

THE IMPLEMENTATION OF STAKEHOLDER MANAGEMENT AND BUILDING INFORMATION MODELLING (BIM) IN UK CONSTRUCTION PROJECTS

Sukhtaj Singh¹, Ezekiel Chinyio and Subashini Suresh

Faculty of Science and Engineering, University of Wolverhampton, Wulfruna Street, Wolverhampton, WV1 1LY, UK

The implementation and usage of Building Information Modelling (BIM) on construction projects affects procurement and the supply chain activities. The BIM process is changing the traditional modus operandi of the construction industry where many projects have failed to achieve their objectives due partly to ineffective stakeholder management. An on-going PhD study is exploring how to mitigate delays and conflicts between stakeholders on BIM implemented projects in the UK. However, the scope of this paper is limited only to the role BIM can play in managing stakeholders. This paper is based on a critical literature review and primary data collection through five semi-structured interviews. Findings from the literature review show that BIM publications such as PAS 1192-2:2013, Employers Information Requirements (EIR) and BIM Execution Plan (BEP) set out clear requirements for the coordination and collaboration process that will facilitate the use of the BIM model. This inadvertently strengthens communication and mitigates conflicts among stakeholders. The findings from the interviews which were analysed by content analysis show that BIM can help project teams to proactively satisfy stakeholders by engaging them early on in the construction process and seek solutions that avoid or minimise delays and conflicts. The paper concludes that BIM has a huge potential to manage stakeholders on construction projects. Communication, collaboration, stakeholder engagement, trust, common goals, technology and people are at the core for managing stakeholders within BIM projects.

Keywords: BIM, communication, conflict management, stakeholder management

INTRODUCTION

Missonier and Loufrani-Fedida (2014) postulated that projects fail due to ineffective social interactions between the project stakeholders rather than lacking or ineffective project management practises. Numerous studies by various authors such as by: Aaltonen *et al.*, (2008), Schepper *et al.*, (2014), El-Gohary *et al.*, (2006) show the essence of stakeholder management. Ineffective stakeholder management on construction projects can have dire consequences such as cost overruns, significant delays and in worse cases project closure. So it is highly important for any

¹ s.singh13@wlv.ac.uk

organisation to manage stakeholders effectively in order to achieve their project's goals.

Stakeholder management has been researched a lot in the context of projects delivered by traditional means. However it has not been researched on Building Information Modelling (BIM) implemented projects. BIM affects the overall traditional modus operandi of organisations in the delivery of projects. So it is important to investigate how stakeholder management is changing on BIM implemented construction projects. Moreover, BIM has been explored a lot in its technical domain, for example, in the aspects of 3D visualisations, energy analysis, clash detections, 4D, 5D, among others. However how BIM can assist in stakeholder management has not been explored. So a PhD study is being carried out to fill this gap. Moreover, this will act as an additional pull factor for organisations to adopt BIM on their projects. The following sections, based on the study, will briefly discuss the critical literature review, methodology, data analysis, discussion, conclusion and outstanding work consecutively.

Literature Review

Building Information Modelling (Bim)

The concept of BIM originated at Georgia Institute of Technology and was developed in the mid-1970s by Eastman and was originally called Building Description Systems (Cao *et al.*, 2015; Rokooei, 2015). There is no universal consensus on the definition of BIM. However, for this research the definition proposed by Succar (2009) is adopted which described BIM as “a set of interacting policies, processes and technologies that generating a methodology to manage the essential building design and project data in digital format throughout the building's life-cycle” (p.357). This definition promotes the holistic nature of BIM that also incorporates project management related tools and processes in addition to the software that enables 3D modelling and input of information. From this perspective BIM is viewed as a tool for more effective project management (Bryde *et al.*, 2013).

Rokooei (2015) argued that BIM helps to foster communication among stakeholders in several ways, for example, BIM models allow the input, modification and analysis of data which makes stakeholders to communicate with each other more effectively and thus reduces disputes between them. BIM provides project managers opportunities to improve and promote collaboration among stakeholders (Bryde *et al.*, 2013) because different models prepared by different parties are federated into one model, so that all parties have to work simultaneously as a team on one big model (Rokooei, 2015).

