Achieving Level 2 BIM by 2016 in the UK

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ABSTRACT

The growth and advantage of Building Information Modeling (BIM) has recently gained momentum in the expanding needs of the construction industry, one that varies across disciplines. The UK government is the largest public stakeholder client that has realized the benefits and advantages of BIM when used in procuring projects. The usage and adoption of BIM in all UK government-procured projects with a Level 2 BIM status will be mandatory by 2016. Will this target be achievable by 2016? This study investigates that possibility. A critical review of the BIM literature was carried out and the evidence based on the government target of 2016. At the current stage, it appears that Level 2 adoption is achievable by 2016 for large construction firms. However, the technology needs to be properly tailored to meet SMEs variables, if the Level 2 status is to be achieved for the entire industry.

Keywords: building information modeling, construction, adoption, levels

1. INTRODUCTION

The construction industry sector in the UK has undergone noticeable changes over the last six decades, which has put it under considerable pressure from its member-organizations to respond swiftly and appropriately to their requirements and needs. The change imperative was well recognized in pivotal reports, including the 1964 Banwell Report 1994 Latham Report and 1998 Egan Report, both of which criticized the construction industry and acknowledged it as inefficient relative to other industries, especially manufacturing. Furthermore, the reports claimed that the construction sector is highly fragmented, with poor levels of profitability, and slow to adopt technology and change in management and process. The issues raised in many reports and public commissions sponsored by the government have been implemented in some areas, most notably the way the UK government procures its projects. Presently, most government

projects are procured through the Public Private Partnership (PPP), e.g. Private Finance Initiative, which enhances the working patterns of practitioners within the construction industry, and as well augments the way the government does business. Through this procurement route, the UK government is able to offload most of the risk associated with such public projects, but at the same time meeting the needs of the local clients with their limited funding. Since usage of the new procurement route adopted by the UK government, several projects have been done successfully. However, one of the disadvantages with this approach is that the practitioners on PPP contract projects are loosely integrated when it comes to processes and procedures used by different practitioners (Ganah & John 2013). One of the downsides is that most practitioners and their organizations want to protect their IP (intellectual property) but, at the same time, present a single front to the client stakeholder, that is, the UK government. In this regard, issues of cost escalation, time overruns, other project risks, and lean management are evident in most of the reports that are coming out (Murray & Langford 2003). Against such background, the UK government has realized that BIM will enhance such negative connotations about these areas and will bring about tight integration and coupling amongst firms operating within the industry – hence one of the underlying reasons for the mandate for achieving Level 2 usage by 2016.

Although a mandate for full 3D collaboration exists at this stage, which will translate to a substantial cost reduction of approximately 20%, the UK Government did not prescribe in its requirements how BIM Level 2 usage will be achieved by the practitioner organizations and their supply chain within the built environment. That target is left to the practitioners and stakeholders, to come up with their own solutions to meet the government's minimum requirements. In this regard, this research investigates how the strategic, technical, and operational requirements of BIM management are presently achieved. This study also looks at the way BIM education for practitioners is being delivered in most tertiary institutions. In this study, the scope of the systematic literature review undertaken starts from 2011, when the government issued the mandate for the BIM theoretical approach, usage, and practical implementation. The rest of the paper is divided into the following sections: the methodology used in the overall research, the BIM evolution, the issues investigated with regard to BIM for practical implementation of Level 2 BIM, the discussion, and then finally piecing together the various strands in the conclusion.

2. METHODOLOGY

A systematic review is an overview of primary studies which contain an explicit statement of objectives, materials, and methods and has been conducted according to clear and reproducible methodology. The purpose of a systematic review is to provide the best available evidence on the likely outcomes of various actions and, if the evidence is unavailable, to highlight areas where further original research is required. The advantages of systematic reviews are (Higgins & Green 2011):

- explicit methods limit bias in identifying and rejecting studies
- conclusions are more reliable and accurate because of methods used

- large amounts of information can be assimilated quickly by practitioners, researchers, and stakeholders

The guidelines for this systematic review have been adapted from methodologies developed and established over more than two decades in the health services sector (Higgins & Green 2011) and informed by developments in other sectors such as social sciences and education (Gough et al. 2012).

The question then to be asked is:

What is the evidence that there is an increase in the activities to the usage and uptake of BIM by organizations within the built environment on government projects?

The research designed and used to find an answer to the above-mentioned question is an eclectic approach, embracing both quantitative and qualitative research methods. High quality systematic reviews were adopted and the following steps were carried out (Higgins & Green 2011):

1. identify all relevant published and unpublished evidence
2. select studies or reports for inclusion
3. assess the quality of each study and report
4. synthesize the findings from individual studies and reports in an unbiased way
5. interpret the findings and present a balanced and impartial summary of the findings with due consideration for any flaws in the evidence

The sources used in this study came from the following, in order of relative importance to academic rigor (see Table 1).

