BIM'S IMPACT ON THE PROJECT MANAGER

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Building Information Modelling (BIM) has been drawing increasing attention since the announcement by the UK government in 2010 that BIM will become compulsory for all major centrally procured government construction projects by 2016. Not only is BIM an innovative design tool, it may fundamentally change the way how a construction project will be procured, constructed, managed and maintained. This paper examines the new challenges faced by project managers who play a central role in a construction project and the inevitable adaptations needed to work in a BIM environment. Based on an extensive literature review, semi-structured interviews were conducted with project managers who have had BIM project experience. This research found that although it has indeed started to impact on the construction industry as a whole and on the projects themselves, BIM's impact on the project manager and the project performance is actually far less substantial than expected. BIM is still at a relatively early stage of development in the UK and even though it represents a new way of undertaking a project, it is not necessarily changing the way a project is currently managed. In addition, BIM is advancing very fast and yet few companies have directly and fully supported the project managers and none was found to have updated the governance and/or project management process. Furthermore, many of the project managers simply are underprepared and not exploiting BIM to anywhere near its full potential, which is leading to missed opportunities. It is recommended that the industry needs to learn to embrace the full potential of BIM across all project team members. The resistance to change should be identified and managed more effectively to achieve a successful BIM implementation.

Keywords: BIM, project manager, adaptation, change.

BIM AND THE PROJECT MANAGER

The UK construction industry is facing increasing pressure with regards to Building Information Modelling (BIM) following the announcement in September 2010 by Paul Morrell, chief construction advisor for the UK government, that by 2016 all major centrally procured government construction projects must use Level 2 BIM (Rawlinson, 2013). This government strategy is regarded as a key catalyst to the momentum towards BIM (Davidson, 2013) because the UK government currently procures around 30% of the overall construction industry output and thus represents a substantial client to construction industry (HM Government, 2013). Many UK construction firms are already finding that both public and private sector clients are seeking to use BIM well in advance of 2016 due to the amount of benefits that it can bring to a project. As a result, the pace of adoption is increasing substantially throughout the industry (Malone, 2013).

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Xiao, H and Noble, T (2014) BIM's impact on the project manager *In:* Raiden, A B and Aboagye-Nimo, E (Eds) *Procs 30th Annual ARCOM Conference,* 1-3 September 2014, Portsmouth, UK, Association of Researchers in Construction Management, 693-702.

BIM has been in existence for far longer than people realise. The first notion of virtual buildings came about in the 1970's (Eastman and Teicholz, 2011) and it really came to the forefront of thinking when the term 'Building Information Modelling' was used in a paper by Van Nederveen and Tolman in 1992. Moving the development further was a white paper aptly titled *"Building Information Modelling"* by Autodesk in 2003 (who also introduced the acronym *"BIM"*). However, to define BIM is problematic as no single agreed definition of BIM seems to exist. Some authors tend to look mainly at the technological elements of 3D modelling (Smith and Tardiff, 2008; Lewis, 2012), whereas others appear to concentrate mainly on the organisational transformation and integrated project delivery (Eastman and Teicholz, 2011; FM and Beyond, 2011; O'Grady, 2013). Regardless of this, what BIM requires is that all project team members can access and work on a single collaborative design from a single centralised information pool. Therefore, BIM is far more than a simple transition to 3D modelling (offered by the likes of Autodesk Revit and Bentley Structural) but represents a change to the way projects are undertaken and managed as the fundamental issues of the business process and workflows have also changed (Smith and Tardiff, 2008). BIM is a socio-technical system which requires centralised commitment from the companies involved along with substantial organisational changes. It is as much about people and the processes as it is about technological elements (Harty *et al*., 2010; Martin, 2012). Therefore, BIM will have a profound impact on participants involved in a construction project.

Literature (Construction Executive, 2013; Mott McDonald, 2013; RICS 2013) is conclusive in agreeing that BIM can bring multiple benefits to project management, as summarised in Table 1 below. But BIM does come with some reported disadvantages, the most prominent of which are the initial software outlay costs, software interoperability, the level of training required and legal issues surrounding design liability (Hardin, 2009; Olatunji, 2011; Jenkins, 2013).

Table 1 Potential Benefits of BIM to Project Management

Potential BIM Benefits to Project Management	Rationale
Project programme and budget control	A BIM model can instantly update both the programme and budget when modifications are made to the design.
Design team collaboration	A BIM model can enable the impact of changes to be fully analysed and thus the scope can be monitored to enable the PM to liaise easily with the design team and clients.
Subcontractor control	Increased knowledge on clash detection changes, information requests etc. results in sub-contractor work becoming more predictable.
Request for Information (RFI) and change orders	The increased certainty brought about by BIM should result in a marked reduction in the number of changes and RFI's.
Progress monitoring	By utilising BIM, the PM has more tools available to understand and report on progress.
Client understanding	The client can understand a virtual model far easier than a 2D drawing, thus increasing understanding and satisfaction about the end product.

