

Improvement Strategy for the Level of BIM Utilisation in the Australian Construction Industry

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ABSTRACT

Despite the various BIM guidelines and frameworks, the current BIM utilisation level in the Australian construction industry is low.

To identify the current perceived BIM benefits among the design and construction professionals as well as investigate essential supports for BIM utilisation level improvement, the research conducted a questionnaire survey and several semi-constructed interviews among 45 design and construction professionals. The research identified that BIM is currently perceived as a useful tool enabling design and construction professionals to perform their tasks productively. While BIM is recognised as useful, there are concerns related to data security and access management and interoperability. Discipline-specific BIM guideline and standard and BIM Training are identified as crucial supports to improve BIM utilisation level in the design and construction industry. This research disclosed the importance of the BIM utilisation level improvement across the supply chain of a construction project. The findings will provide fundamental explanations of the way to improve BIM utilisation level in the Australian construction industry.

Keywords: Australian Construction Industry, AEC Industry, BIM, BIM Benefit, BIM Utilisation

INTRODUCTION

The construction industry contributes approximately 8.1% of Australia Gross Domestic Product (GDP) and generates approximately \$360 billion nationally (Australian Industry and Skills Committee, 2020). Australian Construction projects are trending towards increasing complexity, driving the influence of new techniques which are pursued to increase amenities and reduce the carbon footprint of construction. In an attempt for stakeholders to seek out competitive advantages, the adoption of smart technology such as Building Information Modelling (BIM) can help to increase

the level of control and reduce the economic risk of complex projects (Kim et al., 2016; Azzouz & Hill 2017). Currently, BIM is recognised as a major steppingstone within the built environment, identified as a platform predicted to revolutionise customary building techniques, helping to improve its productivity, cost, time and quality benefits (Azzouz & Hill 2017). BIM can be defined as an Information management system to integrate and manage various construction information throughout the entire construction project and product life cycles based on a 3D parametric design to facilitate effective communication among project stakeholders to achieve a project goal (Kim, 2015).

The Australasian Building Information Modelling (BIM) Advisory Board (2018) states that such an effort to support the adoption of BIM within the built environment could reflect financial benefits of up to 10%, translating to 36 million dollars in potential savings annually. Yet, the Australian construction industry indicates a relatively low BIM adoption rate compared to other countries such as the US, UK and South Korea (Kim et al., 2016). Furthermore, the recent research revealed that there are inconsistent adoption rates within the AEC on a national basis due to the complexities of the implementation, high associated costs and different perceived understanding (Drogemuller et al., 2017). Hence, the research aims to investigate an effective way to improve the BIM utilisation level and provide fundamental explanations of the way to improve BIM utilisation level in the Australian construction industry.

GLOBAL TREND OF BIM GUIDELINE

Government support and industry leadership is a fundamental factor and relates directly to the success of BIM adoption within the construction industry including small-medium enterprises. Globally, BIM implementation has been supported by the

governments, and further mandated for its use in the public sector in various countries such as the US, UK, South Korea and Singapore. For example, the US released the National 3D-4D BIM program supporting BIM use throughout all its public building sector lines from 2003 (Brewer et al., 2012).

Similarly, the Department of Business, Innovation & Skills in the UK released a strategic plan 'Government Construction Strategy' mandating the use of BIM on all public construction projects from 2016 (Cabinet Office, 2011). Currently, national guidelines and standards as well as mandatory use of BIM are recognised as an essential requirement to adopt and utilise BIM for productivity improvement (Poljansek, 2017; Edirisinghe and London, 2015). In addition, Smith (2014) revealed the correlation between national BIM guideline implementation strategies and BIM utilisation levels. The US, UK and Scandinavian countries indicated relatively higher BIM utilisation levels among other countries since the countries mandate BIM use for construction projects. Based on the finding, it is evident that the appropriate government's drive toward BIM adoption and implementation is instrumental to improve BIM utilisation level within the AEC industries.

