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Article

A REVIEW OF BIM ADOPTION AND BARRIERS TO QUANTITY SURVEYING PRACTICE IN NEW ZEALAND

Omer Altaf

OTAGO POLYTECHNIC AUCKLAND INTERNATIONAL CAMPUS

ABSTRACT

Building Information Modelling (BIM) has been adopted in the construction industry as a collaborative tool for designing, constructing, and managing building projects. The 5D BIM incorporates specification data and other properties that can be used to price construction jobs using relational and parametric models directly. The application can be used by quantity surveyors for a wide range of tasks, including quantity take-offs, cost estimation, and cost management. Despite its many benefits, the adoption of BIM has been slow in New Zealand, especially in quantity surveying practice. This review examines the current state, efforts to accelerate the adoption, and barriers to the adoption of BIM in quantity surveying practice in New Zealand. Some of the barriers to the adoption of BIM in quantity surveying practice in New Zealand include a lack of awareness and understanding of BIM, lack of BIM standards and protocols, lack of interoperability and integration among BIM software, high cost of BIM software and hardware, and the reluctance of construction industry stakeholders to adopt BIM. Overcoming these barriers is crucial for the successful adoption and implementation of BIM in quantity surveying practice in New Zealand. This review also presents recommendations for the facilitation of the cost modelling process to find solutions to these barriers between 3D and 5D BIM.

Keywords: BIM, Quantity Surveying, Construction, Estimation

INTRODUCTION

Building Information Modeling is generating and managing information about a created item. Based on an intelligent model and backed by a Cloud platform, BIM combines structured, multi-disciplinary data to generate a digital representation of an asset throughout its life cycle -from planning and design to building and operations (Autodesk, 2022). The purpose of BIM is generally to address and improve coordination and collaboration between stakeholders in the construction industry (Wood & Samarasinghe, 2020). The construction industry has become increasingly familiar with BIM technology. As a result of its more efficient and effective working practices, it has contributed to the success of many construction projects. A large part of the quantity surveyor's (QS)role in determining a construction project's costs involves the preparation of construction cost estimates. Traditionally, construction project drawings and specifications are used in measuring software, and quantities are taken off. Then, an estimating database is used to price these Schedules of Quantities (SOQs). As an alternative to traditional estimating practices, BIM significantly reduces errors and inaccuracies (Olatunji & Sher, 2010). A BIM is a representation of the different elements in a construction project combined with their associated data. Throughout the life cycle of a construction project, it serves as a reliable, shared knowledge resource (Suermann & Issa, 2010).

In a global survey conducted by National Building Specification (NBS) (2020), clients, practitioners, and professionals were surveyed, providing a holistic perspective on BIM applications worldwide and efficient adoption policies. A BIM Acceleration Committee (BAC) survey of BIM adoption in New Zealand is also conducted every year, providing information on implementation circumstances, benefits, and barriers to adoption. These surveys show that despite the growing interest in BIM around the world in both industrial and scholarly segments, New Zealand's BIM implementation is still modest. The BAC Annual Survey 2021 shows that a total of 89% of architects say they anticipate using BIM by 2024, and more than half of those who use it say they use it for more than half of their projects (BIM Acceleration Committee (BAC), 2021). Therefore, the QS needs to upskill in the same manner and adopt BIM models in quantities and estimating. Digital BIM models allow numerous people to work on the same project simultaneously and create various versions instead of having just one set of drawings, which also facilitates the production of multiple versions. Using Cloud-based technologies like Autodesk's BIM 360, BIM collaboration amongst all project disciplines may be accomplished with ease. The BIM 360 ecosystem ensures that all design stakeholders have access to the most current information by promoting collaboration and information exchange (Hall, 2018). By encouraging communication and sharing, the BIM 360 ecosystem guarantees that everyone involved in the design process has access to the latest data (Hall, 2018).

The BIM models can be used to design, construct, and manage buildings and facilities as part of an innovative, collaborative environment that offers a variety of opportunities to a wide range of disciplines within the construction industry. With its multidimensional nature, BIM, commonly referred to as nD BIM, can provide modelling in an infinite variety of dimensions, including 3D (object model), 4D (time), 5D (cost), 6D (facility management), 7D (sustainability), and even 8D (safety) (Vidalakis & Oti, 2020).