Table 1: Selected databases used in systematic review

Database name	Meta- search terms used	No. of articles found	No. of article chosen
Science Direct	BIM, adoption, barriers	124	14
Emeralds Engineering	BIM, adoption, barriers	19	2
Sage	BIM, adoption, barriers	6	1
ARCOM	BIM, adoption, barriers	9	1
COBRA	BIM, adoption, barriers	36	1
CIB W78	BIM, adoption, barriers	2	0
Total No. of articles from the database		194	19

The search used within the systemic review process is that all documents should start in and around the time the government strategy for full implementation was issued in 2011. This will in effect follow the trend of BIM progress from this point onwards, underpinned and supported by the UK government. Anything before this period will be taken as known from the traditional literature review and how it is may have an impact on this study. The information that is relevant for the full implementation of BIM in 2016 is summarized in the next section.

3. BIM INNOVATION: EVOLUTION AND DEVELOPMENT

Innovation comes in different types, amongst which are evolutionary innovations; these involve delivering a new service to existing users. Process innovations, on the other hand, affect management and organization. They change relationships amongst organizational members and affect rules, roles, procedures, and structures, and communication and exchange between them and the environment. They are concerned with how services are rendered (Abernathy & Utterback 1978; Damanpour & Gopalakrishnan 2001; Edquist et al. 2001).

Generally, BIM innovation is a digital model of a building in which information about a project is structured in such a way that the data can be shared. However, there are different definitions of BIM, depending on whose perspective one takes. For these definitions, see the following publications: NBIMS-US (2007), RIBA (2012) Penttila (2006), and Succar (2009). BIM is a new innovation that is pervasive both in technology and in work processes affecting intra- and inter-organizational activities.

It is widely believed that BIM will help with integrating processes throughout the entire lifecycle of a construction project (Grilo, & Jardim-Goncalves 2010; Jung & Joo 2011). Even though the BIM concept has existed since the 1970s, it is only over the last five years that building owners have become aware that it has the potential for making the design, construction, and operation of buildings much more streamlined and efficient (Arayici et al. 2011); and BIM has increasingly gained ground as a means of developing buildings and infrastructure that are problem free, and a better fit with high efficiency. Still, there are a number of barriers to the implementation of BIM in the UK construction industry, including but not limited to:

- resistance to change culture within construction industry professionals, especially those at the top management level, and getting these people to understand the potential and realize the value of BIM over conventional design and management tools (Cabinet Office 2011; Murray & Langford 2003).
- training employees on BIM; this requires buy-in from all stakeholders in a project to ensure that it happens
- the availability of the infrastructure required for BIM, including high-end hardware and networking facilities to run BIM applications and tools efficiently; and components' library, which requires manufacturers to produce 3D models for their components in BIM-compatible format (NBS 2013)
- understanding the importance of collaboration, integration, and interoperability between all stakeholders (BIMTG 2011;NBS 2013)
- lack of clear understanding of the responsibilities of different stakeholders in the new process by construction lawyers and insurers (Arayici et al. 2011)
- lack of a common language for data exchange (Arayici et al. 2011).

All of the above can only be overcome through collaboration, including government, public and private sectors, industry bodies, software developers, and researchers. The industry needs to become less fragmented and less adversarial, and there is a strong wish to encourage better integration from all stakeholders involved in a construction project.

In the UK, a BIM maturity framework has been developed to ensure clear delivery of the levels of competence expected and the supporting standards and guidelines, their relationship to each other, and how they can be applied to projects and contracts in the construction industry. The UK Government requires fully collaborative BIM Level 2 (with all project information, documentation, and data in an electronic format) as a minimum by 2016 on all public projects (Cabinet Office 2011). Level 2 comes third in a four-tiered system as presented in BIMTG (2011).

From the above, Smith (2012) argued that many projects were on different parts of their BIM journey. Most of the UK is still at Level 1 (2D/3D CAD) with regards to BIM, while some firms were seeing the benefits of Level 2 (managed 3D CAD utilizing 4D or 5D), thus improving productivity and time management with their projects. He argued further that a firm's adoption of new BIM systems would be dependent on industry/client push/pull. In May 2011, the UK Government Construction Strategy was published with its ultimate aim of reducing the cost of government construction projects by 15-20% by the end of April 2014. The Construction Strategy is to implement Level 2 BIM throughout all UK practices by the year 2016 in all projects worth £5m and over (Cabinet Office 2011).