PAS 1192-2:2013, EIR and BEP

In the paper: PAS 1192-2:2013, Employer's Information Requirements (EIR) and BIM Execution Plan (BEP) are discussed in the context of the stakeholder management only. PAS 1192-2:2013 provides guidance for information management during the construction phase of a project. It explains the EIR and BEP, among other issues. EIR is a pre-tender document which becomes a part of the tender documents for the procurement of design and construction teams. BEP has two parts i.e. pre-contract BEP and post-contract BEP. The pre-contract BEP provides guidance on how the requirements set by the employer in the EIR will be met. Once the contract is awarded, the post-contract BEP will specify everything in detail. It is basically a refined and more detailed version of the pre-contract BEP. PAS 1192-2:2013

provides a good guidance for both the BEPs. All these three documents are interrelated.

PAS 1192-2:2013 and EIR are coherent documents in terms of providing guidance for stakeholder management on BIM implemented projects. PAS 1192-2:2013 provides an overview of what should be included in the EIR. For example (related to stakeholder management), PAS 1192-2:2013 states that EIR should specify requirements to bidders for the management of coordination, clash detection and collaboration processes. It also states that training requirements (if required) should be included in the EIR. The EIR takes this to the next level by specifying in more detail the requirements from the bidders. EIR has explicitly categorised its contents into three parts, namely, technical, management and commercial. The EIR highlights the key areas for which the bidders have to fulfil the requirements. For example, for the collaboration process it asks the bidders to specify how frequently they will collaborate, details of model review workshops and other collaborating working practices, among others. For roles and responsibilities, the EIR highlights the guidance documents to be followed. PAS 1192-2:2013 also provides guidance on the roles involved in a BIM process.

The guidance provided in these documents will make project stakeholders to overcome the boundaries in other procurement approaches (for example, traditional procurement approach) and contractual barriers and make them to collaborate and coordinate with each other (Singh *et al.*, 2017) because they have to increase collaboration and coordination to devise plans to specify in the BEP.

Stakeholder management

The APM Body of Knowledge (2006) defined stakeholder management as “the systematic identification, analysis and planning of actions to communicate with, negotiate with and influence stakeholders” (p.20). Many researchers have proved that project stakeholder management is one of the most critical factors to make a project successful (Offenbeek and Vos, 2016; Travaglini *et al.*, 2014) because the project’s success or failure significantly depends on the perceptions of every individual stakeholder backed by their ability and willingness to act either in favour or against the project (Bourne, 2005).

METHODOLOGY

A constructivism philosophical orientation underpins the empirical research which is a sequel to the (foregoing) review. This orientation believes that individuals develop subjective views about objects or phenomenon from their experience. In this paradigm, a researcher would seek the complexity of the views developed by individuals (Creswell, 2014).

Semi-structured interviews were conducted to collect data and discover the experiential world of the interviewees within topical dimensions. Semi-structured interviews allow an interviewer freedom to diverge slightly from the script (McIntosh and Morse, 2015).

Purposive sampling was adopted for selecting the interviewees because it allows the selection of participants based on their specific characteristics such as experience, perspectives, expertise (McIntosh and Morse, 2015). Specifically the participants targeted are working on BIM implemented projects. The sample size of 5 is too small to represent the whole construction industry but more interviews are planned.

The interviews were conducted face to face except the interview No.4 which was conducted using a webinar. The average interview time was 58 minutes. The interviews were recorded using both a phone and Dictaphone simultaneously. The interviewer played a major passive role and a partial active role while conducting interviews. The questions were asked and prompts were provided only when an interviewee was diverging from the topic. The interviewer did not suggest ideas while interviewing. The interviews were transcribed exactly word to word where the “oTranscribe” tool was used. The interview transcripts were uploaded to the “NVivo” software which was used to analyse the data in a process explained by McIntosh and Morse (2015).

Data Analysis

Conventional content analysis was adopted for analysing data. Conventional content analysis is an inductive approach in which the researcher develops categories from the data to make new insights to emerge (Hsieh and Shannon, 2005). It is usually used in research where the aim is to describe a phenomenon. Thematic analysis could be adopted for analysing data but content analysis provides opportunity for quantification of the data. It means themes or categories in content analysis can be presented as a frequency of appearance. However, quantification in this regard requires extreme caution because one theme could appear more frequently in one interview and less in others. This can erroneously make a theme or category to look more predominant (Vaismoradi *et al.*, 2013). Due to the limited number of interviews, the quantification of data is not considered in this paper.

