A Case Study Investigating BIM Model Process with the Special Focus the Value of Information Handover

Jackline Baragu Kibe*¹, Dr Ljiljana Marjanovic-Halburd*²

*UCL Institute for Environmental Design and Engineering (IEDE), The Bartlett, UCL Faculty of Built Environment, Central House, 14 Upper Woburn Place, London, WC1H 0NN, UK
¹jackline.kibe.14@alumni.ucl.ac.uk
²l.marjanovic-halburd@ucl.ac.uk

Abstract
The fragmented nature of the AEC industry frequently leads to incompatibilities in semantics, process and software between collaborating disciplines and the application of Building Information Management (BIM) systems is its latest culprit. Despite many investigations into its adoption and benefits, there is still a lack of clarity as to how the AEC industry is coping with this change and many remain sceptical about potential benefits. This paper provides an overview on the history and development of BIM and further investigates the information exchanges pertinent to the operations and management of the facility via a case study. The case study presented investigates the current status of BIM processes in a concrete AEC’s SME Practice in the UK industry by evaluating the BIM Model handover processes and its value to facility management (FM) as well as of the current perceptions and attitudes towards BIM. A significant finding was that the Practice in question rarely delivers BIM models for FM. Majority of BIM enablers in the given Practice indicated that they rarely ever handover 3D models post-construction to clients/owners to suggest that that the current BIM standards specification for facility handover information in the chosen SME Practice are not creating opportunity to extract additional value out for operations and management beyond the scope of the requirements of design and build as there is no demand for it.

Keywords – Building Information Management (BIM), Facility Management (FM), Case study

1. Introduction

Building Information Modelling (BIM) represents a new paradigm within Architecture, Engineering and Construction (AEC) industry aiming to increase productivity, efficiency, value, quality and sustainability, and to
reduce lifecycle costs (Arayici et al. 2011). It is a data-rich, object-oriented, intelligent and parametric digital representation of the facility (Eastment et al. 2011) that encourages integration of the roles of all stakeholders on a project. BIM can support automated creation of equipment inventory lists, populates facility management (FM) systems, and reduces redundancy in the maintenance of facility data for FM activities to help maintain facilities that are more efficient, have lower carbon emissions, cost less to run and are better, more effective and safer places to live and work (BIFM 2012). This is a fundamental step towards moving the industry away from traditional process of manual information handover via paper documents which often creates opportunity for errors. Germany, Finland and United State are regarded as the pioneering countries for this technology (Wong et.al. 2011, Arayici & Farzad K., 2012). The UK Government’s decision to mandate the use of BIM on large central government infrastructure projects from 2016, (Gov.UK, 2012), is likely to position the UK among these world leaders. Many organisations working within AEC sector have started to adopt BIM tools and adapt their existing delivery systems to satisfy evolving market requirements (Succar et al. 2013) with building owners and clients realising benefits that BIM can offer (Eastman et al. 2011). Despite the fact that there are multiple lines of evidence of the transformative and complementary benefits of BIM, it is fundamentally a technology-driven concept and thus entwined with issues pertaining to people, processes and organisations.

3. Potential Value of BIM in FM and Barriers to Its Adoption

Investigations into the status of BIM Implementation in project lifecycle stages by Becerik-Gerber's (2012) and Eadie et al. (2013) have found that use of BIM is indomitably in the early stages of project lifecycle it is progressively less used in the latter stages. According to Eadie’s investigations over 51% of the respondents use BIM at the design stage and pre-construction stages while 34% reported to using it in the construction stage. Only 8.82% of the respondents associated with the operation and management phases use BIM. The study finds that while there is more interest in implementation of BIM at this stage from BIM non-users than BIM users, BIM users were more optimistic than non-user about the use of BIM for various FM application areas. It attributes this to the awareness of BIM functions and features among the BIM users. Eadie, R. et al., (2013)
support this assessment by suggesting that recent developments within BIM technologies have not permitted assessment of the entire lifecycle and that, currently most BIM projects handed over at completion don't extended the boundaries of BIM beyond its traditional use in design and construction into the operational life of the building as the most beneficial aspect to the FM’s (i.e. the Cobie dataset) is often not provided.

Eadie et al. (2013) argues that the three main reasons for not adopting BIM on current projects relate to the lack of expertise within the project team and external organisations and lack of client demand. The study builds up on Gu and London's (2010) research into BIM adoption in terms of current status and expectations across disciplines which reveals that the AEC industry's overall lack of experience in BIM led to limited understanding and articulation of industry needs and technical requirements for BIM. Gu and London put forward the view that BIM adoption require changes to four key interrelated domains including; work processes, resourcing, scope/ project initiation and tool mapping and discern the view that creating the enabling environment of a decision framework to integrates both the technical and non-technical challenges will help stakeholders ‘understand the full resource implications of BIM technologies on projects and the impact of their decision making on BIM implementation’ (Gu and London's, 2010).