OBJECTIVES

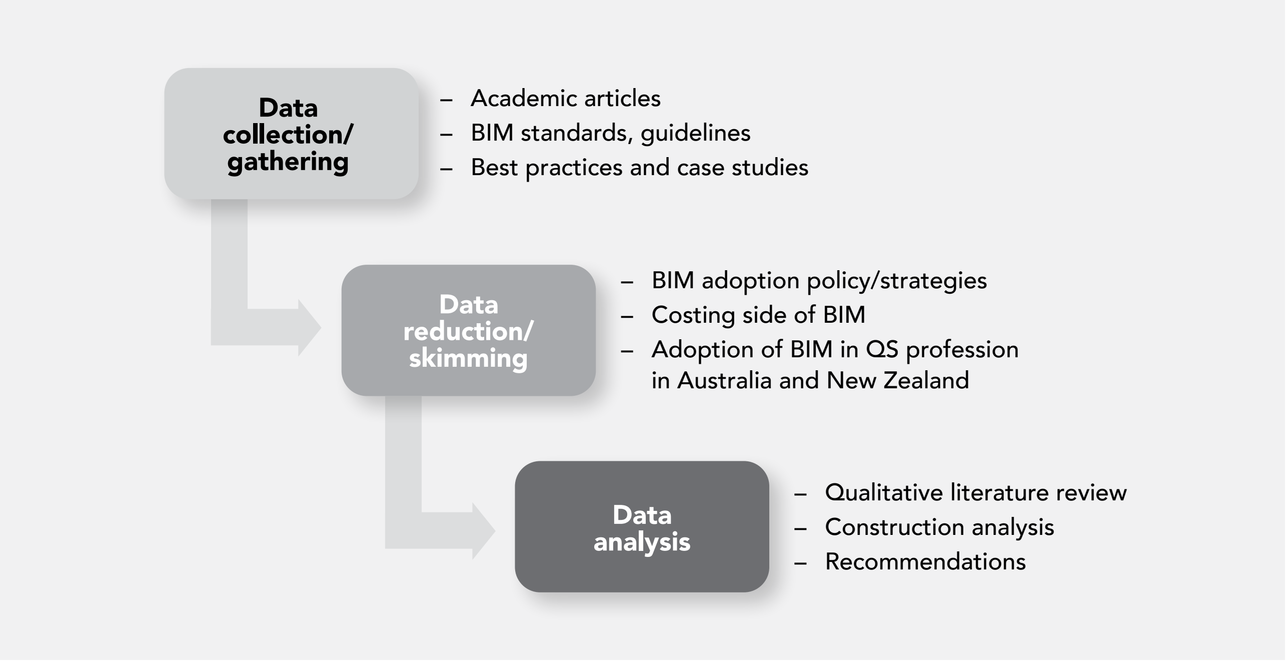
The primary objective of this review is to identify the advantages and barriers to the adoption of 5D BIM by QS in New Zealand and explore some of the strategies to overcome identified barriers.

The conclusions from this review can assist in understanding the current use of BIM in the construction industry in New Zealand, specifically by QS, insights into its adoption in addition to barriers to its implementation and some solutions to overcome these obstacles.

RESEARCH METHODOLOGY

A systematic review method was adopted to identify and analyse relevant academic articles, BIM standards, guidelines, best practices, and case studies. The subject "BIM adoption/implementation" + "BIM in QS practice" + "BIM New Zealand" was searched on Google Scholar and several academic journals, books and reports were found. The following criteria were used to filter the abstracts of articles: BIM adoption policy/strategies, the costing side of BIM, and the adoption of BIM in the QS profession in Australia and New Zealand. After scanning and downloading 12 peer-reviewed articles, they were reviewed critically, and the relevant information was extracted and clustered into relevant summary and analysis matrices. Figure 1 shows the methodology adopted for conducting this review.

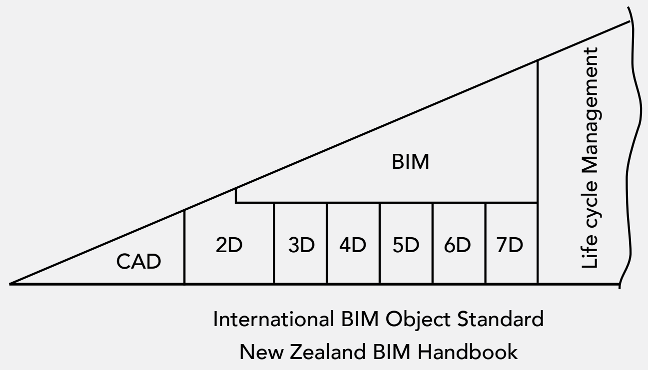
Figure 1: Methodology for conducting this review.