BIM GUIDELINES AND AUSTRALIAN CONSTRUCTION INDUSTRY

The Australian Construction Industry Forum (ACIF) and the Australian Procurement and Construction Council (APCC) released a BIM framework for project team integration (ACIF, 2014). This proposed framework was developed specifically for the construction industry, focusing on improving BIM usage and maturity levels. Lee et al. (2015) asserted that the best way for the AEC industries to increase the current low BIM uptake and improve BIM utilisation

level is to provide more BIM education and training opportunities for the design and construction professionals as well as students who study design and construction-related subjects. Consequently, the ACIF and APCC also released the BIM Knowledge and Skills Framework for BIM education (ACIF, 2017) to provide a step-by-step guide for BIM education, which is comprised of three steps – a) Technical Level; b) Managerial Level; c) Strategic Level.

Recently, the Australasian BIM Advisory Board released the Australasian BIM Strategic Framework (2020) to improve the productivity of the construction industry in terms of BIM model collaboration and coordination. Each framework and guideline emphasise the importance of BIM maturity level in the construction industry. The ability to achieve and maintain a standardised level of BIM maturity is key for the AEC disciplines providing opportunities to capitalise on proclaimed BIM benefits such as supporting as-built designs on a global scale, allowing modular components to be manufactured off-site with increased levels of accuracy, and streamlining the construction process (Mostafa et al., 2020). Organisations with lower levels of BIM maturity have been shown to struggle to achieve the efficiencies that similar organisations achieve with higher levels of BIM maturity (Smits et al., 2017). To identify the BIM maturity level, researchers and professional bodies introduced several BIM maturity level measuring models such as BIM Maturity Matrix (Succar, 2010), ARUP ProjectOVE (ARUP, 2012), buildingSMART BIM Maturity Assessment (buildingSMART Australasia, 2015).

However, the maturity models measure the BIM efficiency and effectiveness based on an assumption that organisations already fully understand the capabilities of BIM as well as can use BIM (Jayasena and Weddikkara 2013). Poljansek (2017) pointed out that it can cause operating issues in BIM to further develop BIM utilisation strategy based on measured BIM maturity since the level

of measured BIM maturity level is not capable of indicating the current level of BIM capability for each discipline and roles such as design, construction, construction project management. Thus, the research aims to reveal the current BIM utilisation level in the construction industry, and to suggest an effective way to improve the current BIM utilisation level.

RESEARCH METHOD

This research adopted a web-based questionnaire survey and a semi-structured interview to identify the current BIM utilisation level in the different roles in the construction industry. A total number of 45 design and construction professionals responded to the questionnaire survey. The participants were identified through professional bodies such as the Australian Institute of Building, Chartered Institute of Building, and Online Professional Special Interest Group such as PMI Special Interest Group and LinkedIn to obtain various BIM utilisation status depending on respondents' roles such as architect, engineer, construction manager, and contractor. The questions were categorised into three main groups: a) Participants demographic profile; b) BIM utilisation status for each role; c) Recommendation for BIM utilisation improvement. The questions were structured based on the literature review and comprised of multiple choices and Liker Scale to measure the experts' viewpoints. Due to the social distance restriction, interviews were conducted via phone and an online tool such as Zoom.

RESULTS AND DISCUSSION

80 construction professionals were invited for the questionnaire survey, and 45 responses have been received (56% response rate).

The average experience of the respondents was 8 years and 31% of respondents (14 respondents) have more than 10 years of experience in using BIM or getting involved in a BIM-based project. The respondents' profile is as shown in Table 1.

Table 1. Profile of respondents (Total 45 Respondents)

Role	Number of Respondents	Percentage (%)
Architect	12	27
Engineer (Civil and Mechanical)	5	11
Contractor	9	20
Construction/Project Manager	9	20
Quantity Surveyor	10	22
Total	45	100

BIM Utilisation Status

Perceived Benefit of BIM

Participants asked to indicate the perceived usefulness of BIM since it is important to understand how BIM capabilities are currently being received within the design and construction industry.

