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The Application Barriers and Development Prospects of Building Information Technology (BIM) in China's Construction Industry

Meng Zichen, Salman Riazi Mehdi Riazi

School of Housing, Building and Planning, Universiti Sains Malaysia, 11800 USM, Pulau Pinang, Malaysia

Corresponding Author Email: salman.riazi@usm.my

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Abstract

Building Information Modelling (BIM) as an advanced digital technology in construction has significantly revolutionized and improved various aspects of project management. The potential of BIM to improve construction project management, engineering efficiency, reduce costs, and enhance the quality of construction projects has been widely recognized however, its application in China's construction industry has progressed relatively slow. Within the specific framework of China's construction industry, the adoption of BIM encounters unique obstacles, which constitute the central issue that this research aims to tackle. This paper reports a progress to date of a Ph.D. research aimed at improving BIM adoption in China's construction industry. Both quantitative and qualitative data collection methods will be used to achieve research objectives. Analysis will cover on the impact of technological, legislative, educational, and cultural factors on BIM adoption and further exploration will also be made on innovative policies and practices to promote the widespread application and effective utilization of BIM in China. The research findings are expected to offer crucial insights on overcoming obstacles and improving BIM adoptions in China. Furthermore, findings could contribute to the current academic knowledge by offering a context-specific examination of BIM in China, a subject that has been minimally explored.

Keywords: Barriers, Building Information Modeling (BIM), China, Construction Industry, Development Prospects.

Introduction

Building Information Modeling (BIM), an advanced digital technology, has revolutionized architectural design, construction, and management procedures (Migilinskas et al., 2013). However, its implementation in China's fast-developing construction sector encounters distinctive obstacles. The introduction focuses on the study context, emphasizing the dynamic construction industry in China and the growing global dependence on BIM technology (Zou et al., 2017).

Considering this background, the issue statement focuses on the obstacles impeding the wider implementation of BIM in China (Zhou et al., 2019). These constraints encompass technological, legislative, pedagogical, and cultural aspects that deviate substantially from Western models, where BIM has achieved higher levels of integration (Liu et al., 2017). The study explores the deficiencies in existing literature, namely the lack of thorough research that explicitly examines China's distinct market conditions, regulatory structure, and the technological preparedness of its building industry. This research contains a certain importance by showcasing its ability to provide valuable insights into customized approaches for integrating BIM in China. This encompasses evaluating the preparedness of industry participants, advocating for legislative changes, and recommending educational programs to foster BIM proficiency. The project seeks to address the knowledge gap on the optimal use of BIM technology in China's construction sector. This will not only contribute to academic discussions but also provide practical answers for industry professionals.

The implementation and efficient use of BIM (Building Information Modeling) technologies signify significant progress in the global building sector (Khudhair et al., 2021). Nevertheless, within the specific framework of China's construction industry, the adoption of BIM encounters unique obstacles, which constitute the central issue that this research aims to tackle (Wu et al., 2021). Although the advantages of BIM in increasing efficiency, decreasing expenses, and raising the quality of construction projects are well recognized, its adoption in China has needed to be more robust and significantly faster in comparison to Western nations. This discrepancy gives rise to crucial inquiries on the precise obstacles impeding the broader use of BIM in the Chinese construction sector. Although there is a wealth of research on the adoption of BIM in many parts of the world, more detailed studies are needed, especially examining its application in China. An in-depth examination is necessary to comprehend the barriers to BIM adoption in China due to distinct elements such as legislative frameworks, technology preparedness, and cultural and educational components of the construction sector.

This study analyzes the obstacles to the application of BIM technology in China's construction industry, explores the implementation pathways for adopting BIM technology in the industry, and offers a specific outlook on the impact of BIM technology adoption on the future development of China's construction industry. The main aim of this research is to identify and analyze these obstacles thoroughly. The objective is to investigate the legislative, technological, educational, and cultural factors that impact the use of BIM technology in China. Furthermore, the study aims not only to identify and describe these difficulties but also to suggest effective tactics for surmounting them and to predict the future growth potential of BIM in the Chinese construction industry. The study seeks to fill the information gap on BIM implementation in China and provide insights for developing specific policies and practices that might promote the widespread acceptance and efficient use of BIM in this important industry.

The motivation behind this research stems from the recognition of the significant potential of Building Information Modeling (BIM) technology to revolutionize the construction industry. Despite its proven benefits based upon various research conducted globally, BIM adoption in China's construction industry has been notably slow. This discrepancy raises critical questions about the specific barriers that hinder the widespread implementation of BIM in China. These barriers may include technological, legislative, educational, and cultural challenges unique to the Chinese context. Understanding these obstacles are crucial towards developing tailored strategies that can facilitate the effective integration of BIM in China. The study aims to fill

the existing knowledge gap by providing a context-specific examination of these barriers and proposing innovative solutions to overcome them.