BIM FOR QUANTITY SURVEYORS IN NEW ZEALAND

Figure 2 shows the stages of maturity of BIM adoption in New Zealand. Progression from Computer-aided Design (CAD) drawings to basic 2D BIM, and 3D BIM models were the first stages of adoption. This was followed by the adoption of 4D BIM, which links the 3D BIM design models with the programme schedule, meaning that QS could provide comprehensive commercial advice to planners on labour and plant hire, for instance, as they would on a traditional project. But by better collaboration using BIM, they can foster a lean process that optimises resources. Whereas 5D BIM is not about quantities but about cost. A QS skill set and knowledge are utilised to perform a professional cost management role in this phase or space (Bew & Richards, 2008).

Figure 2: Stages of BIM maturity in New Zealand (Doan et al., 2021).



Harrison & Thurnell (2015) analysed how BIM is applied in quantity surveying practice, Ghaffarian et al. (2017) and Doan et al. (2021) proposed another approach to using BIM in the architectural, engineering and construction (AEC) industries as a sustainable practice. Although the adoption of BIM by QS is slow in New Zealand, the use of BIM in some recent projects has helped the construction industry to overcome many inefficiencies (BIMinNZ, 2023), including cost and time savings and collaboration throughout the organisation has increased. Overall, the quality of construction projects, cost estimates, cost plans, value management, and collaboration have improved using BIM. For example, BIMinNZ, 2023 reported the following projects that have successfully implemented BIM in New Zealand and their benefits:

– The Pukete wastewater treatment plant project proved the value of digitising and centralising asset information using BIM, despite misconceptions about its applicability to existing assets.
– In the New Zealand Defence Force (NZDF) Whenuapai gym project, standard data extraction from BIM models enabled data to be exported to platforms such as Excel quickly and easily. Documentation was tracked, and a common data environment was established with BIM, with metadata standards guiding the BIM data collection.
– Similarly, in the University of Auckland project, in order to ensure teams worked in a coordinated manner, Beca and Jasmax used BIM processes throughout the entire building design of B405 - a highly complex building with 98 research labs.

The costing side of 5D BIM is contained in the model by adding the cost data and relevant information that can be accessed by all stakeholders in the project. Compared to other countries like the United Kingdom and the United States of America, New Zealand is still in the early stages of adopting BIM in the construction industry. The New Zealand government decided not to mandate the use of BIM; however, it has supported the activities of the BAC and encouraged its adoption, especially in all government projects (Pham et al., 2020). Current quantity surveying practices in New Zealand consist of the utilisation of the software that extracts the quantities automatically and then a pricing database is used to prepare estimates (Likita et al., 2022). Working with 3D BIM models, the maturity level of BIM in New Zealand is still slow compared to the rest of the Western world. The New Zealand government's efforts to accelerate the adoption of BIM in the construction industry have resulted in better awareness, and large construction companies have started seeing the benefits. The annual BAC survey (2021) revealed a dramatic increase in project BIM implementation in New Zealand, growing from 34% in 2014 to 70% in 2021.

A one-way collaboration model is being used in New Zealand in the many large construction projects such as Shirley Boys High and Avonside Girls' High School in Christchurch, Fisher & Paykel Healthcare Building in Auckland and the New Zealand International Convention Centre in Auckland. At the concept design stage, a refined project brief and concept approval are usually the outputs following the feasibility and option studies. In this stage, only a single BIM model is shared with other project participants for collaboration, with the update of this model being done in isolation, and there is no connection to other models. Most of these projects follow a linear procurement process, but to achieve the best outcomes from BIM-based project delivery, the construction industry needs to practice integrated project delivery (IPD)R. This allows the whole project team to develop feasible design solutions and ensures that the QS is engaged early in the process. The feedback to the original BIM model author for design and coordination is in traditional formats, and there is no real collaboration between different disciplines within the BIM model (Stanley & Thurnell, 2014).