Table 2. Perceived benefit of BIM (Total 45 Respondents)

Level of Usefulness ^b	Number of Respondents	Percentage (%)
Extremely Beneficial	12	27
Beneficial/Useful	22	49
Relevant (can be improved)	11	24
Not Useful	0	0
Negative Impact	0	0
Total	45	100

As shown in Table 2, 76% of participants (34 respondents) rated BIM as being either extremely beneficial or quite useful within their line of work. Providing a high level of confidence that the Australian

construction industry identifies the benefits such technology can promote. The rest of the participants indicated that BIM is useful, but it retains the potential to be further improved. During the interviews, construction professionals addressed their concerns and needs for data security, data access management and data interoperability. Especially, interviewees commonly addressed the learning curve to utilise BIM tools since it requires a certain period for the construction professionals to assimilate the BIM environment and capabilities. The findings confirm that the awareness of BIM utilisation within the design and construction industry has been improved compared to previous studies for BIM awareness and utilisation conducted in 2016 and 2017 (Drogemuller et al., 2017; Kim et al., 2016).

BIM Workload for Daily Task

Participants asked to indicate the required daily workload using BIM-related tasks.

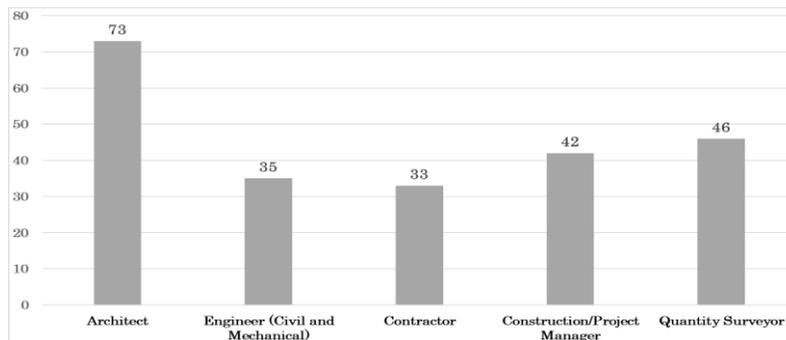


Figure 1. BIM Workload for Daily Task (X-axis: Roles, Y-axis: % of workload)

As shown in Figure 1, architects presented the highest workload for BIM usage (73%), and contractors presented the lowest level of

workload (33%). Based on the findings, it is evident that design professionals such as architect are currently using BIM more frequently compared to other professionals. Contractors addressed the BIM maturity across the construction sector is not up to the standard where BIM can be collaboratively used among contractors and sub-contractors as an information integration platform.

Contractors commonly commented that sub-contractors and specialists who are responsible for specific shop drawings and specific building components specifications do not actively adopt BIM for their works. Indeed, there is no specific BIM tool that can enable sub-contractors to develop a shop drawing. As aforementioned in the literature review, the finding supports the importance of BIM maturity level improvement for each role prior to increasing the overall BIM utilisation level of the design and construction industry. Construction and Project managers stated that the current construction project is executed separately from a managerial perspective. Project management plan and BIM execution plan are developed separately, and contractors try to consolidate the two plans in the construction stage where the opportunities to fix design error and improve project management plan are already limited. Construction and Project managers pointed out that the main reason for the current limitation is the uneven BIM adoption and utilisation level in the design and construction industry.

Recommendation for BIM Utilisation Improvement

Participants asked to rank the most essential support required to improve BIM utilisation for their role. The four most essential supports are identified from the previous research conducted by authors (Kim et al., 2016, Kim and Park, 2013), and the identified supports are a) Government Funding/Incentive for BIM Utilisation; b) Government Mandate; c) Discipline-specific BIM Guideline/

Standard; d) BIM Training Opportunity. In order to identify experts' diverse opinions, multiple selection was allowed.

As shown in Figure 2, the Discipline Specific BIM Guideline and Standard was considered as the first priority among other supports. The currently available BIM guidelines and frameworks mainly focus on the overall improvement of BIM maturity as well as general BIM project processes regardless of individual project participants' roles and responsibility.

