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Briefing: Towards exploring profession-specific BIM challenges in the UK

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Building information modelling (BIM) has been proposed as an enabler for greater efficiency and effectiveness within the UK construction industry, providing digital management of construction data throughout the project life cycle. The potential benefits of BIM have been widely discussed in published literature but relatively less attention has been paid to the discipline/profession-specific challenges of wider industry adoption. Further studies, such as the authors' ongoing research, could help to remedy this.

1. Introduction

Process inefficiencies and lack of innovation have contributed to entrenching long-standing UK construction industry problems of fragmentation and poor delivery, as highlighted in seminal industry reports (Egan, 1998; Latham, 1994; Wolstenholme *et al.*, 2009).

Criticism of the industry goes further to include: overestimated or underestimated target costs; strongly ingrained adversarial culture; fragmentation; unmanageably delegated risks and rewards; inadequate safety and quality; lack of thought assigned to asset life cycle and sustainability; high levels of energy usage and waste; overrun budgets; and delayed completion of construction (Egan, 1998; Latham, 1994; Wolstenholme *et al.*, 2009).

The challenges have been linked to lack of integration and effective communication across the highly diverse professional teams within the project life cycle (Egan, 1998). Technology has been advocated for addressing these challenges and improving the present state (Arayici *et al.*, 2012). Consequently, building information modelling (BIM) is being promoted as a catalyst towards bringing real change within an industry notorious for lack of adoption of innovation (Cabinet Office, 2011).

BIM is expected to deliver several benefits which are, however, reliant on its wider adoption by the relevant key project participants. This paper, in highlighting these benefits as well as the challenges to an industry-wide BIM adoption, reveals an important research gap that remains to be interrogated.

2. BIM and implementation in the UK

BIM is described as a collaborative process underpinned by technology (Arayici *et al.*, 2012; NBS, 2012). In BIM, the parametric three-dimensional (3D) modelling of buildings aids dynamic design and embedment of product and asset data (Eastman *et al.*, 2011). Complementary workflows and processes allow the various construction professionals/project participants real-time access to centralised virtual models, which can be used to perform individual functions such as design works, cost estimation, programming and scheduling, and energy analysis (Singh *et al.*, 2011). BIM offers evolutionary changes from traditional work-flows that have been characterised by silos of knowledge and information as well as laborious exchange and sharing in mainly paper-centric communication systems (Eastman *et al.*, 2011).

In the UK, the government's announcement within its 2011 construction strategy has instigated great attention to BIM. All public projects are expected to use BIM level 2 by 2016 in a road map towards universal adoption (Cabinet Office, 2011). The government's targets include a general increased efficiency of delivery, improved carbon performance and up to 20% cost reduction on public projects when BIM is deployed (Cabinet Office, 2011). It is expected that the achievement of these targets will be delivered by means of the benefits associated with BIM, which are considered in the next section.

3. BIM benefits

BIM is expected to deliver real time sharing of information and collaboration towards an integrated supply chain to unearth the associated efficiencies in the delivery of projects (Eastman *et al.*, 2011). The potential benefits of implementing BIM in a construction project are copious including early collaborative decision-making, increased design clarity, a strong link between design and costs, early virtual prototyping, improved visualisations and simulations, optimal asset performance, reduced waste, decreased errors in documents, reduced costs, better construction outcomes, higher predictability of performance, increased understanding of the entire life cycle, and data sharing between all disciplines from cradle to grave (Bryde *et al.*, 2013; McGraw-Hill Construction, 2010, 2012; Suermann and Issa, 2007). Such benefits have been widely acknowledged within BIM literature including the expected benefits of adoption by various professional disciplines (Eastman *et al.*, 2011). In spite of the benefits of BIM, there are several challenges to its wider adoption within the industry.

4. Challenges/barriers to BIM implementation

Whereas the challenges holding back the progression of BIM implementation are numerous, they can be considered from three viewpoints: technological, organisational and environmental.

4.1. Organisational

Newton and Chileshe (2012), in Australia, reveal that the highest ranked challenges of BIM implementation are: lack of understanding about BIM, education and training costs, start-up costs, and changing the way companies do business. BIM promotes significant knowledge sharing and organisational interoperability that can lead to legal issues regarding data ownership, copyright and data protection (Azhar *et al.*, 2011). When project members contribute information there might be a requirement for licensing issues. Problems may arise relating to data inaccuracies with associated risks that create legal barriers (McAdam, 2010). Beyond these, studies have also reported challenges such as: overcoming the resistance to change, and getting people to understand the potential and the value of BIM over traditional approaches; adapting existing workflows to lean-oriented processes; training people in BIM, or finding employees who understand BIM; and a clear understanding of the responsibilities of different stakeholders (Arayici *et al.*, 2011, 2012; Eastman *et al.*, 2011). Another related problem revolves around the issue of control, supervision and authority over usage in such integrated environments (Davies and Harty, 2012). In addition, there is an element of confusion surrounding which project participant (e.g. owners, designers or contractors) should develop and operate the BIM models and also who should bear the related costs (Azhar *et al.*, 2011). All of these highlight the socio-organisational implications of BIM adoption including relational and transactional issues that impede adoption.