Many researchers have investigated the key perspectives towards the adoption of BIM in the New Zealand construction industry. Doan et al. (2021) undertook qualitative research to examine the existing state of BIM adoption in New Zealand by conducting 21 semi-structured interviews with 25 interviewees working in a wide range of positions. The findings revealed that construction practitioners in New Zealand did understand BIM well, especially contractors, quality specialists, QS, supply chain companies, and small businesses, and there was an inconsistent understanding of BIM among them. Most interviewees identified time savings, cost savings, collaboration, coordination, and efficiency improvements as the most significant benefits of BIM adoption. Most of the interviewees identified BIM knowledge and expertise as barriers, along with high economic investment, lack of collaboration, and legal concerns. Only one-third of interviewees believed BIM was mandatory; half said the opposite, but more interviewees agreed with Doan et al. (2021). This shows that construction industry stakeholders may have realised the benefits of BIM adoption but are not yet ready to implement it due to identified barriers. Similar research by Harrison & Thurnell (2015) highlighted that the benefits of BIM for QS are well known, but implementation is hindered by some barriers, which include legal issues, lack of standards and facilities for electronic measurements, lack of support from government and incomplete design and insufficient model object data in the BIM model. Data collected from 146 respondents to a questionnaire in New Zealand and China by Ma et al. (2023) revealed a difference in perceptions of knowledge barriers, technology barriers, internal strategies, and external strategies (legal/technology viewpoint) between New Zealand and Chinese construction industry professionals.

BENEFITS OF IMPLEMENTATION OF 5D BIM

Quantity surveying in the 5D BIM environment has additional benefits, which involves extracting data from models to construct cost estimates. The benefits of the implementation of 5D BIM in the New Zealand construction industry for QS are summarised below:

- Improvement in the process to achieve accuracy, better communication, and information related to design and specifications. Better coding results in fewer errors in the model, and that inherently increases the accuracy of the estimates. Rework is reduced by improving collaboration, coordination, and information management (Likita et al., 2022; Stanley & Thurnell, 2013).
- Through the integration of specifications and clash detection, 5D BIM improves coordination. Unlike traditional methodologies, where the QS had to scan through revised documents in order to identify changes, centralised BIM models have the capability of automatically updating changes and rapidly disseminating this information to stakeholders (Harrison & Thurnell, 2015, Ismail et al., 2016, Stanley & Thurnell, 2013).
- A method for efficiently extracting early-stage (preliminary) estimating data provides a smooth and quick workflow (Likita et al., 2022; Ma et al., 2023).
- Tendering risks in construction projects can be reduced, unforeseen construction issues minimised, project-specific construction methodologies can be developed, sequencing can be optimised, and a sense of confidence in the project can be created (Harrison & Thurnell, 2015, Ismail et al., 2016, Stanley & Thurnell, 2013).
- A better understanding of the configuration of the assets helps to reduce capital costs. The time required to maintain asset records and research the information is generally reduced on projects. The scope of contractors' proposals is better defined, resulting in narrower cost spreads because fewer unknowns are present, and variations between main contractors are reduced because of a better shared understanding of design intent and delivery (Doan et al., 2021, Harrison & Thurnell, 2015, Ismail et al., 2016, Likita et al., 2022, Ma et al., 2023, Stanley & Thurnell, 2013).
- A schedule of quantities can be prepared with a time-efficient and effective data extraction. (Likita et al., 2022, Stanley & Thurnell D, 2013).
- If there are any design changes, these can be rapidly identified and updated for estimating purposes (Doan et al., 2021, Ma et al., 2023, Stanley & Thurnell D, 2013).

BARRIERS TO THE ADOPTION OF 5D BIM

Quantity surveying in the 5D BIM environment also has barriers, such as incomplete design and insufficient model object data in the BIM model. The barriers to the implementation of 5D BIM in the New Zealand construction industry for QS are summarised below:

- Hardware and software investments, changing workstreams, and reshaping service offerings and skills composition of construction companies represent substantial capital investment costs and change management risks (Likita et al., 2022, Stanley & Thurnell D, 2013).
- Although advancements in technology have improved the 5D BIM software compatibility with existing systems software, inter-operability issues are still highlighted by the construction industry; the in-house tool needs to be compatible with BIM models for its compatibility with estimating software programmes (Doan et al., 2021, Ma et al., 2023, Stanley & Thurnell D, 2013).
- There is an incompatibility between the design embedded in the 5D BIM model and the estimating elemental format and quantity scheduling formats used by the QS (Harrison & Thurnell, 2015, Ismail et al., 2016, Stanley & Thurnell, 2013).

