

Development and Challenges of BIM in the Construction Industry in China and Australia

Haotian Shi *

School of Civil Engineering, University of New South Wales, Sydney, Australia

* Corresponding Author Email: z5212614@ad.unsw.edu.au

Abstract. This article examines the application and development of Building Information Modeling (BIM) in the construction industries of China and Australia. The visual, coordination, simulation, and optimization characteristics of BIM provide a foundation for project management. In China, BIM has been widely adopted in major engineering projects, but it still faces challenges such as inactive design institutes, inconsistent data standards, and a shortage of BIM talent. BIM usage in Australia is relatively low, partially due to the lack of government enforcement. It is recommended to promote wider BIM application in various fields through training, resource support, establishing industry standards, and providing incentives. In summary, BIM technology holds significant potential for the future development of the construction industry, but overcoming various challenges is necessary to achieve its maximum benefits.

Keywords: BIM technology; Personnel training; Policy support.

1. Introduction

The construction industry is a crucial pillar supporting economic development, and the construction phase of projects represents the most time-consuming and capital-intensive stage in the entire project lifecycle. It is also a critically important aspect of cost management. However, the construction process has long suffered from inefficiencies and significant waste, leading to insufficient cost management and challenging control over construction schedules. Building Information Modeling (BIM) is a modeling method based on relevant information data for construction engineering projects. Its purpose is to simulate the real information of buildings through digital information simulation. BIM establishes an integrated process based on project information, covering various stages from design and construction to operation. This approach possesses characteristics such as visualization, coordination, simulation, and optimization. The application of BIM enables construction companies to achieve unified management, innovation, design, and drafting of information throughout the entire project process. Additionally, BIM provides features for realistic simulation and architectural visualization, facilitating better communication and ensuring that all parties involved in the project understand key information such as project duration, real-time site conditions, costs, and environmental impacts. This, in turn, provides a solid foundation for effective management and decision-making in construction projects.

This paper will first introduce the positive impact that the use of BIM can bring to the construction industry. Subsequently, it will compare the development of BIM in China and Australia, exploring the similarities and differences in BIM adoption, policy support, and industry standards between the two countries. The aim is to promote innovation and sustainable development in the construction industry.



Fig 1. Modeling example.

2. BIM development in China

2.1. Policy

China's research and application of Building Information Modeling (BIM) technology started relatively late, and over the course of nearly 20 years, it can be divided into different stages. Specifically, from 1998 to 2005, this period is referred to as the "concept introduction phase" of BIM. During this time, BIM technology gradually made its way into China and was officially introduced to the Chinese market in 2002, promoted by AUTODESK. In 2003, the Chinese government issued the "2003-2008 National Construction Industry Informatization Development Plan Outline," which explicitly emphasized the crucial role of construction informatization and outlined specific plans for its development. This laid the policy foundation for the promotion of BIM technology in China. As BIM technology gradually gained popularity, in 2007, the Shanghai region began adopting BIM design technology in some projects, further attracting attention and recognition from the national government, construction enterprises, and various related entities towards BIM technology. The period from 2011 to the present is known as the "rapid development and deep application phase." During this stage, BIM technology has been widely applied in various stages of the entire lifecycle of construction, bringing significant economic, social, and environmental benefits. Major engineering projects in China, such as the Hong Kong-Zhuhai-Macao Bridge, Xiong'an New Area construction, Beijing Urban Sub-center, Shanghai Tower, Yalong River Hydropower Station, and the Beijing-Zhangjiakou Railway, have fully embraced BIM technology in their design and construction processes.

2.2. Application

Currently, BIM technology in China is predominantly applied in large-scale architectural and structural engineering projects, complex electromechanical projects, and projects with high technical requirements for construction companies. This trend poses challenges in terms of upfront capital investment and later-stage cost management. While some owners require the application of BIM technology throughout the entire lifecycle, the use of BIM in most construction companies remains relatively limited, and there is a shortage of BIM technical talent.

At present, BIM technology is primarily widely applied in the architectural design phase. It is noteworthy that the chances of rework after civil construction are extremely low, and for construction companies, electromechanical installation is the area where rework is most likely to occur and cost control is challenging. Therefore, BIM technology has been more extensively applied in the electromechanical profession. Compared to international BIM applications, China's application of BIM technology in construction cost management is still in the early stages, focusing on model construction, clash detection, and preliminary construction simulation. This is mainly reflected in the application of drawing checks in the pre-construction phase, and the full lifecycle application potential of BIM technology has not been fully realized.