Project closure	BIM captures O&M information which can be used throughout the life of the building. This also saves significantly on administration costs as well as on-going management.
Mandatory BIM and growth	As clients increasingly request BIM, the PM firm can become skilled and grow faster than competitors.

The Project Manager (PM) is a key player because he/she is ultimately responsible for the successful delivery of a project through managing a multitude of factors such as cost, time, quality, sustainability and safety in a project's lifecycle from initiation to completion (PMI, 2013). Meredith *et al* (1995) identified five key skill areas which a PM needs to have: ability to communicate, team building, leadership, coping and technology. Katz (1991) advocated just three key skills areas: personal relationships, conceptualisation skills and technology skills. However, more importantly, the PM needs to be able to adapt and has a high degree of versatility (Oz and Sosik, 2000) as he/she has to work on different projects in differing environments with different resources (Keller, 2001). And BIM is the latest change a PM is facing.

There are some researches on how BIM may change the project team and their roles in a construction project. For example, because BIM can hold a vast amount of information such as specification properties, resource, programme activities, quantities and costs, it may take only 30 minutes now under BIM for a QS to measure a building rather than the normal two days in the traditional way (Rendall, 2011). But this automation is no substitute for using a Quantity Surveyor (QS) with experience, especially when it comes to looking at the interpretation, details and omissions. As a result, the QS will certainly have to adapt accordingly to a more consultancy role (Hamil, 2012). Another possible change is the introduction of a BIM manager to provide professional support to a project, apply the standards and advise on technology and overall coordination (Howard and Bjork, 2008). The traits a BIM Manager must have resemble those a PM must also have, such as knowledge of the industry, project interface, stakeholder empathy, communication and leadership (CICRP, 2009; Reinhardt and Lanzetti, 2011). A BIM Manager should also develop plans which ensure the project deliverables are met with the right project team members in place and provide ongoing guidance especially in the decision making process (Kymmell, 2008). These are all activities which are similar to the traditional PM role and thus the PM could take on. However this role is arguably more suited to those who currently undertake a CAD Manager role due to the level of technical and engineering knowledge and the PM being required to oversee the project rather than manage the BIM process (Hamil, 2012; Jenkins, 2013).

But there is very little research from a PM perspective and on how a PM's role may change in a BIM environment so far. One could argue that the output is still the same as well as the core job role and BIM is no more onerous for the PM to adapt to as working under a different contract, or perhaps working in a different country, but this is far from certain. Therefore, this paper aims to investigate the impact of BIM on PM and how the PM profession can adapt to this change at both the organisational and individual level. Based on a semi-structured interview with practicing PM who have had BIM project experience, this paper will present a snap shot of the current situation of BIM implementation in PM. Conclusions and recommendations on how PM can effectively adapt to BIM will be made through critical analysis and discussion.

RESEARCH DESIGN

This research took a qualitative approach because BIM is still a relatively new practice in the UK construction industry and it would be very difficult to secure a large number of PMs with BIM project experience for a quantitative research. A semi-structured interview has been chosen because with a basic template, it can not only ensure consistency and ease of analysis, but also allow deviance to explore new lines of questioning so that the complexity and subtlety involved can be fully explored and generate rich and in-depth data.

In total, seven interviews were carried out in the summer 2013 with practitioners from five different consultancy companies in the West Midlands, UK, of which five were PMs and two were Regional or Associate Directors (see Table 2 below). Each participant had managed between 1-3 BIM projects at the time of the interview, and each interview lasted between 30-50 minutes. All the interviews were recorded to ensure the interviewees had all the attention and were not distracted by the note taking. This also allows for playback later to create transcripts to ensure nothing has been missed. A copy of the transcript was offered to each interviewee for proof reading to ensure points are captured accurately. The interview questions started with their roles and practice in managing their projects, and then moved to how BIM brought changes (if any) to their daily job, and how they and their organisation adapted these changes.

Table 2 Interviewee details

Interviewee 1	Assistant Project Manager	3 years in the industry
Interviewee 2	Project Manager	10 years in the industry
Interviewee 3	Project Manager	5 years in the industry
Interviewee 4	Project Manager	15 years in the industry
Interviewee 5	Senior Project Manager	15 years in the industry
Interviewee 6	Associate Director	40 years in the industry
Interviewee 7	Regional Director	25 years in the industry

RESULTS

In this section, the key results from the interviews are summarised and presented.

Does BIM actually bring a change?