- Currently, there is a slow progression in the construction industry standards and there are no construction industry standards and protocols to support 5D BIM implementation. It is up to the New Zealand government and the construction industry to develop these standards in order for 5D BIM to advance in New Zealand (Likita et al., 2022).
- A lack of acceleration for 5D BIM adoption from the New Zealand government. Overall, New Zealand government initiatives have increased the adoption of 3D BIM in the construction sector, but still lacking in utilising the full benefits of costing aspects, i.e., 5D BIM. Most of the projects are still being measured and priced in a traditional way. In contrast to New Zealand, where the government has been passive in promoting 5D BIM adoption, European governments have been politically active in mandating 5D BIM for certain types and stages of projects (Travaglini et al., 2014).
- As opposed to 'Product Procurement Quantities', which are design components present in the BIM model and thus easily quantifiable, such as concrete volumes or steel masses, the 5D BIM models do not include 'Process Construction Quantities'. These quantities are based on construction processes (Ma et al., 2023).
- Changing from traditional quantity surveying methods to 5D BIM is still culturally challenging. People do not want to move from their comfort zone and are not ready to change (Doan et al., 2021, Harrison & Thurnell, 2015, Ismail et al., 2016, Likita et al., 2022, Ma et al., 2023, Stanley & Thurnell, 2013).
- A number of legal barriers related to 5D BIM adoption are also reported in different studies, such as intellectual property, liability, and contractual obligations (Doan et al., 2021, Ma et al., 2023, Stanley & Thurnell D, 2013).
- Increased cost, lack of training, and understanding of 5D BIM for stakeholders. In the early stages of a project, clients do not recognise the value of 5D BIM or have not considered it within a project brief. Therefore, it is not cost (Doan et al., 2021, Ismail et al., 2016, Likita et al., 2022, Ma et al., 2023).

STRATEGIES TO OVERCOME THE BARRIERS OF 5D BIM

Lack of understanding, expertise, and client demand can be mitigated through education and training (Alreshidi et al., 2017); BIM-related courses and topics are incorporated in all construction-related diplomas and degrees, including Bachelor of Construction (Quantity Surveying) (Pham et al., 2020). This will lead to the construction industry understanding and set in motion the adoption of 5D BIM for QS working in the construction industry. Additionally, there is a need to demonstrate the value of 5D BIM to clients in their project briefs and create general awareness among all stakeholders.

It may also be possible to improve New Zealand's 5D BIM adoption by developing an execution plan and investigating technology. As part of its efforts to revise New Zealand's standard measurement method, a technical subcommittee of the New Zealand Institute of Quantity Surveyors (NZIQS) is proposing the use of the Coordinated Building Information (CBI) classification system of the Association of Coordinated Building Information in New Zealand (NZIQS, 2023). The successful adoption of 5D BIM in New Zealand depends upon the government and the construction industry working together to develop these standards. Recently, this collaboration has contributed to the development of the New Zealand BIM Schedule and New Zealand BIM Handbook, both of which could improve things somewhat if adopted (BAC, 2019). Australia and New Zealand BIM Best Practice Guidelines were published in 2018. The Australian Institute of Quantity Surveyors (AIQS) and NZIQS developed these guidelines as a collaboration and are essential guides for QS, cost managers, and cost estimators involved with BIM projects (NZIQS, 2023). These guidelines aim to encourage the adoption of BIM by QS in Australia and New Zealand at all levels and capabilities and further enhance the value of QS in the construction industry.

It is essential to involve QS early on in BIM-enabled projects to provide cost-related alternatives and participate in the whole process. It will also help to remove errors and improve collaboration-related barriers. There is a need to discuss and develop a collaborative approach among the construction industry on how BIM costs will be covered. Also, making sure that the procurement process is integrated with BIM.

CONCLUSION

This review provided valuable insights into understanding BIM in New Zealand in the construction industry, highlighted the current barriers and made recommendations regarding 5D BIM adoption for QS. In New Zealand, the adoption of 5D BIM may not yet have matured in the construction industry, but the success of the stories from many international construction projects and a growing number of local projects demonstrate that it can reduce whole-life costs, improve safety, improve collaboration, and reduce risks in design and construction. The use of 5D BIM in New Zealand is increasing, and its adoption will affect QS in every area, and its adoption will ensure a better future for the QS, including quick and accurate estimates with less rework and better collaboration can help in clash detection early in the project.

Lack of standards in measurements using BIM models, existing tools to be compatible with BIM models and revising the standard practice are some of the identified barriers for QS in adopting the 5D BIM for estimating.

It has been identified that the most important factor in promoting the adoption of 5D BIM in the construction industry is having the early involvement of QS to provide insights on cost and better alternatives.

Collaboration between the New Zealand government and the construction industry is also crucial to developing practical 5D BIM acceleration strategies that are fit for purpose; for example, the 5D BIM acceleration group is working well in this regard. The government also needs to provide a framework to outline the 5D BIM legal processes and procedures to address ownership, sharing, copyright, intellectual property allocation, and insurance issues. Moreover, developing clear definitions of each participant's roles and responsibilities within the new way of working is required in construction companies to promote 5D BIM.

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