BIM technology encompasses various applications in the construction phase, including 3D coordination/pipeline integration, support for detailed design, site use planning, construction system design, construction schedule simulation, construction organization simulation, digital construction, construction quality and progress monitoring, as well as material tracking. These applications aim to achieve five main goals: firstly, to enhance the quality and efficiency of detailed designs in civil engineering, electromechanical, and other disciplines; secondly, to strengthen collaborative capabilities between project departments, creating an efficient working environment; simultaneously, to improve on-site construction efficiency, reducing material loss and waste; furthermore, to enhance the accuracy and timeliness of project business management for better cost control; finally, to improve the supervision and control capabilities of project quality and safety. The application of BIM technology not only covers multiple areas such as project site management, construction plan simulation, and construction drawing review, detailed design, schedule management, cost

management, and quality management but also brings innovation in collaborative cooperation and efficiency improvement to the field of architecture and engineering.

2.3. Challenge

Despite policy support, the development of BIM in China still faces several challenges. Firstly, design institutes in China are not fully active in BIM application, leading to a relatively low adoption rate of BIM technology. This low adoption rate manifests as difficulties in effectively integrating and connecting BIM technology during project implementation. Secondly, due to the lack of unified data standards and shared data platforms, the problem of information fragmentation is significant. This hinders the full collaborative application of BIM technology across the design, construction, operation, and maintenance phases. Currently, BIM technology is still independently applied in each phase, which is not conducive to achieving the "construction-maintenance integration" of information management in construction projects.

Another challenge in the development of BIM is the shortage of BIM talent. Effective application of BIM technology requires individuals with a combination of computer technology and civil engineering knowledge. In engineering practice, many companies lack BIM professionals and the corresponding knowledge base, limiting the application capabilities and proficiency of BIM technology. This limitation affects the accurate research and comprehensive planning of BIM technology, ultimately leading to increased project costs and delays. This issue significantly hampers the effective implementation of BIM technology.

3. BIM development in Australia

3.1. Status quo

With the rapid growth of Australia's population, the number of infrastructure projects in the country has increased significantly. However, the adoption rate of Building Information Modeling (BIM) as a tool to enhance engineering construction efficiency is currently not high in Australia. Illankoon [1] conducted a survey that compiled the literature on BIM publications worldwide, revealing that the United States has the highest research output on BIM, followed by China. There is a considerable gap in the quantity of literature on BIM between Australia and these two leading countries.

According to Smith [2], the primary reason for this situation is that, although the Australian government recommends the use of BIM in infrastructure projects and has issued guidelines related to BIM, it has not implemented policies compelling construction companies to use BIM. As a result, research on BIM in Australia remains mostly in the theoretical stage. Due to a lack of specific practical studies on BIM, there are significant limitations for companies when using BIM. For instance, Suprun [3] highlighted a shortage of research on BIM in the water industry, preventing companies from constructing BIM models on their own. Additionally, existing BIM models are often deemed too expensive, and the utilization of BIM does not necessarily lead to cost savings for companies.

3.2. Application

Similar to China, BIM in Australia is primarily applied in construction, with limited application in other areas such as engineering cost estimation. Aibinu [4] noted that cost consulting firms are generally not actively adopting BIM features. Reasons for this include uncertainties about the completeness of three-dimensional (3D) models released by designers, incomplete information, insufficient understanding of new business processes to drive BIM usage, lack of client demand, the cost of BIM features, and the time required for learning. Typically, these firms use computer-aided take-offs from two-dimensional (2D) drawings for early-stage tasks in projects, such as cost planning and quantity surveying. Most cost consultants have limited experience in using 3D models for

automated quantity extraction. Only a small number of firms have incorporated BIM features into their contract management responsibilities.

In many BIM-based projects, cost consultants do not receive the 3D BIM models developed by designers; instead, they receive 2D drawings for quantity extraction and cost estimation. This is because, before using 3D models for automated quantity extraction, cost consultants need to spend more time verifying the accuracy of the 3D model and sorting and breaking down quantities. Therefore, they have a certain degree of uncertainty about the time-saving benefits of BIM. Additionally, due to a lack of trust in the completeness of 3D models, cost consultants are more inclined to use 2D drawings for manual take-offs on the screen while utilizing 3D models for visualization. Moreover, in the absence of standardized building construction classifications and codes, cost consultants have little incentive to transition to five-dimensional (5D) BIM estimation.