Initial themes were generated from the data and coded. As the analysis progressed, more themes were generated, some were merged with others, and thus the analysis progressed as an iterative process.

Information about Interviewees and Their Background

Data from five of the interviews conducted so far have been analysed. The paper is based on this limited analysis. The profile of interviewees and their organisation is shown in table 1. For confidentiality reasons, the identities of the interviewees have been anonymised as A, B, C, D and E.

Table 1: Profile of interviewees and their organisation

Interviewee	Experience	Role	Length of using BIM (organisation)	Organisation’s BIM maturity level	Organisation sector
Interviewee A	1 year	BIM coordinator	2 years	Between 1 and 2	Infrastructure (highways)
Interviewee B	17 year	Divisional engineering manager	10 years	Level 2	Infrastructure (geotechnical)
Interviewee C	30+ years	Design manager	2 years but has been using BIM for 4 years	Between 1 and 2	Infrastructure (highways, airfields, rail)
Interviewee D	20 years	CEO	20 years	Level 2	Software firm
Interviewee E	10 years	BIM manager	6 years	Level 2	Infrastructure (schools, prisons), housing sector

The objective was also to investigate who are the key stakeholders on BIM projects as perceived by the construction industry. The interviewees perceived stakeholders as usually those with whom they liaise with on a daily basis (shown in table 2). For instance, interviewee B treated stakeholders as those who have financial input to the project i.e. people who are more linked to the client, their supply chain, employees and, sub-contractors. However, interviewee B further acknowledged that if it is a big project like High Speed 2 (HS2) then members of the public would be key

stakeholders as well, as permission would be required from some of them to access their lands to do site investigation.

Table 2: Entities perceived as their stakeholders by the interviewees' organisations

Interviewee	Stakeholders
Interviewee A	Designer, client (infrastructure), all office colleagues
Interviewee B	Client (infrastructure), supply chain, employees, sub-contractors, public
Interviewee C	Asset managers, contractors, local councils
Interviewee D	Owner, teams that are creating 3D models
Interviewee E	Architects, structural engineers, MEP engineers, supply chain, sub-contractors, internal team, client, client's representative, technical advisor, end users

The Role BIM Plays in Stakeholder Management

Common goals and problem solving

BIM models hold the potential to assist in solving problems between different construction stakeholders. This is due to the inherent property of the BIM models which allows data to be added, modified and then to be verified against real life scenarios. This unique property of BIM models assists in reducing disputes among different project stakeholders (Rokooei, 2015).

This was noted by one of the interviewees on a motorway construction project where one of the stakeholders objected to the construction of a gantry because of the fear of glare from the gantry into their window during night. This stakeholder approached the project team and raised the concern. The project team then put the exact location of the house, fence and gantry into the BIM model and showed them that if the fence of their house was 3 metres high then light would not glare into their window. The organisation presented the result to the concerned stakeholder in a visual way by using the BIM model and this convinced the stakeholder. According to interviewee A:

The stakeholder was satisfied with the result otherwise we have to stop the construction of that gantry because that stakeholder didn't want it.

There are other ways as well in which this issue could have been demonstrated to this concerned stakeholder e.g. by using simple maths or theodolite. However, BIM provided a ready basis through visual representation which was comprehensible to the stakeholder and it addresses stakeholder's concern.

Pre-planning

BIM helps in pre-planning the activities to be carried out in much advance and provides opportunity to stakeholders for providing feedback. The project team then can work on this feedback to implement required changes (if demanded by stakeholders). This makes stakeholders to feel that their concerns are being addressed by the project team and eventually helps in setting common goals (in favour of a project) among all stakeholders. For example, interviewee A illustrated traffic management signs on a BIM model (on a highway project in the UK) to client, police and other stakeholders eight months in advance to get their feedback. According to interviewee A:

We showed to police and client and lots of other stakeholders and got feedback from them and we will change it before that.....and get the same thoughts and things.

Interviewee B also noted that BIM assists in pre-planning activities. If the stakeholders are not agreed then the plan can be changed digitally. Interviewee B stated,

adjust things digitally so that when we turn up on site, all we do is implement the plan.

Clarifying intentions

Emmit and Gorse (2003) argued that in the construction industry when one party fails to convey its intentions to another party, it engenders dispute between both the parties.