Succar (2010) recognises that behind the theoretical premise of BIM there is a very definitive lack of understanding on the value of BIM especially for owners/FM while Becerik-Gerber et al. (2012) acknowledge that the FM industry is quite rigid in its approach to new technology, and that unless BIM for FM benefits are clearly proven, its uptake in the FM industry will continue to be low. NIBS (2007) attribute most of key issues with use of BIM mainly to lack of sharing of information between lifecycle phases and argue that since many practitioners are still only concerned with their phase of the project they fail to recognise their stewardship role in the overall lifecycle of the facility.

4. Research Design and Data Collection

This paper presents the results of the observational case study about BIM application and its associated processes within an AEC SME Practice. The core disciplines in the Practice include Quantity Surveying, Building
Surveying, Project Management, Architecture, Structural and Mechanical and Electrical Engineering, CDM Coordination, Sustainability Consultancy and BREEAM Assessment. The scope of the research was limited to the headquarters office housing approximately 110 multi-disciplinary employees and only those involved in projects using BIM and working in the Architecture, Construction, Mechanical and Electrical Engineering disciplines. The authors started by identifying which individuals within the chosen Practice have access to BIM software. Once all 29 individuals were identified, preliminary discussions over the phone was used to evaluate respondent competencies with BIM processes and technology which was particularly useful for ensuring participation in the study as 20 individuals agreed to participation. After a series of conversations with several participants it became clear that the use of a survey would be the effective method of data collection and the questionnaires were subsequently sent to all 20 participants with 100% response rate.

Following an interview with the Principle BIM Manager of the company, the authors were able to collect and review the technical specifications of the in-house standards for BIM projects. These (the interview and the access to relevant existing documentation) gave insight into Practice’s conceptual organisation while survey data from 20 respondents presented an analysis of actual practice.

The information collected through literature review informed the questionnaire design. The full literature review conducted as well as the full set of survey results can be found in (Baragu Kibe, 2014). A series of statements expressing support & opposition towards various claims in current studies were designed to determine attitudes, knowledge, perceptions, values, and behavioural changes with regard to use and adoption of BIM. A number of questions were adapted from an existing NBS Survey (2015) which investigates how UK building design professionals are adapting to the use of BIM. The questionnaire was broken down to 4 parts with a total of 40 questions.

5. Results and Discussions

Apart from the questionnaire results presented in Figures 1-4, the findings in relation to attitudes, perception and challenges in BIM adoption
were also informed by the interview conducted with the Practice’s BIM Manager.

![Figure 1: Responses on Key barriers to using BIM for project delivery](image)

The survey found that respondents consider “lack of expertise within the project team & lack of expertise within the organisations" and “investments costs” as the key barriers. 95% agreed that adopting BIM requires change in their workflow, practices and procedures. According to the BIM Manager, although the practice has no formal policy on training, specific training on software, standards and methods of work is available if and when it is required. When questioned on the Practice’s view on BIM adoption and implementation the manager states; "...By utilising BIM and these standards it allows the company to stay at the forefront of the construction industry and provide a more refined and high quality services with reduced costs for construction and after care. The company pushes to stay ahead of the industry standard by reaching level 2 across all disciplines within the practice by January 2016". ‘When asked whether there are any limitations placed on the practice’s ability to exchange electronic information by their PI insurers the BIM manager stated that they were “none outlined in the PI cover” although he recommends ‘appending the CIC BIM protocol to a construction contract where there are concern’. On the other hand 60% of respondents remained unsure of this fact, an indication of poor communication within Practice. Results indicate that the
Practice has a strong collaboration culture with 70% of respondents disagreeing with the notion "that reluctance of team members to share information" as a key barrier to using BIM. 60% of respondents felt that "Cultural resistance" was a barrier to using BIM to suggest that most feel that a change in the organisation's culture is necessary to facilitate for the paradigm shift. On continued development the manager reports that the company has developed a BIM focus group to ‘provide a platform for reviewing existing standards, as well as new design technologies and processes as they emerge. We have established a Focus Group to support and drive the adoption of BIM locally, and to ensure a consistent development and deployment of protocols and skills across the businesses’.