Literature Review

Global Perspective on BIM Adoption in China's Construction Industry

The widespread implementation of Building Information Modeling (BIM) technology in the construction sector has been extensively debated in academic circles, highlighting a significant change in architectural, engineering, and building methods. Influential research conducted by Cui et al (2021) emphasizes the transformative impact of BIM on project management and design procedures in Europe and North America. The report attributes enhancements in project efficiency and cost-effectiveness to the utilization of this technology. Similarly, Sinoh et al (2020) highlight the significance of BIM in promoting cooperative work cultures, resulting in improved communication and fewer errors in extensive projects. In contrast to these achievements, Olatunji and Akanmu (2021) highlight the comparatively sluggish rate of BIM implementation in poor nations, attributing it to infrastructural difficulties and a shortage of knowledge as the main barriers. Research conducted by Yang et al (2021) in the Asia-Pacific region demonstrates a steady rise in the use of BIM. This growth is primarily influenced by government efforts and advancements in technology. Nevertheless, the adoption of this technology varies, with nations such as Japan and Singapore taking the forefront while others are still in the early phases of implementation (Kaneta et al., 2016).

These studies demonstrate the varied worldwide landscape of BIM implementation, characterized by progress in certain areas and significant scope for expansion in others. Gaining a global perspective is essential for comprehending the diverse tactics and issues encountered in different socio-economic and technical settings. This viewpoint serves as a thorough foundation for analyzing the function of BIM in the construction sector on a global scale. China's construction sector has experienced significant growth in recent years, with the widespread adoption of BIM technology in major building projects (Ding et al., 2015). Nevertheless, the use of BIM technology in China's building sector remains constrained. In 2019, a survey done by the Ministry of Housing and Urban-Rural Development revealed that a mere 25% of Chinese construction businesses have implemented BIM technology (Tan et al., 2019). The poll further revealed that most organizations using BIM technology are large-scale construction firms, whilst small and medium-sized enterprises (SMEs) are falling behind. The sluggish uptake of BIM technology in China's building sector might be attributed to many factors. The absence of standardized BIM technology protocols and regulations in China has impeded its extensive implementation. Furthermore, the exorbitant expenses associated with BIM software and hardware equipment provide a substantial obstacle for small and medium-sized enterprises (SMEs) (Zhang et al., 2014). Additionally, the need for more proficient staff and the inadequate level of education and training in BIM technology pose substantial hindrances to the use of BIM technology in China's construction sector. In addition, the conventional construction management approach and the limited level of digitization in the construction sector are further hindrances to the extensive use of BIM technology (Jiang et al., 2015).

Barriers to BIM Adoption in China

Building Information Modeling (BIM) has garnered considerable attention as a potent tool for enhancing building project management and augmenting efficiency worldwide. Nevertheless,

the implementation of BIM in China has encountered several obstacles despite its potential advantages.

A vital obstacle noted in the literature is the need for more knowledge and comprehension of BIM among industry experts and stakeholders in China (Zhou et al., 2019). The broad adoption of BIM is hindered by the inadequate understanding that many practitioners have regarding its ideas and capabilities. This lack of consciousness frequently results in doubt and opposition regarding using BIM in building projects (Wu et al., 2021). More investment in BIM technology and infrastructure is needed. Companies, such as tiny and medium-sized firms (SMEs), need help in implementing BIM due to the significant expenses related to hardware, software, and training (Ma et al., 2023). Limited financial resources and the impression of BIM as a costly investment impede its adoption and restrict organizations from fully harnessing its potential advantages (Tan et al., 2019).

Moreover, the fragmented structure of the building sector in China poses a substantial obstacle to the widespread use of BIM. The absence of standardized procedures, data compatibility, and cooperation among project parties poses challenges in efficiently implementing BIM. The lack of a cohesive strategy for using BIM further complicates the process of adopting it and restricts its potential influence on project results (Wu et al., 2021). Furthermore, the need for more proficient experts with BIM proficiency is an additional substantial obstacle. Proficiency in BIM technologies and techniques is essential for the effective deployment of BIM. Presently, China needs more professionals equipped with BIM expertise (Wu et al., 2021). The need for more skilled professionals proficient in running BIM software and properly implementing BIM processes is a significant obstacle to its broader acceptance. Regulatory and legislative obstacles further exacerbate the sluggish implementation of BIM in China. The lack of explicit norms and laws about BIM adoption generates ambiguity among stakeholders in the sector (Li et al., 2019). The incorporation of BIM into mainstream construction processes needs to be improved by adequate government backing, the absence of standardized standards, and uneven enforcement of BIM-related policies (Zhang et al., 2020).

