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Research on the Application of BIM Technology in Urban Renewal

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Abstract. Urban renewal has gradually become a core theme and key component of contemporary urban development. However, it currently faces numerous challenges, such as information opacity and low collaboration efficiency. Against this backdrop, Building Information Modeling (BIM) technology, with its powerful capability to integrate building lifecycle information, provides innovative and effective solutions to these issues. This paper employs a literature review method, combined with domestic and international case studies, to explore the positive role of BIM technology in urban renewal. The findings indicate that BIM technology significantly enhances the performance and quality of urban renewal projects through precise 3D modeling and valid multidisciplinary collaboration. Nevertheless, current limitations—such as software compatibility issues and a shortage of skilled professionals—still constrain its broader and deeper application in urban renewal. In the future, the deep integration of BIM with cutting-edge technologies like artificial intelligence (AI) and the Internet of Things (IoT) is expected to drive urban renewal projects toward intelligent lifecycle management, thereby laying a solid foundation for smart cities.

Keywords: BIM, Urban Renewal, Lifecycle, Internet of Things (IoT), Technology Integration

1. Introduction

With the continuous advancement of urbanization, urban renewal has increasingly become a critical direction for new urbanization construction. It is also entering a new era guided by green construction, smart construction [1]. However, building renovation—a core aspect of urban renewal—faces challenges such as information opacity, low collaboration efficacy, and cost control difficulties. As an advanced digital tool, BIM (Building Information Modeling) technology offers an innovative solution to address these urban renewal challenges. BIM technology, centered on a 3D digital model, effectively integrates geometric, physical, and functional information of construction projects. By leveraging BIM, urban renewal projects can achieve lifecycle management—from design and construction to operation—ensuring high quality, efficiency, and long-term sustainability. Thus, BIM provides an effective solution for urban renewal [2].

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This article aims to explore the role of BIM technology in urban renewal. It comprehensively employs the literature research method to systematically review the theoretical achievements at home and abroad. By deeply analyzing cases, the local practical characteristics are identified, and advanced foreign cases are compared and analyzed to extract universal experiences.

2. Theoretical framework and current status of BIM technology

2.1. Definition and scope of BIM technology

BIM (Building Information Modeling) is a digital representation that encompasses the geometric information, physical properties, and functional characteristics of a building. Its core components include three-dimensional parametric modeling technology and full lifecycle information management. Its manifestations can include multi-disciplinary collaborative work platforms and data interoperability standards, etc.

2.2. The role of BIM technology in urban renewal

In the process of urban renewal, BIM technology, as a key digital tool, its value is comprehensively reflected in the in-depth integration and optimization of urban renewal projects. BIM technology can effectually integrate the design, retrofitting construction and subsequent operation and maintenance information of projects, successfully building a digital platform that supports multi-disciplinary collaboration, effectively breaking down the barriers between different professional fields, and greatly promoting the circulation and sharing of information. With the help of multi-dimensional simulation analysis functions, BIM can accurately assess various performance indicators of urban renewal plans in advance, precisely detect and resolve design conflicts, and effectively reduce risks and hidden dangers during the project implementation process. Meanwhile, the visualization function of BIM professional software transforms the complex and abstract construction process in urban renewal into clear and intuitive three-dimensional operation guidance, thereby significantly enhancing the accuracy and quality control level of construction. BIM technology has become a key technical support force for the effective implementation and intelligent operation and maintenance of urban renewal projects.

In addition, the value of BIM technology is deeply integrated into the data-driven decision-making, full-process collaboration, and risk pre-control integration links in urban renewal [3]. With its powerful visualization technology support, BIM technology can closely link the data, resources and related processes of different stages of urban renewal projects, forming a complete and accurate description of the urban renewal objects. When renovating and upgrading existing buildings, BIM technology can integrate the geometric data, historical archives and equipment information of existing buildings, quickly generate high-precision models and further form complete digital archives, providing a strong basis for scientific decision-making in urban renewal. In the operation and maintenance stage after urban renewal, the BIM model can embed detailed equipment information and mark scalable components, fully supporting the intelligent management of facilities. At the same time, it reserves interfaces for possible subsequent renovations, ultimately contributing to the efficient management of the entire life cycle of urban renewal projects and the sustainable development of the city.

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2.3. Actual case analysis

2.3.1. The expansion and renovation project of Shanghai First People's Hospital

The BIM technology is most widely applied in the building renovation of hospitals. In the design stage of the expansion and renovation project of Shanghai First People's Hospital, the BIM technology precisely restored the spatial features of the existing hospital buildings through 3D laser scanning and reverse modeling technology. The project team first collected point cloud data of the historical buildings built in 1864 and constructed a 3D real-scene model including the existing buildings, underground pipelines and surrounding roads [4]. In addition, in response to the complex functional requirements of the new comprehensive medical building, the design team used the Revit platform to build a professional 3D collaborative model, achieving synchronous design of architecture, structure, medical process and mechanical and electrical pipelines. The project team also connected the BIM model with the urban geographic information system (GIS) to simulate the traffic flow lines of the hospital area and re-plan the three-dimensional traffic system of the emergency, inpatient and scientific research functional modules. The final BIM design results not only include 3D visualization schemes, but also generate multiple data deliverables such as door and window tables and bill of quantities, providing precise data support for the prefabrication processing and progress control in the subsequent construction stage.