3.3. Suggestion

There are various methods to enhance the adoption of BIM in other areas of engineering construction, taking cost consulting as an example. First and foremost, providing training and education for consultants is a crucial step to ensure they have a thorough understanding of the core concepts and application methods of BIM. This will help eliminate uncertainties when using BIM and elevate their skill levels. Secondly, providing support and resources is equally important. Cost consultants require appropriate technical support, software tools, and model libraries, among other resources, to facilitate easier application of BIM in projects. This will assist in overcoming potential technical barriers when using BIM. Additionally, establishing industry standards is a key initiative to promote the application of BIM in cost consulting. Developing specifications and standards, including standards for the classification and coding of building construction operations, will help cost consultants use BIM more conveniently for estimation and budgeting tasks. Finally, to encourage cost consultants to use BIM features, various incentive measures, such as reward and recognition systems, as well as providing projects and opportunities related to BIM usage, can be offered. This will help them recognize the benefits and value of using BIM, thereby boosting their motivation.

In conclusion, by implementing training and education, providing support, establishing standards, and offering incentives, the willingness and ability of cost consultants to use BIM features can be increased.

4. Conclusion

This article delves into the application and development of Building Information Modeling (BIM) technology in the construction industries of China and Australia. Firstly, the article underscores the core features of BIM technology, including visualization, coordination, simulation, and optimization, which provide a solid foundation for construction project management and decision-making. Our research indicates that BIM technology holds enormous potential in the field of architecture, with the capacity to enhance efficiency, quality, and sustainability.

In China, BIM has made significant progress at various developmental stages, evident in government policy support and successful applications in major engineering projects. However, challenges persist, such as the inactivity of design institutes, inconsistent data standards, and a shortage of BIM talent, limiting the full-scale adoption of BIM technology. To address these issues, China needs to further encourage design institutes to actively embrace BIM technology, establish unified data standards, and provide more BIM training and education.

In Australia, despite government recommendations for BIM, its usage is not mandatory, resulting in a relatively low adoption rate. Australia faces similar challenges, including a lack of sufficient BIM research literature to support practical applications and constraints faced by construction companies using BIM. To promote a broader application of BIM in Australia, it is suggested to enhance professional training, provide more support and resources, establish industry standards, and offer incentive measures.

In conclusion, BIM technology holds immense potential for the future development of the construction industry. However, realizing this potential requires collaborative efforts from the government, construction companies, educational institutions, and professionals. Successful BIM implementation will contribute to improving the efficiency, quality, and sustainability of construction projects, propelling the industry toward greater innovation and sustainability. BIM is not just a technology; it represents a transformative way of thinking and managing projects in the construction industry, shaping the entire industry's future development.

Reference

- [1] Illankoon, I.M.C.S., Tam, V.W.Y., Le, K.N. and Fernando, W.C.K. (2021). Building Information Modelling (BIM) for Infrastructure Projects: The Case of Australia. Proceedings of the 24th International Symposium on Advancement of Construction Management and Real Estate, pp.1127–1135. doi:https://doi.org/10.1007/978-981-15-8892-1_79.
- [2] Smith, Peter. “BIM Implementation – Global Strategies.” *Procedia Engineering*, vol. 85, 2014, pp. 482–492, <https://doi.org/10.1016/j.proeng.2014.10.575>.
- [3] Suprun, Emiliya, et al. “Digitisation of Existing Water Facilities: A Framework for Realising the Value of Scan-To-BIM.” *Sustainability*, vol. 14, no. 10, 18 May 2022, p. 6142, <https://doi.org/10.3390/su14106142>. Accessed 12 Sept. 2022.
- [4] Aibinu, Ajibade, and Sudha Venkatesh. “Status of BIM Adoption and the BIM Experience of Cost Consultants in Australia.” *Journal of Professional Issues in Engineering Education and Practice*, vol. 140, no. 3, July 2014, p. 04013021, [https://doi.org/10.1061/\(asce\)ei.1943-5541.0000193](https://doi.org/10.1061/(asce)ei.1943-5541.0000193).