Finally, cultural, and organizational obstacles substantially hinder the adoption of BIM in China (Zhao et al., 2018). The conventional hierarchical frameworks and entrenched opposition to change inside organizations can hinder the effective adoption of BIM. The cultural resistance to adopting new technology and collaborative working methods presents obstacles to the extensive use of BIM in the Chinese construction sector.

Development Prospects of BIM in China

Building Information Modeling (BIM) has garnered considerable recognition as a potent digital instrument for enhancing building project management and augmenting efficiency worldwide. The use of BIM in China has been seeing significant growth, with a multitude of studies examining its potential for expansion.

Li & Yang (2017) indicate that BIM is seeing a growing trend in China's building sector. Several construction firms are allocating resources to use BIM technology and infrastructure in order to enhance their project management and cooperation. The Chinese government has acknowledged the potential advantages of BIM and has enacted laws to encourage its adoption in construction projects. The extensive implementation of BIM is projected to persist, especially in significant infrastructure projects. Furthermore, Chen and Tang (2019) indicate that BIM is revolutionizing conventional building methodologies in China. BIM facilitates enhanced project planning, design, and construction through the facilitation of

real-time collaboration and data exchange among project participants. The implementation of BIM has resulted in substantial enhancements in project quality, cost management, and schedule coordination. BIM is also enabling the incorporation of sustainable design techniques in construction projects, a crucial aspect in China's expanding green building industry. Furthermore, a noteworthy discovery is the progress made in establishing BIM-related standards and protocols in China. The government has implemented many national and local BIM standards, rules, and laws to promote the widespread use of BIM in the construction sector (Zhang et al., 2014). Implementing these standards would effectively tackle obstacles to BIM adoption, including issues with data exchange and cooperation. Additionally, the discovery of BIM-based services and platforms is another noteworthy revelation. A number of Chinese enterprises provide BIM-based services, including project management, design coordination, and facility management. These platforms facilitate enhanced collaboration among project participants, decreasing project risk and expense (Wu et al., 2021).

Finally, the discovery of BIM education and training is a significant finding. Several universities and vocational institutions in China currently provide BIM-related courses and training programs to cater to the increasing need for proficient workers with BIM proficiency (Li et al., 2021). The government has moreover enacted regulations to bolster BIM education and training to alleviate the scarcity of proficient workers possessing BIM expertise.

The Research Route

The research approach for this study is a mixed-methods design, combining both qualitative and quantitative methodologies. This dual approach is essential due to the complex nature of the subject matter, which involves understanding nuanced barriers and stakeholder perceptions and forecasting future trends of BIM technology in China's construction industry. The first step of the research was to obtain existing relevant information on what is hindering the development of BIM technology, the difficulties in further developing BIM technology in the Chinese construction industry, and the direction in which BIM technology can be improved in the Chinese construction industry. This included a literature review and initial structured interviews with experts in the Chinese construction industry aimed at identifying current issues facing BIM technology in the Chinese construction environment, taking into account local factors that may be applicable.

The literature review method primarily entails a comprehensive examination of existing academic literature, including peer-reviewed journal articles, industry reports, case studies, and government publications, as the primary source of data. The literature is derived from many sources, such as Scopus, Web of Science, and Google Scholar, in order to ensure a comprehensive but pertinent range of study (Easton et al., 2000). The emphasis is placed on articles and reports that have been published within the past ten years to guarantee the currency and pertinence of the material. In addition, the study encompasses several geographical settings, with a particular focus on research undertaken in China or those that draw comparisons to the Chinese construction sector. The use of a multi-dimensional strategy in data collecting guarantees a diverse and comprehensive compilation of information. This is essential for the identification of patterns, deficiencies, and growing patterns about the obstacles and potential growth of BIM technology in China's construction industry. The collected data serves as the foundation for a comprehensive and intricate analysis, which is essential for comprehending the intricacies and particularities of BIM implementation in the Chinese context.

The next phase of the study will use both qualitative and quantitative methods of data collection in order to obtain a large amount of data for analysis. Questionnaires will be sent to professionals in the construction industry to determine the main reasons why BIM technology is hindered in the Chinese construction industry. In order to increase the validity of the findings, the study will ensure that the questionnaire is purposefully dispersed throughout the industry. The recommended sample size is 100 with a response rate of at least 40%.