4.2. Technological

Some challenges are directly related to the current state of development and characteristics of BIM technologies. There is a general lack of high-end hardware resources and networking facilities to run BIM applications and tools efficiently (Eastman *et al.*, 2011; Singh *et al.*, 2011). There is also a lack of interoperability that implies the inability of organisations to exchange, share or integrate information across heterogeneous information systems (Eastman *et al.*, 2011; Gallaher *et al.*, 2004). In the USA, it is estimated that losses to the industry due to such interoperability bottlenecks is as high as US$15 billion (Gallaher *et al.*, 2004). Lack of universality and poor adoptability of data and software standards; unavailability of vendor-neutral data models for effective exchange; scalability and capacity constraints; accessibility and security of data are all challenges that relate to the current state and capabilities of BIM (Mahamadu *et al.*, 2013; Singh *et al.*, 2011).

4.3 Environmental

Wider industrial support and leadership is vital for BIM adoption from both the construction industry bodies and software vendors (Cabinet Office, 2011; Eastman *et al.*, 2011; Mahamadu *et al.*, 2013). Bryde *et al.* (2013) mention setbacks due to lack of awareness or promotion of BIM software, and Fischer and Kunz (2006) further explore barriers including a lack of standardised BIM processes with defined guidelines. Currently, the UK government is the major client promoting BIM and developing frameworks and strategies to aid practices to implement BIM effectively (BCIS, 2011; Cabinet Office, 2011; NBS, 2012). The adoptability and relevance of these are, however, yet to be tested in practice. Overall, procurement and legal guidance are yet to be fully developed and this is evidenced by the lack of comprehensive coverage of BIM-related issues in current procurement documents used in the UK (McAdam, 2010).

Although the above discussion demonstrates that BIM implementation challenges have been a subject of considerable attention, in the main the challenges reported in the literature, however, tend to be generic. There is a lack of insight into discipline/profession-specific challenges that could be undermining industry-wide BIM implementation. The fact that BIM awareness and usage surveys have reported different levels of awareness and usage among various professional disciplines (NBS, 2012) could be indicative of peculiar challenges that need interrogation from a discipline/profession-specific viewpoint. It is therefore imperative to look beyond the reported generic challenges and interrogate in greater depth the peculiar challenges being faced by the various individual professions/disciplines. This is very crucial as the various professional practices/project participants will have to engage with BIM within their respective functions/roles, albeit in a collaborative manner.

5. Towards interrogating the profession/discipline-specific challenges to BIM implementation

Although industry surveys within the UK and other contexts have acknowledged the need for consideration of contextual factors (such as professional disciplines) in assessing BIM implementation issues (McGraw-Hill Construction, 2010, 2012; NBS, 2012), this has, however, not led to deeper profession/discipline-specific exploration of BIM implementation challenges. Challenges to implementation are to some extent influenced by industrial norms and environmental settings within which each of the disciplines/professions operate within the industry (Davies and Harty, 2013; Jacobsson and Linderoth, 2010; Vrijhoef and De Ridder, 2007). The individual professional dispositions of these stakeholders affect their attitudes towards adoption of technology including BIM (Jacobsson and Linderoth, 2010). Similarly, this affects their readiness, capability, maturity and subsequently their disposition towards use (Davies and Harty, 2013). Barriers will therefore not be perceived or experienced to the same degree. Furthermore, the levels of technological development and competence across the various professional groups may also differ. Drawing on concepts from task–technology–fit (information systems) theory (Mathieson and Keil, 1998), the ability to use technology such as BIM could be dependent on how suited it is to existing work tasks. This is supported by a very recent Royal Institution of Chartered Surveyors research report, which highlights the incompatibility between current BIM technologies and UK quantity surveying practice as one of the key factors responsible for the limited use of BIM by quantity surveyors (Wu *et al.*, 2014).

Given therefore the relatively varied ways of working across construction professions/disciplines, it is expected that challenges to BIM implementation would also be dependent on the extent to which BIM characteristics or capabilities are compatible with existing work processes of each profession/discipline (Arayici *et al.*, 2011, 2012; Eastman *et al.*, 2011). Arguably, different disciplines/professions would thus perceive, experience or adapt to BIM challenges differently. They may also possess different levels of knowledge and, consequently, their ability to overcome the challenges could also differ.

In summary, the foregoing synthesis of the literature points out a fertile research ground that must be explored in depth if smooth industry-wide adoption of BIM is to be achieved. To this end, further studies on BIM challenges with a discipline/profession-specific focus are encouraged.

6. Conclusion

Undeniably, BIM offers some benefits, which, if well harnessed, could be instrumental in mitigating some, if not all, of the age-long industry problems. There are, however, challenges that if not addressed in a timely manner would undermine the realisation of the improvements being heralded to be derived from BIM. Beyond the generic challenges that have been reported, there are also hints or indications of discipline/profession-specific challenges lurking within the industry. These have to be uncovered to enable clarity of BIM challenges so that effective strategies could be devised to help push the BIM agenda for 2016 and beyond. It is envisaged that ongoing research by the authors will help to shed light on this grey area.

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