To determine the value of information exchanged by identifying the requirements for BIM objects from the Practice’s perspective, the survey asked respondents how often they use BIM objects from varying sources i.e. NBS, in-house & project specialist library, manufacturer's, other libraries. 50% of respondents acknowledged that it was common practice to use objects provided by the manufacturers (see Figure 2). The in-house BIM Manual encourages users to use manufacturer's component where possible and provides a list of websites. The availability of manufacturers’ BIM objects is an important factor in achieving success with BIM (NBS, 2015) although it is still essential that a standardised approach is taken to ensure that objects used utilise appropriate data exchange tools and aligns to the requirements of COBie to enhance its value to post-construction stakeholders. 11% claimed to use BIM objects often from the NBS library whilst 37% admitted to the rare use of NBS objects even though the company has access to the NBS BIM Library. When asked to briefly describe the arrangements and protocols for scheduling /quantity take off, the Manager explains that within the BIM authoring tool templates, the practice has pre-defined, discipline specific schedules for capturing information embedded within the model to automatically itemise components with their properties.
The overview of the results related to information hand-over is presented in Figure 3. 65% of respondents indicated that they rarely handover 3D models post-construction to client/owners while 40% indicated that they extract 2D files from Models for handover processes. A closer look at the results with regards to the organisation’s 2D working practices support the observation that although there is effort to adopt BIM as a new business practices the traditional 2D information delivery is still deeply rooted into everyday practice. This can be attributed to the fact that 65% of Practice’s clients prefer their documentation in 2D format.

When questioned on what kind of services the Practice offers in terms of integrating BIM in design and FM the manager stated “We work closely with a specialist FM consultancy and would recommend appointing a third
party FM specialist from the outset of a project to ensure appropriate selection of CAFM tools and development of data throughout all project stages. Benefits expected in this kind of projects include: CAFM to ensure effective maintenance of assets, ensures maintenance and asset performance history maintained and enables FM contractors to effectively manage and optimize maintenance service.”

When asked to describe the Practice’s collaborative BIM Workset the BIM Manager quotes; “At a start of a project the collaborative work will be set out with a meeting to agree who is doing what on the project, set upload dates to sync all the models together and when to have collaborative work meetings to monitor how the work is going and iron out any issues that maybe arising. Workset are used to create and set up collaborative working on projects. These work by creating a central model in Revit and allowing consultants and other disciplines take their own local model to work on these are then synced with the central model which is the main model used for client to see”. Results from the survey (see Figure 4) find that while 68.4% of the respondents have a wealth of experience in working collaboratively on 2D applications; only 27.5% have experience in working collaboratively on 3D applications.

<table>
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<tr>
<th>Work collaboratively on 3D AutoCAD Applications - External</th>
<th>20%</th>
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<th>65%</th>
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<td>30%</td>
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<tr>
<td>Work collaboratively on 2D AutoCAD Applications</td>
<td>98.40%</td>
<td>15.70%</td>
<td>15.80%</td>
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![Figure 4: Responses on BIM Model collaborative processes](image)

6. CONCLUSION

BIM is currently the most common denomination for a new way of approaching the design, construction and maintenance of buildings. While it’s clear that the benefits of BIM extend beyond the design and construction phase of a building to its operation and maintenance it is
important to recognise that the value of BIM to FM is determined by the value of information contained in a BIM model at handover. This paper aims to understand the value of current BIM Models delivered by AEC SME's in the UK and their value to the operations and maintenance of the facility by investigating the BIM workflow processes of a specific AEC Practice.

The case study presented focuses on the specifications for delivery of BIM models by investigating engagement with BIM collaborative environments, use of BIM objects, clients/owners interactions and on key barrier affecting the adoption, implementation and use of BIM within the organisation. The adoption of BIM is meant to serve as a catalyst to improve information flow between stakeholders as data from BIM models is often used to populate and integrate other systems. A significant finding was the indication that the Practice in question rarely delivers BIM models for FM. 65% indicated that they rarely handover 3D models post-construction to clients/owners with 65% of respondents agreeing that their clients prefer their documentation in 2D format. This suggests that ensuring that accurate information is incorporated in a model beyond the requirement of the in-house BIM protocols is not a priority for the Practice as that is rarely required by clients. Other studies have also suggested that lack of client demand is a key barrier to adoption of BIM limiting industrial efforts to improve the operation, maintenance and management of facilities through efficient information management. Whilst most of respondents showed a positive attitude towards BIM, the BIM users in the Practice are mostly inexperienced in 3D collaborative work to suggest that the impending national move from 2D CAD drawings to 3D BIM will require a significant shift in not just technology but also in the organisational change management, standards and processes. Although it is evident that the Practice is attempting to establish collaborative practices, it is also clear there is a need to develop the right environment to foster effective implementation of BIM through training.

References