BIM technology has addressed issues such as the crowdedness and disorderly facility planning of this project by transforming design, implementing smart construction, and ensuring sustainable operation [5]. It has shortened the construction drawing design cycle of the project and reduced the material loss rate.

2.3.2. Beijing Daxing International Airport construction project

Taking Beijing Daxing International Airport as an example, BIM technology has also played a significant role in the hoisting simulation and collision detection during the construction phase. Based on the high-precision model meticulously constructed in advance, the design team utilized the BIM model to carry out collision detection work [6], successfully identifying and resolving collision issues among various specialties. This process not only optimized the design quality but also reduced potential errors, omissions, collisions, and deficiencies in the subsequent construction stage, supporting the high-efficiency advancement of the project. During the construction phase, the construction team also used the BIM model to simulate the hoisting of steel structures [6]. Through virtual rehearsals, they precisely planned the hoisting routes, equipment selection, and construction sequences, effectively enhancing the validity and safety of hoisting operations. Construction companies such as China Construction Eighth Engineering Division fully utilized the BIM model to conduct 3D layout work, providing precise positioning and dimensional data for the processing and installation of complex components [7]. Meanwhile, the project also established a construction management platform based on BIM technology, which visually displayed the construction progress in a dynamic manner.

This refined management based on BIM technology not only enhances construction productivity and reduces the risk of cost overruns but also significantly improves the quality of construction projects. It effectively ensures the timely completion and smooth operation of major projects such as Beijing Daxing International Airport.

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2.3.3. Boao International Conference Center operation and maintenance project

For the later operation and maintenance stage of building renovation projects, BIM technology also holds indispensable significance. This article, through the case of Boao International Conference Center, analyzes how BIM technology can provide strong support for the effective management and intelligent services of the conference center.

Firstly, the entire operation and maintenance work is closely centered around valid conference services and intelligent facilities [8]. Through BIM models, real-time status monitoring is conducted for conference halls, VIP rooms, and other spaces. The authorities can precisely grasp information such as the usage of each space, equipment configuration, and personnel distribution, thereby enabling quick adjustments to the venue layout. At the same time, in the face of outdated facilities and poor performance [8], maintenance personnel can quickly understand the specifications, installation locations, and service life of the facilities by querying the facility information in the model, so as to carry out timely maintenance and replacement, extend the service life of the facilities, ensure the normal operation of the indoor facilities, and achieve the long-term goal of carbon-neutral operation.

Secondly, the application of BIM technology in the Boao International Conference Center covers the entire life cycle of the building. The BIM model integrates information from the design to the operation and maintenance stages, including architectural structures, equipment parameters, and historical maintenance data, forming a comprehensive and dynamic data platform.

3. Problems and solutions

3.1. Existing problems of BIM in urban renewal

Although BIM technology has played a significant role in urban renewal, there are still some bottlenecks that need to be overcome during its application. From the perspective of application depth and breadth, only a small number of enterprise projects have achieved comprehensive application of BIM technology, while most enterprise projects have a relatively small application scale. Its support for urban renewal construction is not sufficient. During project implementation, some construction units lack BIM planning management and execution capabilities, as well as a sufficient understanding of BIM technology applications. This results in ineffective follow-up and dedicated management in later project stages, ultimately preventing BIM from fulfilling its potential in urban renewal projects. In addition, the application of BIM collaborative management platforms is mainly concentrated in the design stage, and is less applied in process and schedule plan management. BIM is disconnected from the actual site, and projects with excellent collaborative effects account for only about 27%.

From the perspectives of technology and talent, the integrated application of BIM technology with cutting-edge technologies such as artificial intelligence (AI) and the Internet of Things (IoT) is still in the exploratory stage in China. Enterprises are also lagging behind in using IoT technology to achieve real-time data interaction between BIM models and on-site equipment. Domestic BIM software lacks core technologies and is unable to effectively support professional technical work. There are obstacles in data interaction among different BIM software, decreasing work productivity. Moreover, the application of BIM technology in urban renewal projects also faces challenges in integrating with existing building historical data. In China, there is no mature solution yet on how to effectively integrate the historical archives of existing buildings with renovation design information.