4. FINDINGS

From the systematic research methodology Step 5 is reported here in a summarized format. The results so far from this review are that:

- There are presently a number of trial projects that the government has identified and commissioned for BIM usage. Of these, only one has been completed (Cabinet Office 2012).
- Currently, designers and consulting practitioners are the predominant users of BIM (Conference Proceedings from ARCOM and COBRA 2011-2013).
- There were a few systematic approaches, but these were not followed up by practitioners in the way the technical issues of BIM were being implemented before the PAS 1192-2:2013 protocol (BSI 2013); and BIM overlay of RIBA Plan of Work 2013 were developed (RIBA 2013).
- The literature is deficient in the usage of BIM amongst construction subcontractors; even with specialist subcontractors, it is rare and almost non-existent.
- The task groups formed by different institutions (CIB, RICS, CIOB, RIBA, etc.) are not yet fully integrated to give a holistic understanding of the underlying long-term issues about integrated and collaborative working.
- The social networking sites discussing BIM are not sufficiently grounded in issues related to original research for them to make a meaningful contribution to the developing of BIM Level 2 adoption in 2016 (LinkedIn 2013).
- Universities and further education colleges are not significantly engaged in new undergraduate course development addressing the usage of BIM in such a way as will bridge the knowledge gap about this technology in the near future. So far, some architecture schools have incorporated the usage of BIM software into their design

studios. However, this is in the area of technology only, not in BIM management issues and their related capability.

- Very few postgraduate courses have been identified so far solely dedicated to BIM usage and practical implementation.
- There are not many articles within journals and conference proceedings that are effective in disseminating utilization of BIM throughout the product's life cycle.

From the documents examined so far, it is not clear from all the practitioners what is meant by achieving Level 2 BIM by 2016. Since the government strategy did not define a road map or steps through which it is to be achieved, this aim is rather difficult from the practitioner's perspective.

5. DISCUSSION AND CONCLUSION

The industrial variables, which have changed significantly since May 2011, are the following:

- There is now an *RIBA Plan of Work 2013* with BIM overlay, naturally not part of the literature before 2011, which one can safely point to now. This plan of work will underpin the way professional institutions and bodies plan their strategy in the usage of BIM holistically. The buy-in of these institutions is lending weight to shaping the way BIM adoption will be undertaken, both strategically and managerially.
- There now exists a new protocol for BIM usage (PAS 1192-2) that underpins the British Standard (BSI 2013); uptake of this was low, as it was thought geared towards the information industry in the first instance. Considering the fact that PAS was sponsored by the Construction Industrial Council, a body with sound organizational membership, this will improve the way BIM is procured and used. The introduction and appointment of the information manager within the PAS protocol is new and not yet fully spelt out in relation to the issues of communication and collaboration with the other organizations that will be involved in the project.
- Most professional bodies and institutions now have task groups that actively promote BIM within their rank and file, as well as holding seminars or workshops to educate their members through continuous professional development (CPD).
- Research in educational institutions has also increased, although it is not evident that there is a definite strategy in achieving meaningful results from a more strategic agenda rather than 'firefighting' the issues of BIM as they develop.
- Most undergraduate courses in institutions now have modules that are BIM oriented or have incorporated aspects of BIM into existing modules, which will make outgoing graduates sensitive to, and active users of, BIM technology.
- The surveys conducted by industrial groups, in particular NBS, from 2011 to date show that there is an increase in the adoption of BIM in the industry; however, this increase was mainly by large companies which have the resources to do so. Small and medium enterprises are still lagging behind because of lack of resources and or management strategies.

Finally the construction industry practitioners (i.e. contractors) and stakeholders need an integrated platform to collaborate and create an effective and efficient working environment which is offered by BIM. So far it has been shown that the industry is responding positively to this challenge in most areas. Practitioners are becoming more knowledgeable through their institution-run CPD programs, and (large) contractors are also informed through the relational procurement routes that they are engaged in, forcing them to change and adapt to this new form of collaboration. Some universities are starting to adopt a multidisciplinary curriculum supported by BIM, but this needs to become the standard not the exception. The downside is the fact that although every organization has some form of data presence in BIM, there is no evidence of a federated approach that will manage the legal sharing and usage of data, as each firm wants to protect its intellectual property rights. The main challenges for the SMEs is the added cost, i.e. in training of personnel, software, and related hardware, and potential reduction of their profit margins. For SMEs to buy in, there must be government incentives, e.g. tax rebate/relief, which will motivate them in the direction of BIM adoption. However, it is paramount that the UK Government continues to champion and sustain the push towards BIM adoption with more projects to achieve the goal of Level 2 collaborative working by 2016. The research presented in this paper should be of great interest to the industry, as we are operating in a globalized world. As such, having a persistent data platform in the UK (i.e. BIM), accessible from anywhere in the world, will make it possible to solve the teething problems other nations face during their BIM implementation stage.

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