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Preliminary Investigation Of The Residential Housing Contractors' View Of The Adoption Of BIM Technology

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Abstract

The construction industry increasingly embraces Building Information Models (BIM) in an attempt to enhance work practices and overcome difficulties inherent in complex construction projects. However, widespread use of BIM in small projects, specifically in the residential housing sector, is rarely evident. In an attempt to address BIM's lack of uptake amongst residential housing contractors, a study was initiated to better understand their information/technology needs and the site planning process requirements. The premise is that a construction- orientated BIM tailored to the specific needs of those residential housing contractors can offer better value and possibly contribute to the uptake of BIM technology in that sector. In the current phase of this study, pilot interviews were conducted with housing construction professionals in Victoria, Australia, to investigate some of the existing site and resource management procedures as well as the technology context. The paper reports on selected findings of these pilot interviews particularly the technology support and potential use of BIM in housing projects. The preliminary findings suggest that the technologies actually being used for construction management are quite simple with main focus on managing administrative functions such as procurement rather than undertaking a sophisticated onsite planning process. Furthermore, while the interviewees seem to be positive towards the adoption of new technologies such as BIM, they had concerns about the lack of understanding of BIM technology and the uncertainty about its impact on changing the existing work practices.

1 Introduction

The recent proliferation of Building Information Models (BIM) technology is purported to address the complexity incorporated with the delivery of construction projects. The construction industry has increasingly adopted BIM in recent years in an effort to enhance work practices and redress the adversity in construction projects. However, the adoption is not widespread across all industry

stakeholders (Ghaffarianhoseini et al., 2016). A good example is the relatively small contractors, e.g. those working in the residential housing sector, which did not necessarily follow suit (Georgy et al., 2016). Indeed, it is more likely for projects of higher dollar value to involve the use of BIM (Alabdulqader et al. 2013). The need for additional resources to adopt an advanced full-fledged BIM, for instance, has impeded the utilisation of BIM by smaller size contractors (Lui et al., 2015; Gerrard et al., 2010). Furthermore, while final outcome may be rewarding, the transition to more innovative BIM-centred process was not undemanding for the few small contactors that attempted to utilize such technology (Poirier et al., 2015).

The authors argue that a less architecture-focused and more construction-orientated BIM, i.e. one that better captures construction- related information, will offer more benefits to contractors including ones in the residential housing sector. Such construction-orientated BIM can help facilitate resource planning and the management of on-site operations. Hence, a study was initiated to better understand the residential housing contractors' information/technology needs and the site planning process requirements. An earlier stage of this research concerned a desktop research of the salient literature to understand the essence of on-site resource planning and type of information/knowledge required in housing construction. Outcome of the literature review was reported elsewhere (Georgy et al., 2016). Building on the first stage, the current on-going stage involves interviewing housing construction professionals in Victoria, Australia, to investigate some of the existing site and resource management procedures as well as the technology context. This paper reports on selected findings of the pilot interviews conducted to date, particularly the findings that concern the technology support and potential use of BIM in housing construction projects. A long term goal of the research, and subsequent to interviewing industry professionals, is to develop BIM testbed/s that can be used to examine the construction- orientated BIM concept.

The paper is structured as follows: first, a review of relevant studies is presented followed by a brief description of the qualitative research methodology pursued. A summary of the research participants is then provided. Afterwards, the preliminary findings of the study are presented and discussed. Ties with relevant literature are established. Finally, the paper ends with concluding remarks.

2 Background And Selected Literature

The Architecture, Engineering and Construction (AEC) industry constantly seeks for new methods to enhance quality, productivity, and efficiency, by eliminating waste and reducing construction costs (Alabdulqader et al., 2013). However, the intrinsic characteristics of the AEC industry, e.g. the diverse nature of required knowledge, the uniqueness of products and services, etc., inhibit the sector to compete with the other industries in taking on innovative technologies (Nicolini, 2002). Development of BIM as a revolutionary building design and construction technology is simply a response to this need by enabling the transformational changes throughout every phase of the project delivery lifecycle such as design, construction, and operation (Osan et al., 2012).

