incremental.

The department for Business Innovations and Skills (2017) stated that funding is the essential barrier to research and development within construction. The industry consists

largely of small to medium sized enterprises (SMEs) with restricted resources and low profit margins. This indicates that the mantle of innovation lies heavily with the remaining larger companies who have the resources to fund research and development. However the onus is not exclusively on the private sector. The public sector represents a significant proportion of annual spending in construction. This sector has been instrumental in prompting innovation through its own internal processes (Construction Strategy 2025). The issue of fragmentation (Farooq, 2012) also has an effect on an organisations willingness to innovative. Organisation size i.e. number of employees has a profound effect on innovation diffusion (Damanpour and Schneider, 2006) due to critical mass of staff members to be reached and impacted. Thence, the utilization of innovation becomes wide spread in large organizations and bring with it resultant economies of scale. In converse, SMEs may see the significant expenditure to a small number of employees as wasted income, were other organisations will also benefit from their endeavours. This unwillingness to take the necessary first step due to the fear of handing over cost effective solutions to competitors for no cost is a fundamental barrier within SMEs in the construction industry's structure.

The aim of this preliminary research is to examine the impact of organisational structure towards achieving innovation adoption - A study related to large main contractors in the UK construction industry with opposing fragmented and consolidated organisational structures. It attempts to explore the impact of leadership and organisational culture within these types of differing organisational structures, leading to the identification of themes for further and detailed analysis. The above aim will be achieved by the pursuance of the following objectives. The objectives move from a critical review of literature to the construction of an analytical framework, then on to data collection and analysis, identifying key factors for further research.

Analytical Framework

A deductive approach from the key factors discovered in the literature namely; organisational structure; decision making in regards to innovation adoption; will be utilised to identify how a main contractor's organisational structure, specifically consolidated vs fragmented workforce may impact innovation adoption at organisational level. This will be measured by a cross comparison of two opposing structured construction organisations of the same size and turnover. Exploratory/inductive further research will assist in defining the level of adoption perceived by both organisations at senior management level and project professional level. Furthermore, the most effective decision making approach to innovation adoption will be explored.

METHODOLOGY

From a pragmatic philosophical stand-point, the approach to theory development led the author to a deductive literature review to elucidate parameters of existing knowledge and thus constructing an analytical framework. A stratified convenience sampling technique was adopted to ensure alternative organisational structures could be explored. An inductive cross case analysis (mono-method) using four qualitative semi-structured interviews lasting approximately 1 hour each allowed the researcher to examine two UK based main contractors with local, national and international standings of a similar size in construction related turnover in the UK (The Construction Index, 2017) but with differing organisational structures with the intent on examining the key factors that have arisen from the literature. Namely, contractor "C" has a consolidated organisation, attempting to execute the works utilising its own in-house workforce and resources. In

contrast, contractor “F” takes a fragmented organisational approach to executing the works, choosing to sub-contract the majority of the work to other organisations. To further validate the data the sample draws from experienced (organisational senior management level) national managers and (project level) newly qualified professionals (see Figure 1). Nvivo is utilised as an effective means of data analysis with a thematic approach to analysis.

Consolidated Approach Organisation	C1	C2
Fragmented Approach Organisation	F1	F2
	Newly Appointed Project Professional	Experienced National, Senior Manager

Figure 1: Study Sample

FINDINGS

Cost and Fragmentation were identified by all participants as the most significant barriers to innovation adoption in the industry generally, with short-termism, mimetic behaviour, age and bureaucracy also were highlighted in the data but did not appear as regularly and across all data collected. This compounds the existing literature and the author’s industry experience (Volk *et al.*, 2014) and validates the line of inquiry. The data has been thematically analysed, condensed and tabulated into its simplest form to create themes for discussion (see Table 2 to 5).

Both interviewees from the fragmented organization identify their organization as a “Laggard” (Rogers, 1957). Volk *et al.*, 2014 identify fragmentation in the construction industry in a long line of previous authors such as Paavola, 2014; Rezgui *et al.*, 2013 and McAuley *et al.*, 2012. They all point to the issue of each project being bespoke due to this factor. The interviewees identify this a significant challenge to overcome for their organization, one which hinders innovation adoption wholesale as a common thread/theme.