The quantitative data will be collected using the questionnaire approach. The questionnaire technique is a proficient approach for collecting quantitative data on the obstacles to using BIM technology and its future growth prospects in China's building sector. Professionals in the sector, including project managers, architects, and engineers, can provide precise information using a well-designed questionnaire. The questionnaire should encompass inquiries that address various aspects pertaining to the adoption of BIM technology. These include the availability and ease of access to BIM software, the proficiency level of professionals in technical matters, the costs and advantages associated with BIM implementation, and the influence of government policies in promoting BIM technology.

Discussions

This study provides insights into the barriers to the application of BIM technology in China's construction industry and its potential development prospects. Through a mixed-methods study, this paper not only reveals the challenges in various aspects such as technology, legislation, education, and culture, but also points out possible strategies to promote the widespread adoption of BIM.

First, technical challenges are a major obstacle to the popularization of BIM in China. Although BIM technology can significantly improve the efficiency and quality of construction projects Migilinskas et al (2013), high initial investment costs and maintenance fees make it unaffordable for small and medium-sized enterprises (Zhang et al., 2014). In addition, technical support and services are still not perfect enough in China, which further limits the application of BIM technology. Second, the lack of legislation is also an important factor. China currently lacks exhaustive regulations and standards for BIM applications, which makes the industry face uncertainty and risk when adopting this technology (Li et al., 2019). The government can provide a legal guarantee and support framework for the implementation of BIM technology by setting clear policies and standards. Educational and cultural barriers cannot be ignored either. Currently, China has not invested enough in BIM education and training, resulting in a lack of professionals with BIM skills (Li et al., 2020). In addition, traditional work styles and culture with low acceptance of new technologies have hindered the promotion and application of BIM technology (Zhao et al., 2018).

In order to overcome these barriers, this study proposes several recommendations: first, increase investment in BIM education and training to improve the technical competence and acceptance of practitioners; second, the government should introduce more incentives, such as tax incentives and financial support, in order to lower the threshold of adopting BIM in enterprises; and lastly, establish industry standards and regulations to provide clear guidance and support for the application of BIM technology.

In conclusion, although the application of BIM technology in China's construction industry faces multiple challenges, the future application of BIM technology in China is still promising through the advancement of comprehensive strategies. Policy support from the government and positive response from industry will be key to driving this process.

Significance & Contributions of the Study

The study is significant in exploring the barriers to the application of BIM technology in China's construction industry and its development prospects. By shedding light on technical, legislative, educational, and cultural challenges, this study provides valuable insights for academia and the industry as well as suggests concrete strategies to address them. It not only helps to promote the application of BIM technology in China, but also provides a valuable reference for other countries and regions.

The importance of this study on the obstacles to implementing and the future potential of BIM technology in China's construction sector cannot be emphasized enough, as it offers numerous advantages for the industry, society, environment, and academic research. This research offers crucial insights for the construction industry to overcome the current obstacles in adopting BIM. BIM adoption is essential for boosting operating efficiency, cutting costs, and raising the quality of building projects. To fully realize the promise of BIM, the industry must overcome these obstacles, which will result in the adoption of more sustainable and creative building methods.

From a communal standpoint, the successful execution of BIM holds the potential for enhanced building quality and safety, which directly influences the welfare and contentment of the final beneficiaries. On the other hand, from an environmental perspective, BIM technology promotes environmentally friendly building practices by improving resource management and reducing waste, supporting sustainable development's overall objectives.

Beyond that, this research also contributes to the body of knowledge by offering a context-specific examination of BIM in China, a subject that has been minimally explored. This study is expected to fill a significant need in the current literature on building technology by providing a distinct viewpoint on the obstacles and possibilities of BIM in a prominent worldwide industry. The results of this study are relevant not just for those involved in China but also offer valuable insights and approaches that may be applied in other global settings, thereby expanding the worldwide comprehension of BIM adoption in the construction sector.

Conclusion

The study found that the application of BIM technology in China is constrained by a variety of factors, mainly including the lack of industry standards, high technology input costs, talent shortages, and cultural and organizational resistance. Government policy support and the establishment of industry standards are essential to promote the widespread adoption of BIM technology. In addition, increased education, and training on BIM technology, as well as increased awareness and understanding of BIM's potential within the industry, will be key to driving its wider adoption in China's construction industry. Looking ahead, with the advancement of technology and optimization of policies, BIM technology is expected to play a greater role in China's construction industry and provide strong technical support for the sustainable development of the sector.

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