In fact, information and information-orientated technologies have been the centrepiece of many developments in the AEC industry in the past two decades. Sriprasert and Dawood (2002) evaluated the impact of adopting web-based information systems on the project stakeholders and suggested that the use of such systems enhances collaboration among project members by supporting communication, reforming the information flows in the supply chain and sharing information and documents. Peansupap and Walker (2005) supported this point of view and asserted that effective communication as a result of information technology utilisation enhances construction processes at different stages of the project. They argued that construction organisations increasingly perceive the potential benefits of information and communication technologies (ICT) and thus are more motivated

to adopt and invest in these technologies. Furthermore, properly managed and integrated technologies such as BIM can provide a platform to support informed decisions in different business operations within the AEC projects (Aram et al., 2013).

Despite the opportunities a technology such as BIM offer to the construction industry, it can create a number of challenges for organisations wanting to adequately implement it across their mainstream practices. According to Aranda-Mena et al. (2009) these challenges are resulted due to the lack of globally agreed definition of BIM and understanding of its inherent attributes and characteristics. While BIM for some is an integrated technology to facilitate the design process and documentation, for others it is a new concept for managing projects by embedding new policies and principles amongst stakeholders (Aranda- Mena et al., 2009).

Peansupap and Walker (2006) also analysed the challenges in implementing ICT in construction organisations and suggested that efforts should be made at all personal, organisational and group levels to enable successful diffusion of a new technology. In the context of BIM, as a critical ICT, absence of appropriate contract structures supporting the BIM implementation, ambiguous risk allocation mechanism, unclear team responsibilities and interoperating issues between project participants are identified as major barriers to widespread use of BIM within the industry (Ghassemi and Becerik-Gerber, 2011). Another challenge reported by Suermann (2009) pertains to the need for a new set of skills and expertise in addition to the technical levels required for the conventional project setups. Subsequently, the effective deployment of BIM requires additional resources with specific essential skills and knowledge. Moreover, organisations need to make necessary adjustments in their organisational structure, strategies and process in order to earn the full benefits of a new technology (Weston, 2001).

Despite a wealth of literature regarding the benefits and challenges of BIM implementation, most of the BIM potential benefits are demonstrated on pilot projects; and practical experience to advance with BIM is lacking (Davies and Harty, 2012, Hooper and Ekholm, 2015).

3 Research Method

This phase of research employs a qualitative approach as advocated for the study of complex phenomena and when the objective of research is to develop new techniques and processes based on understanding and describing the phenomena from the participants' position (Flick, 2009; Creswell, 2013).

The choice of techniques for collecting data is highly influenced by the strategy adopted for conducting the research. For the "piloting" stage, which the paper reports on, the data, was collected through in-depth semi-structured interviews with four practitioners/experts who have been involved in residential housing projects and play significant –but different– roles in the project process. These experts were thus viewed to have the potential to provide high quality data with deep insight from different angles into the research problem being explored. Table 1 provides a summary of the interview participants at the pilot stage. Interviews helped to document individual attitudes, feelings, beliefs, experiences and reactions. With semi-structured interviews, the authors were able to probe/ask detailed questions about the interviewees' views, and not adhere only to the interview guide. In addition, the semi- structured format allowed explaining and/or rephrasing the questions if interviewees were unclear about them.

Potential suitable residential builders were selected and invitational emails were sent directly to the participants or to the company's office seeking their availability and consent. Each interview took approximately 60 minutes. Interview was audio-recorded and then transcribed. This produced approximately 60 transcription pages in the text format. All interview texts were loaded to the

latest version of qualitative data analysis toolkits, QSR, NVivo 10 to organise and assist with the analysis of content from these 4 interviews.