This was noted by interviewee B that BIM helps in clarifying intentions about the project programme to the construction stakeholders. If intentions are made explicit among all the stakeholders then they will all know what is needed to be done. It often happens that not all stakeholders understand the intentions of project teams equally. So the time when a task is required to be executed, some stakeholders may perceive things differently. According to interviewee B:

It [BIM] increases I think their confidence that they understand our intentions and sometimes they don't agree with our intentions and that's absolutely fine....at least if everybody understands our intentions even if half of them wouldn't agree with it and then they can say alright lets discuss what your plans are and we can come to an agreement.

Collaboration

Liu *et al.*, (2017) investigated how BIM made project stakeholders to meet frequently which resulted in generating higher trustworthy environment and strengthening their relationships.

This was echoed by interviewee E who explained that their organisation organised BIM workshops where all the design teams could collaborate with each other. It helps in taking much better informed decisions because everybody is working together. No one is working in silos and no one can hide anything. Accordingly;

...rather than doing things individually we bring everyone together. So everyone in the room can collaborate. It's a much better way of working. (Interviewee E)

Communication

Communication is highly important for the execution of complex projects performed by teams. This is extremely pertinent to the construction industry where stakeholders need to exchange information in order to execute projects successfully (Dubas and Paslawski, 2017). Communication helps stakeholders to establish trust and foster empathy among themselves (Emmitt and Gorse, 2003). Digital tools such as BIM can assist in improving communication with construction stakeholders (Dubas and Paslawski, 2017) in many different ways. Three common themes (common language for communication; facilitates communication with non-technical stakeholders; effective communication of complex ideas) related to communication emerged from the interviews are discussed below.

Common language for communication

According to interviewee D there is a huge potential of miscommunication on construction projects due to disconnected data sources. Moreover, project stakeholders come together for one project and then their teams are disbanded. This factor further contributes to miscommunication. The objects in BIM models can retain the data attached to them. This property of BIM helps to avoid miscommunication among stakeholders by providing a common language for communication.

...for us to say that you know there is an object that certainly can take data and have a path right the way through from a section to right the way through the in life you know facility. That's a very valuable thing. So what role does it play in stakeholder management? It integrates and it helps to improve the communication between people. (Interviewee D)

Facilitates communication with non-technical stakeholders

BIM improves communication with stakeholders who cannot understand 2D drawings. The reason for this is that 3D models are easy to understand than 2D drawings. In 2D drawings, a person has to analyse the drawing first and then to visualise what a structure would look like in 3D. Moreover, different stakeholders may visualise them in different ways. This may create confusion among various stakeholders and could have detrimental impacts on the project (Fazli *et al.*, 2014).

It is helping in communication by showing them the models is better than just standing in front of them and talking and saying we are going to do this and that. But if you show them the model like we have done with the traffic management signs, they can actually visually see it as you are explaining to them. So it's better communication for them because they can visualise what you are talking about. (Interviewee A)

Interviewee C had similar perception that 3D models can play a key role in explaining what a project is about to the public or stakeholders with less technical knowledge.

Interviewee E had a similar perception that BIM models make stakeholders understand what is going to be built. This interviewee E gave an example of one of their project where stakeholders came to the room straight away, picked 2D drawings from the boards and said they hate these drawings because they could not visualise from these.

Effective communication of complex ideas

Clash detection in BIM enables early risk identification and communication (Zou *et al.*, 2017). Interviewee B noted on one of their projects that digital tools can assist immensely to communicate complex ideas to stakeholders. While carrying out one of the geotechnical projects, an owner of the existing asset under the ground approached interviewee B's organisation with a concern that they may damage their asset. Interviewee B's organisation performed clash detection in a BIM model and presented the real results to the owner of that asset.