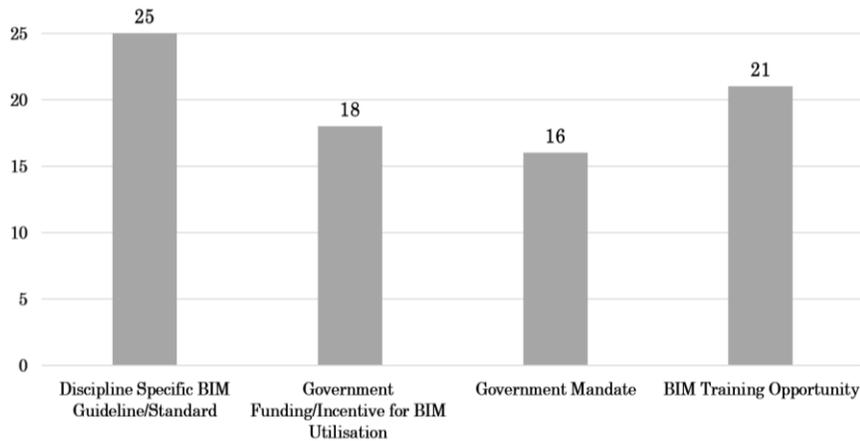


Figure 2. Recommendation for BIM Utilisation Improvement (X-axis: Recommendations, Y-axis: Number of Response)

Although the guidelines and frameworks can improve design and construction professionals' overall knowledge about a BIM project environment and process, it is still unclear how each project participant is supposed to work individually and collectively throughout a project lifecycle. In response to this gap in the construction industry, the Royal Institute of Chartered Surveyor released a series of BIM guidance for Cost Manager, Building Surveyor, and Project Manager (RICS, 2015; RICS, 2016; RICS,

2017). However, the guidance provides detailed explanations about the implications of BIM to three professionals rather than specific explanations about the BIM process and required tasks for each project stage. Consequently, most of the respondents indicated that they need more discipline-specific BIM guidelines and standards for them to communicate and coordinate effectively with other project stakeholders.

Respondents indicated more BIM Training Opportunities as the second priority. In particular, design professionals including architects and engineers pointed out that the current user interface and functions of various BIM tools limit their creativity since learning how to fully utilise BIM tools is challenging as well as the steep learning curve often discourage design professionals to create more innovative and creative designs of building and infrastructure. Subsequently, design professionals commonly stated that they search for more advanced BIM tool training as they more utilise BIM for their daily work. In addition, design professionals emphasised that training should be more discipline-oriented rather than general trainee oriented since discipline-specific knowledge and skills will enable them to remain professionally competent in the construction sector.

Interestingly, respondents indicated relatively low priorities on the government intervention – Government Incentive/Funding and Government Mandate. Indeed, there is no nationwide BIM mandate in Australia although the Queensland government will mandate BIM use for infrastructure projects from 2023. Interview participants stated that BIM adoption and utilisation is currently driven more by the clients and global trends, and they pointed out that the government mandate or incentive can support BIM adoption and utilisation, but will not significantly affect the current level of BIM maturity and utilisation. Three project managers with 10 years of experience who are currently managing BIM-based

construction project emphasised the importance of overall BIM maturity level increase across the supply chain of a project. They asserted that the current BIM adoption in the construction stage is slow due to cultural resistance. In particular, sub-contractors feel much comfortable when they work on 2D drawings rather than digitised 3D BIM model. Furthermore, most of them are small-medium enterprises, and they do not have enough flexibility to embrace the steep learning curve which can causes temporary income loss while they transform their practices to 3D BIM from 2D. Finally, all interviewees agreed that a holistic approach to BIM utilisation improvement is a key to success since all four essential supports are interrelated.

CONCLUSION

Currently, the AEC industry around the world strives for digital innovation to achieve sustainability and comparative advantage in the global construction market. Various BIM guidelines and frameworks have been introduced to the Australian construction industry. Yet, the current BIM utilisation level is low and not enough investigations have been conducted to identify the essential supports for BIM utilisation level improvement. In order to identify the current perceived BIM benefits among the design and construction professionals as well as recommendation to improve BIM utilisation level, this research conducted a questionnaire survey and several semi-constructed interviews.

The research identified that BIM is currently perceived as a useful tool enabling design and construction professionals to perform their tasks productively. While BIM is recognised as useful, there are concerns related to data security and access management and interoperability. Through the research, the Discipline-specific BIM guideline and standard and BIM Training are identified as

relatively crucial supports to improve BIM utilisation level in the design and construction industry.

This research disclosed that the current Australian AEC industry recognises BIM as a useful tool, and revealed the importance of the BIM utilisation level improvement across the supply chain of a construction project. Although this research is confined to the Australian AEC industry context, the findings will provide fundamental and essential explanations of the way to improve BIM utilisation level and maturity.

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