Participant's Reference Number	Role/Position in Builder Organisation	Role Responsibilities and Duties	Industry/Construction Experience
P1	Building Manager	Tracking jobs, coordinating site and trades supervisors client management, quality control and new products management	2 years as contract administrator, 6 years as site supervisor
P2	Business Operations Manager	Front end sales management, logistic coordination, project team management, building permits and administration	Over 15 years as the business operations manager
P3	Director	Business and construction management, purchasing and pricing management, suppliers management	9 years as construction and building manager, 17 years as the company founder and director
P4	Construction Manager	Managing engineering	5 years contractor administrator, 13 years construction manager

Table 1: Pilot Stage Interviews – Participants' Summary

4 Preliminary Research Findings

4.1 Mixed attitude of the industry

Preliminary findings from the analysis of the pilot stage interviews indicate that residential builders have a mixed attitude towards the use of BIM or other new technologies in construction planning and management. While some are looking forward to seeing ways to embrace the new technologies as potential tools to add value to construction planning, others have concerns over the implementation of such technologies due to the uncertainty associated with the required changes to the status quo.

Commented on this, P3 stated that "we are always open to new ideas and always sit down with possible ways but what I'm passionate about the [team] always doing their role because I think you can only do your role as good as you are not as good as the computer is. So [about the use of BIM] I should say I would have to see it. I could not really make a comment until I physically sat down and looked at it and have seen how it would interact with each person".

4.2 Concerns over transition and security of information

One of the main concerns on the use of BIM pertains to its impact on changing the current practice in transferring information from current tools and the risk of loss of some information during this

information exchange. P4 contended "…transporting all the information from the current software that we have into the new one [is] always the hardest thing. I think that's the big thing especially for a company of our size where there is so much volume involved in there if all that information and all the codes need to be manually typed into this program. But more importantly, in building we have information for so long that we've got to guarantee our houses for years and we cannot afford losing any of them by using any new software".

Another builders' concern is the lack of comfort and confidence in the security of BIM with regard to the sensitive information it may capture and the accessibility of different stakeholders in the supply chain to such information. P2 emphasised that "…my first thoughts as a builder particularly on a larger scale, is that you want to make sure you're responsible for what you need to be responsible for. I just imagine a supplier or subcontractor tampering with our database and that just makes me nervous".

4.3 Need for simplicity and

Interestingly, the majority of the interviewed residential builders use a rather simple/basic set of software tools, mostly dependent on Microsoft Office products, for their construction management related activities. Moreover, the main focus of using these tools is to manage the administrative functions, e.g. procurement and vendor management, rather than undertaking a sophisticated onsite planning process. Yet, it is to be noted that the software they use is likely suited to the way they build and how they customised their products.

P1 states that "…the software we are using is an application on Microsoft Excel. If you were doing a lot standard design homes then a program like that would be great because it's repetitive. I think our current software is great when things are repetitive. I think sometimes when you have things that are changing for every job; the software [we are using] can be maybe making things harder than it needs to be".

Although the builders indicate that they are satisfied with the current software in use, they acknowledge the need for more integrated toolkit, such as BIM, to incorporate various activities throughout the project lifecycle. However, they show reluctance to adopt advanced software due to what they perceive as the rigidity and inflexibility of these tools.

P2 asserted that "If [the software] is too structured it can nearly be its downfall so I believe it should be a bit looser and you can play with it a bit. That's probably the one benefit that we have with our [basic] program is that there's some really good structure to it but it's not all regimented that you have to do it and then if you don't do it, it allows us to play a little bit".

4.4 Required extra cost and efforts

Finally, the extra cost, resources and skill sets required for the use of a new technology, i.e. BIM platform, are other barriers to utilising the inscribed capabilities of BIM within builders. Particularly, since BIM is realised as a new technology with no or little real life evidence of additional benefits or value to companies in the residential housing domain, the industry is yet to be confident to culturally and financially invests on its widely implementation.

P4 emphasised this issue and indicated that "…my genuine opinion about benefits of the BIM, in a nutshell, is that there is a need to keep it real so when you keep it real you're working like real situations and you can make decisions based on real information and not things that might happen it's more about what is happening".

5 Discussion And Parallels To Past Research

Several researchers have developed specific BIM-centred approaches for improving site planning and construction management. For example, Moon et al. (2013) developed a BIM-based construction scheduling method; Choi et al. (2014) demonstrated the use of BIM in construction workspace planning, while Zhang et al. (2015) proposed to leverage BIM data for job hazard analysis on construction sites. Due to BIM being "expensive to operate and maintain" (Alabdulqader et al., 2013), it cannot be expected that smaller size contractors widely embrace this technology. Interviewees have indicated that the use of technology in their respective organisations is limited to simple tools, e.g. Microsoft Products, which they can tailor and customise to their needs and specific building practices. However they also perceive that further benefits might be attained if other more advanced technologies e.g. BIM are properly used. This view coincides with the general conclusion of the study by Peansupap and Walker (2005) regarding the adoption of new technologies in construction organisations.