...what we need to do is to give them confidence that we are not gonna damage their asset, and to give them a cup of tea and say don't worry it will be fine, doesn't cut it. Whereas we show them a 3D model and say let's start, here is your asset and here's an inclusion zone we are putting around it and here's where we have designed the ground anchors to go and here is the zone of tolerance around where they could end up and that still doesn't clash with your exclusion zone - are you happy with that..? and they go well that's better. (Interviewee B)

Visual scoping of work

Interviewee D's organisation has developed a software which assists in developing the scope of work in a visual way. It assists in assigning roles to the stakeholders relative to the time when those roles are required to be performed. It further assists in managing the information requirements at all the project stages, the level of information required, assigning responsibilities to manage that information, updating progress, among others. As all this happens in a visual way, it helps all stakeholders to understand their (and others') responsibilities in a very engaging way and monitoring the progress. Stakeholders can visually see who is required to do what and take mutual decisions. This can help in assisting stakeholders who are lagging behind in their roles. So it promotes collaborative ways of working.

Challenges with BIM and Scope of the Paper

The implementation of BIM on projects has some challenges. For example, training the supply chain on its use, unwillingness to learn new things and unwillingness to adapt digital ways of working are some of the hindrances against the adoption of BIM. However, the current paper is not focused on the challenges but on the role BIM can play in enhancing stakeholder management.

DISCUSSION

The interviewees perceived stakeholders on BIM projects as those who are generally involved in the process. These were usually internal stakeholders (table 2).

Stakeholder engagement is a key aspect in managing stakeholders. It can help in resolving conflicts effectively among stakeholders and setting common goals among them (Singh *et al.*, 2017). BIM provides the opportunity to engage concerned stakeholders by using visual means. This promotes trust and acceptability of project results by stakeholders and aligning their goals. Pre-planning activities provides opportunities to stakeholders for providing feedback. When stakeholders' feedback is incorporated into the project, it enhances their trust in it. This eventually helps in aligning their goals with those of the project. Moreover, when there is a mutually agreed plan, then there is a common goal for all the stakeholders to achieve. Clarifying intentions in advance enables the avoidance of conflicts later on in projects. Conveying intentions to stakeholders and then liaising with them if they are not agreed is a part of stakeholder engagement. This facilitates mutually agreed decisions which engenders trust among stakeholders, and gives rise to common goals.

According to Yong and Mustaffa (2013) communication should not be focused only on tasks or words, it should rather be focused on fostering relationships among stakeholders. Effective communication is a critical tool to maintain existing relationships (Chinyio and Akintoye, 2008; Khafaji *et al.*, 2010). BIM helps in fostering communication among stakeholders whether they possess technical background or not. By providing a common language for communication, it eradicates the probability of miscommunication which may leads to issues at a later stage. By facilitating communication with non-technical stakeholders, it allows them to understand the project in a better way. This enables stakeholders to resolve any confusion digitally rather than doing so on-site. When things are uncertain (especially when the projects are of geotechnical nature), BIM can assist immensely to resolve issues and communicate the results by using visual means to the stakeholders concerned. This helps in engendering trust among stakeholders by mitigating their concerns.

Conclusion, Limitations and Outstanding Research

Setting common goals with the stakeholders is the key to managing them effectively. If stakeholders have different goals then these must be aligned with the project's goals. Stakeholder engagement is the key to setting common goals with them. This is due to the reason that it allows stakeholders to provide feedback to the project activities. Furthermore, it also assists in making them to speak out their concerns related to the project. Their concerns can then be tackled and feedback provided by them can be worked on to set common goals between the project and its stakeholders. This makes stakeholders feel satisfied and their trust is generated in the project.

Communication plays a key role in engaging stakeholders with the project. BIM has a huge potential to facilitate communication among different stakeholders by various means, for example, it facilitates in making communication more visual. Furthermore, BIM fosters collaboration among stakeholders as well. Both these factors assist in facilitating and fostering stakeholder engagement.

In summary, BIM has a huge potential to manage stakeholders effectively on construction projects. Even the roles that are not directly/indirectly related to BIM can benefit from increased and better communication and collaboration.

Communication, collaboration, stakeholder engagement, trust, common goals, technology and people are at the core of managing stakeholders within BIM projects.

This paper is based only on five interviews and the interviewees' do not reflect the entire spectrum of stakeholders. The research interviews are currently on-going and it is hoped that a diverse range of industry professionals will be interviewed. Therefore, the current conclusions are temporary and might change with further data collection.

This paper has presented the findings from the first five interviews related to the role BIM can play in stakeholder management. These findings are treated as preliminary findings. This research is also looking into other aspects which are outside the scope of the current paper e.g. the challenges which organisations face while managing stakeholders on BIM projects and the techniques used to manage stakeholders on BIM projects.

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