Compared to the traditional projects, the interviewees did feel some benefits from BIM. For example, the 3D model can detect design clashes, and the client and stakeholders find BIM very useful in order to visualise the end product, as Interviewee 3 stated:

> *"The model is fantastic, it really is. It creates buzz and the clients love it".*

Interviewee 2 particularly praised the ability of BIM in handover as he detailed example of where in a previous project they had shelves of Operation and Maintenance (O&M) manuals, whereas now it is all built in, so the quality of this element has certainly been improved. Interviewee 1 gave an example of the efficiencies of BIM on QS's that a bill of quantities would take only 4 hours with BIM instead of the previous 4 weeks.

However, all the interviewees found very little real changes in a BIM project from a PM perspective, as explained by Interviewee 4:

"(BIM) may have changed a project but not the way you manage things."

In terms of project specific issues, such as requests for information and change control, many people stated that they hadn't noticed any difference. As for the project performance in cost, time and quality, not a single interviewee stated that it directly improved any of these elements. On the contrary, Interviewee 1 found that BIM was actually a disadvantage as the lack of collaborative working meant version control was lost which made it (time and quality performance) worse. He gave an example where items were drawn in 2D AutoCAD first and then were passed to the others to put into BIM, effectively doubling up the workload. This is because everyone still worked separately, as pointed out by Interviewee 3:

"BIM in theory should be about everyone getting together but I didn't find it to be the case. The engineers and designers still worked in isolation".

Although all the interviewees agreed communication is a primary role of PM, no one said that communication changed for the better or worse as a result of using BIM, indirectly or directly. Interview 3 stated:

"In theory I guess communication should improve as everyone talks to everyone. But in reality this didn't really change much."

But they do expect a wider impact once BIM is fully developed / established.

How can PM adapt BIM?

Most of the interviewees stated that their respective firms have a centralised BIM strategy and often a working or steering group, but generally this failed to resonate at a project level. They expressed concerns and dissatisfaction with the company support they have received, which is highlighted in Interviewee 1's comments:

"the organisation hasn't supported me so I need to learn as I go".

This was concurred by Interviewee 3:

"…apart from getting a lot of information about BIM, (the company guidelines) didn't help me figure out how to approach and manage a BIM job".

Interviewee 6 felt that BIM needed to be *"introduced sooner"* in order to have time to adapt.

Most interviewees realised the importance of experience and knowing all about BIM. Interviewee 5 said he would encourage his PM team to go to webinars, speak to peers and engage with the steering group. Interviewee 6 also believed that investment in people's abilities is needed now otherwise you will be left behind. Interviewee 7 was similar in the people element, which is unsurprising considering the seniority, but really felt passionate as

"no one in the business was ready or trained for it….thus needs to be trained how to manage it in conjunction with our governance".

Another issue raised in the interview is that the corporate management system. It defines the parameters in which project managers can operate, and it must be adhered to, or risk professional misconduct. It is also used to audit the project performance. But this corporate management system has not been updated to incorporate the BIM element.

As for the resistance to change, they reported a generation gap because it seems that the younger generation pick it up easily and go with it fast, while the older generation have a general fear of new technology and the risk of being replaced by machines.

How can the industry adapt BIM?

There was an agreement that the construction industry is slow in adopting change, as reflected in Interviewee 2's comments:

"The industry has always been slow to change unless it has been imposed on it".

Everyone was also in agreement that BIM was good for the industry overall, if not necessarily unified agreement that it benefited at a project level at the moment. Many of them are very enthusiastic about BIM, as stated by Interviewee 4:

"I absolutely love BIM, I love technology and I can see it's the way forward".

However, as Interviewee 5 contrasted:

"No one in the team really drove it. I think the architect should have done but they didn't really. It's hard when people work for different companies of course!"

The 2016 deadline was mentioned by many, and they thought this target helped to focus people's mind, and this mandatory change can bring benefits to the industry as a whole. There is also a sense of urgency among the practitioners, as demonstrated in Interviewee 6's comments:

"In terms of the wider industry, well, BIM is coming in 2016 whether they like it or not."

Some interviewees cited examples where the enthusiasm of clients drove BIM forward but none stated that the engineering/design team did. It is clear that the thought of integrated project delivery (IPD) being a key driver to make things happen is not being realised. The general feeling was everyone knew BIM is coming and is a huge issue, but none could actually give any evidence that any form of industry shift was occurring on the ground.