It is argued that the benefits of BIM are abundant (Gerrard et al., 2015). Through literature review and case study research, Barlish and Sullivan (2012) identified benefits such as duration improvement, reduction in engineering and construction costs, etc. In their work, Barlish and Sullivan (2012) compared two groups of construction organisations, with one group adopting BIM approaches while the other adopting non-BIM approaches and showed that BIM adoption made a difference in the tracked performance metrics. Interviewees of the herein study raised a relevant point that some real life evidence in the residential housing sector should be demonstrated before they attempt it in construction and resource planning. Comparable research in the housing sector to that of Barlish and Sullivan (2012) can contribute to such goal.

Indeed, there are barriers to adopting advanced BIM technology within small construction organisations. Interviewees cited, for instance, the skill sets needed to embrace such an advanced technology. Apparently, acquiring the right skill sets will mean additional resources which they are reluctant to pay for without prior evidence of downstream return on investment (ROI). Hosseini et al. (2016) and Rodgers et al. (2016) examined construction SMEs in Australia and confirmed that a lack of knowledge within these SMEs and across the entire construction supply chain is not the actual barrier to BIM uptake but rather the risks associated with an uncertain return on investment (ROI) for BIM as perceived by the key players in these SMEs. In addition to the aforementioned, the herein study revealed the interviewed practitioners' general awareness of some of the IT-related challenges of migrating to BIM-orientated approaches, including system compatibility, data transfer and exchange, security and access authorisation, application adaptability and customisability, and others. Yaakob et al. (2016) informed that the success of BIM uptake depends on a variety of critical success factors (CSF) including ones that relate to technology e.g. interoperability, safety/security, and user interface.

By the end, one cannot say that the interviewees were against the adoption of BIM technology for site planning and construction management in housing construction projects. However, they did not seem to be ready to be first adopters. They preferred to have a proven record that they can follow since this move will entail investment in resources and equipment.

6 Concluding Remarks

This paper has reported on the preliminary findings of the pilot stage of a study, which aims at investigating the existing site and resource management procedures as well as the technology context within selected residential housing builders in Victoria, Australia. As discussed, the literature has informed that the level of BIM uptake is not necessarily the same across the entire spectrum of the

construction industry and that smaller size contractors/builders are less likely to be among the typical adopters. Therefore, it was critical to understand the builders' attitude and perceptions towards the implementation of BIM as a construction planning and management tool.

The preliminary findings suggest that the interviewees use simple software tools for the purpose of construction planning. These tools do not necessarily cover the more sophisticated functions of construction management e.g. safety analysis, site layout planning, crew planning and work sequencing, and so forth. Despite this and the potential of BIM, interviewees had their concerns e.g. a possible incompatibility between the software currently in use and the BIM platform might lead to a loss of invaluable information, the possible insecurity of sensitive information and the risk of access by unauthorised individuals/stakeholders, and others. But on the other hand, the interviewees still recognised the potential value added to construction planning when using new technologies such as BIM, despite still being reluctant to culturally and financially invest on BIM implementation within their organisations. This is primarily the case due to what they perceive as a lack of documented evidence to justify its cost-benefit in the housing sector.

One has to keep in mind that the findings reported in this paper represent a very small sample and is only intended as part of the pilot study in the interviewing stage. In other words, the sample cannot be considered adequate to represent the entire residential housing construction sector in Victoria, Australia. The full-on study where more industry practitioners will be interviewed may reinforce or alter some or many of the reported findings. Nonetheless, through analysing the interview content, several parallels have been identified with the more generic literature on BIM technology and its adoption in the construction industry. This included various studies addressing the enables, barriers and concerns of industry practitioners to BIM use in big as well as small organisations.

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