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3.2. Solutions

In light of the limitations faced by BIM technology in urban renewal and building renovation as demonstrated in the aforementioned cases, during the research process of this paper, it was discovered that the world is actively exploring solutions to these problems through technological updates or integration. In some scenarios, technologies that utilize artificial intelligence algorithms to optimize the automatic generation of BIM models have emerged, significantly enhancing modeling effectiveness and accuracy [9]. For instance, the expansion and renovation project of Maldives' Veyana International Airport employed the "AI + BIM + Digital Construction" model. Through an AI-assisted BIM collaborative platform (such as Trimble Connect), design conflicts were reduced, construction progress was optimized, and material waste was minimized. Additionally, there are cases where IoT technology is used to achieve real-time data interaction between BIM models and on-site equipment. For example, the Abu Dhabi International Airport project implemented the "IoT + BIM + Construction Safety Monitoring" model. This airport project utilized IoT sensors to monitor large-scale equipment such as tower cranes and crawler cranes at the construction site. The sensors collected equipment operation data (such as position, load, wind speed, etc.) and transmitted it via wireless networks to the BIM system in the central control room, enabling dynamic collision warnings and remote management. This enhanced the timeliness of operation and maintenance management [10].

There are also some positive explorations in China, such as integrating BIM technology with big data analysis. The smart city construction in the Beijing Sub-City (Tongzhou) integrates urban big data including transportation, population, and environment, and combines BIM models to simulate the long-term impacts of different planning schemes, aiming to provide more accurate and reasonable decision support for urban renewal projects [11]. The digital protection of the Tiankang Hall in Taian Dai Temple uses BIM technology for the maintenance of ancient buildings, establishing 3D models to assist in restoration, reducing the trial-and-error costs of traditional restoration. These overseas and domestic cases of technological updates and integration indicate that the current mainstream development trend of BIM technology is to deeply integrate with other cutting-edge technologies [12], in order to better solve various problems in urban renewal and building renovation.

4. Conclusion

This article conducts an in-depth study of the role of BIM technology in urban renewal. Through detailed analysis of multiple domestic case studies, it reveals the significant advantages of BIM technology in the field of urban renewal. The research finds that BIM technology, with its powerful three-dimensional modeling and information integration capabilities, achieves deep empowerment throughout the entire life cycle of urban renewal. In the design stage, BIM technology optimizes the design scheme through digital modeling and multi-disciplinary collaboration platforms, and effectively resolves design conflicts; in the construction stage, BIM technology significantly improves construction efficiency and reduces the risk of cost overruns through virtual pre-performance and progress visualization; in the operation and maintenance stage, BIM technology supports intelligent management of facilities, Moreover, BIM technology demonstrates the advantage of integrating diverse information, combining existing building historical data, renovation requirements, and operation and maintenance information into a dynamic data platform, providing full-dimensional decision support for urban renewal projects. Although current applications still face challenges such as software compatibility and shortage of personnel, the integration of BIM

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technology with cutting-edge technologies such as artificial intelligence and the IoT is driving urban renewal towards a new stage of intelligent management, providing key technical support for the construction of new urbanization.

Authors contribution

All the authors contributed equally and their names were listed in alphabetical order.

References

[1] Qu Jianguo. A Brief Discussion on the Application of BIM in Lean Management of Mechanical and Electrical Installation Projects Abroad. Installation, 2020, (04): 69-71.
[2] Zhu Jinfei. Research on the Comprehensive Application of BIM Technology in Urban Renewal. Theory Research of Urban Construction (Electronic Edition), 2025, (08): 88-90.
[3] Parece, S., Resende, R., & Rato, V. BIM-based life cycle assessment: A systematic review on automation and decision-making during design. Building and Environment, 2025. 282, 113248.
[4] Shanghai Building Information Modeling Technology Application Promotion Center. Shanghai First People's Hospital Expansion and Renovation Project.
[5] Chen Jianqiu, Qi Xin, Chen Jingli. Updating and Regeneration of Shanghai First People's Hospital Expansion and Renovation Project. Era Architecture, 2020, (05): 124-131.
[6] Wang Lingyu, Ge Feng, Wu Degong, et al. BIM Assists Beijing Daxing International Airport Take Flight. Information Technology in Civil Engineering and Architecture, 2020, 12(04): 92-98.
[7] Zhang Jinxun, Duan Xianjun, Li Jianhua, et al. Technological Innovation and Application of Beijing Daxing International Airport Terminal Building Project Construction. Innovation World Weekly, 2021, (09): 14-23.
[8] Yang Ling, Li Shanshan, Liu Qin. Green and Low-Carbon Renovation Design of Boao Yatan Conference Center and Hotel in the Context of Urban Renewal. Urban Environmental Design, 2024, (02): 247-252.
[9] Alves, J. L., Palha, R. P., & Filho, A. T. d. A. (2025). Towards an integrative framework for BIM and artificial intelligence capabilities in smart architecture, engineering, construction, and operations projects. *Automation in Construction*, 174, 106168.
[10] Ma Lu. Application of Interactive Development Technology Based on BIM and Internet of Things in Intelligent Buildings. Intelligent Building and Smart City, 2018(04): 65-66.
[11] Ge Shucheng. Big Data Analysis and Decision-making Based on BIM Technology for Project Management. Science and Information. 2020, 18(07): 47-48.
[12] Ouyang Lixia, Guo Zhiliang, Zou Jiamin. Research on the Application of BIM and Artificial Intelligence in Engineering Management Digitalization. High Technology and Industrialization, 2025, 31(01): 70-72.