DISCUSSION

Previous researchers such as O'Grady (2013) state that project level change is essential to implementing BIM, yet no interviewee in this research noticed any significant project performance improvement (in cost, time and quality) or how a project was managed. Construction project management has well-structured and widely accepted practices which BIM cannot feasibly change significantly in a short period of time. Therefore, an alignment between the BIM tools and the existing project management practices and corporate business models is needed in order to achieve project performance improvement (Hartmann *et al*., 2012; Davies and Harty, 2013). Harty *et al*. (2010) and WSP (2013) also contend that sociological changes are required in order to introduce innovations in practice, and this was in fact confirmed by some interviewees but not to the extent expected. This is probably due to the novelty of BIM and the lack of experience, because all the interviewees had only used BIM for the first time in the past 12-18 months, and thus there was an overall sense of finding their feet with regards to projects. It is thus not surprising that the maximum potential of BIM has yet to be extracted. Another explanation could be down to how easily BIM fit into the project or it could be simply that BIM does not help at all. In either instance, it again contradicts the findings from the literature study which

suggested that a drop off would be found (Construction Executive, 2013; RICS 2013; Mott McDonald, 2013). It is recommended to initially implement just certain elements of BIM, ideally those which bring about short-term benefits and have fewer barriers to implement. This staged approach can encourage practitioners to adopt BIM methods as the initial change required is minimal versus the reward (Jacobsson and Linderoth, 2010).

BIM and IPD should be totally interlinked and the communication within the project team can be improved (Korte, 2008; Eaton, 2011; Smith and Tardiff, 2011) but no one could present evidence of a notable shift in this phase of a project. Whether this is as a result of inexperience of the interviewees or a general fact of BIM is hard to judge. But one hypothesis is that consultants usually work under separate contracts and almost always in separate offices. Research shows that while BIM makes visible the connections among project members, it does not foster closer collaboration across different companies (Dossick and Neff, 2010). The physical separation of a project team whose members may come from different departments of a company or from different companies is undoubtedly an issue. And even though the end model may be a collaborative design, the process of getting there is not. For the project management, this does not particularly cause any change as the same issues will still arise no matter what. Undoubtedly, the PM will still have to chase for updates and for deadlines in the same way they do now, and the only real difference will be the deliverables. The introduction of a BIM Manager/Coordinator into the project management team may be a way forward in order to centralise the BIM support.

The results show that although practitioners have generally realised the importance of BIM and the need for training, it seems that the advent of BIM has been faster than the ability of companies to adapt their corporate governance by incorporating BIM into their corporate management system. Many companies are yet to be convinced of the additional cost and the actual benefits of adopting BIM (Li *et al*., 2009; Barlish and Sullivan, 2012) so they are still at the preliminary stage and only manage to provide some basic facts of what BIM is, not the more practical guidance on how to use BIM to actually manage a project. They have not had a well-thought strategy in place to manage the changes, and it is up to the individuals to invest time and effort in learning and educating themselves about BIM. Jung and Gibson (1999) point out that companies need to have a corporate strategy and management system in place. Without a comprehensive support at the company level, it is questionable how a PM can fully adapt to BIM. No surprise there exists resistance because many felt that BIM has been forced upon people who are simply not ready for it.

This is quite worrying because this shows the industry is far from ready to fully embrace BIM and the changes from it. Preparation is crucial in successful BIM implementation, and the social and organisational contexts need to be taken into consideration when adopting BIM (Taylor, 2007). Any failure to address these from the outset can lead to failure. It is anticipated that with the progress of BIM, practitioners will request more practical guidance and training, and both organisations and individuals have to up their game to truly embrace BIM. On the other hand, PMs have to be flexible and able to adapt as they have to manage different projects under different circumstance such as different forms of contract and different resource restraints, thus BIM can be said to simply be an extension of that need to be flexible as part of the job.

CONCLUSIONS

It has been widely believed that BIM is a change for the construction industry and is here to stay indefinitely. This research did identify some benefits from BIM such as design clash detection, visualisation of the final product and ease for O&M manuals, but did not find any noticeable changes in either the PM practice (e.g. change control) or project performance in terms of cost, time and quality. The impact of BIM is much lower on the day to day project management profession than expected. This could be due to the novelty of BIM and absence of established data and knowledge, and BIM is still yet to be used to its full potential. This may improve when BIM becomes more widely available.

This research also highlighted the lack of preparation for BIM, a large part of which comes down to the lack of organisational support. The corporate governance of many companies has found not to have been updated to incorporate BIM to support the PM drive the project through within the parameters of the company quality systems. Internal training needs to be expanded so that it directly reaches those who will manage a BIM project before the rush to commence a project without adequate preparation.

The construction industry is renowned to be slow to change. It is not surprising that the idea of IPD is not yet manifesting itself at a project level as people are simply not engaged enough and also not exploiting BIM to its full potential. But BIM's arrival is imminent due to the UK government's 2016 target. Whether liking it or not, the industry needs to wake up to BIM and fully embrace it. An improvement in collaboration and integration between the project team members is urgently needed where the PM should be instrumental in driving this.

Due to the relatively small size of the samples from a limited geographical area, this research does not necessarily present a representative picture of BIM in project management profession in the UK construction industry. Instead, it presents a snap shot of the reality at the project and company level, and identifies the problems and barriers faced by PM practitioners when implementing BIM, which can help PMs and other construction practitioners more effectively use BIM to improve their project management practice and project performance.

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