Table 2 Fragmented - Organisational Structure and Findings

Interviewee	Organization Structure	Professional	Measured Opinion on Organizations Innovation Adoption (Rogers, 1957)
F1	Fragmented	Newly appointed	Late Majority
Qualitative Comment	“Innovation is talked about at senior management levels and external influences engaged to promote. Not seeing it filter down yet. Anecdotal without any specifics”		
F2	Fragmented	Senior Manager	Late Adopters
Qualitative Comment	“We perform poorly at innovation although we have promoted ourselves as highly innovative to clients in the past but in reality it seldom gets down to the operational level”		

Furthermore, the fragmented organisation interviewees described their organisation’s approach to decision making with regards to innovation, as optional (see Table 3). This is defined as providing individual flexibility to those adopting the potential innovation. It is done so on their terms and is not part of any legislation or authoritative direction. The senior manager went further to elucidate that this also is a key factor of challenge that their organization must deal with. Professionals at all levels are working at full capacity to ensure targets financial and programme and seldom have the luxury to consider innovation in the short, medium or long term. As this is not used as a key

performance indicator within this business it is often overlooked. This confirms the research conducted by Everett M. Rogers (1981) and Thunberg *et al.*, (2017).

Table 3 Fragmented - Optimum Decision Making Approach to Innovation Adoption

Interviewee	Organization Structure	Professional	Decision Making in Innovation Adoption
F1	Fragmented	Newly appointed	Optional
F2	Fragmented	Senior Manager	Optional

The interviewees from the consolidated organization both considered their organization an innovator (Thunberg, 2017), however the newly appointed professional went further to compare themselves against other industries and conceded that in comparison they were perhaps less innovative and have a long way to go before they can compare themselves to automotive, aeronautical or manufacturing albeit the construction industry was identified as a manufacturer but creating unique products. The interviewee went further to highlight their use of modular construction and off-site manufacturing allowing them to make considerable improvements to their ability to adopt innovations. In many ways they have gained much success in this which leans them towards manufacturers in a sense. The senior manager and newly appointed professional describe their organization as having innovation at the core of their business. It is led by the owner, filtered to board of directors, onto senior managers and down the chain of command at project level. As they complete the majority of the work themselves they are able to continuously feedback and improve/innovate. It was further highlighted that the process of innovation is bottom up and top down, everyone is expected to look for innovative practice at every level. Innovation is the cultural at the heart of the business before profit maximisation. The long-term strategy to self-improvement through innovation is given weight and forms part of employee’s annual review.

The senior manager stated that having a consolidated workforce with innovation at the core of the business, driven by the leadership and championed at each level creates a motivated workforce to engage innovation. These two factors were described as the key to their perceived success in innovation adoption.

Table 4 Consolidated - Organisational Structure and Findings

Interviewee	Organization Structure	Professional	Measured Opinion on Organizations Innovation Adoption (Rogers, 1957)
C1	Consolidated	Newly Appointed	Innovators
Qualitative Comment	"Highly innovative in comparison to peers, slightly less when compared against other sectors".		
C2	Consolidated	Senior Manager	Innovators
Qualitative Comment	"Innovation cultural and leading the business from its core, top down and bottom up".		

Although, it was stated a number of times that the owner of the organization was a driver of innovative culture and as such could be considered an “authoritative” approach to decision making, both interviewees consider their approach to innovation as “collective”. This is a balance between the maximum efficiency and freedom of choice. This may be a result of guidance from opinion leaders or change agents promoting their ideas (Hemström, 2017). The newly appointed professional went further to describe the organization as innovation focused which gave employees autonomy and as a consequence ownership of innovation which had a significant and positive impact on seeking and adopting innovation at all levels. A consolidated organisational structure was highlighted as the key to ensuring a culture of innovation adoption at all levels and allowed a constant feedback loop to decision making in the same regard.

Table 5 Consolidated - Optimum Decision Making Approach to Innovation Adoption

Interviewee	Organization Structure	Professional	Decision Making in Innovation Adoption
C1	Consolidated	Newly Appointed	Collective
C2	Consolidated	Senior Manager	Collective

CONCLUSION

The purpose of this research was to identify the key themes of impact when considering innovation adoption in the UK's main contracting construction arena. 4 interviews were conducted and a thematic approach to data analysis was conducted engaging a thematic approach using Nvivo. The main findings are that organisational structure has the most impact upon innovation adoption. In particular a consolidated organization with innovation at its core and embedded into its culture is deemed more successful. Furthermore, the best favoured type of decision making when considering impact of innovation is the "collective" approach.

The practical implications of the research is that the mainstream model of outsourcing work has less impact on innovation adoption than having your own workforce. If we refer back to the Government report; Construction 2025, its core intent is to promote innovation to drive efficiency and productivity, however this may be stifled partly due to the fragmented nature of the industry.

If a wholesale change back towards perhaps a dated model of the past is deemed inefficient and burdensome, it can only suggest that the supply chain be considered on a long-term strategy basis, tying organizations together similar to that of the other comparable industries. Profits must increase and the construction industry on a whole must be valued more in order for that to happen.

A collective approach to decision making with innovation embedded culturally creates a positive impact.

The limitation of the study is in sample size, further research is planned with a quantitative questionnaire to a larger sample to further test the impact themes.

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