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Application of BIM in project management in China

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Abstract. As a nation that is quickly developing, China's construction industry faces a variety of issues. Despite the size and technical complexity of some Chinese projects, the old paper documents and two-dimensional drawing techniques are no longer adequate to meet demand. China's construction sector has enormous potential. Therefore, effective digital technology and the best project management are crucial for the growth of China's construction business. Throughout the whole life cycle of a construction project, including all phases of planning, design, building, operation, and maintenance, Building Information Modelling (BIM) can be used. This study intends to investigate the use of BIM in project management in China with a particular emphasis on how BIM impacts project design, construction, and operation. By analysing the successful cases of BIM in China's project management, the prospect and development of BIM in China's construction industry are discussed. In the whole process of project management, BIM improves quality, efficiency, sustainability and maintainability through various applications. It is intended to provide China's construction industry with a tool to promote the modernization and long-term growth of the industry.

Keywords: Project Management, BIM, Civil Engineering.

1. Introduction

As one of the largest construction markets in the world, its construction industry has a variety of distinct backgrounds and challenges [1]. The construction industry is in high demand as a result of the rising urbanization. To accommodate the need for housing, infrastructure, and commercial space, a significant number of new buildings must be built. The Chinese construction sector is very competitive due to the huge market potential. However, given some Chinese projects' size and technological complexity, the traditional paper document and two-dimensional drawing methods are insufficient to meet their requirements. Therefore, effective digital technologies and the highest quality project management are essential for the growth of China's construction industry.

Building information modelling (BIM) is a 3D digital technology-based engineering data model that combines various pertinent information about construction projects [2]. It is also a digital technology used in design, construction, and management. Throughout all phases of a construction project's life cycle, including planning, design, construction, operations, and maintenance, BIM can be employed [3]. BIM has enormous potential for resolving issues facing the construction sector and enhancing project management effectiveness. BIM adoption has emerged as one of the most important drivers supporting the modernization and long-term growth of the construction sector in China.

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This paper aims to explore the application of BIM in project management in China, focusing on how BIM affects project design, construction, and operation. Through the analysis of the successful cases of BIM in China's project management, the prospects and development of BIM in China's construction industry are discussed.

2. Application of BIM in project management

2.1. Application of BIM in the design project

The design of the project stage is a critical link in the construction process, and the effectiveness of this stage directly impacts the overall success of the project [4]. The complexity and diversity of current architectural projects may provide difficulties for traditional design methodologies. BIM is now widely used in the design phase and is a potent tool for enhancing design quality, collaboration effectiveness, and visualization.

(1) 3D modeling and visualization

The ability of BIM to show designs as highly accurate three-dimensional models of buildings is one of its most significant advantages [5]. This model gives designers and other project stakeholders the possibility for real-time visualization in addition to providing a clear visual depiction of the building's aesthetic and spatial layout. This aids designers in making better design choices and client communications. Additionally, the design vision is more clearly understood by project stakeholders, lowering the chance of misunderstanding.

(2) Structural and space analysis

BIM can be used for structural analysis during the design process to make sure there exists sufficient space and appropriate connections between building elements. The design team can assess the viability of various design ideas through real-time simulation to make sure that the structure and functionality of the building are completely considered. This reduces the need for design changes at a later stage, lowering the possibility of additional costs and delays.

(3) Material and cost analysis

To assist design teams in understanding the effects of various design decisions on project budgets, BIM can be combined with material and cost databases. It helps in design optimization to adhere to financial constraints and prevent needless cost overruns. Design teams may more effectively balance feasibility and design vision with real-time cost assessments.

(4) Collaboration and information sharing

The design phase typically involves experts in multiple fields, including architects, structural engineers, mechanical engineers, and electrical engineers. Project team members from many areas can share information and collaborate in real-time using the integrated platform that BIM provides. This facilitates improved teamwork and fewer communication issues.

In conclusion, BIM offers various benefits when used in the project design phase. These benefits include increased design quality, effective teamwork, and visualization. In addition to giving designers extra tools, it also supports the entire construction project process.

2.2. Application of BIM in construction management

The application of BIM in construction management provides high efficiency, lower cost and higher quality for construction projects [6]. The following are the main applications of BIM in construction management:

(1) Engineering Visualization and Simulation

Through three- and four-dimensional models, BIM provides the construction crew with a clearer view of the project's design, lowering the likelihood of miscommunication and error. Additionally, BIM enables the construction team to model the construction process in order to predict potential difficulties and disputes and resolve them beforehand, eliminating issues and delays at the construction site. A thorough construction plan and timeline can be established with the use of the four-dimensional BIM

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model [7]. In order to ensure that the project is completed on time, this aids the project team in improved time management and resource coordination.

(2) Real-time collaboration

BIM provides an integrated collaboration platform that allows different members of the construction team to share information and work together in real-time [8]. This helps reduce communication problems and increase collaboration efficiency.

(3) Materials and Resource Management

Construction-related resources and materials can be tracked and managed using BIM [9]. It streamlines traditional processes, reduces waste, ensures timely material supplies, and enhances resource efficiency. By leveraging BIM, construction projects can achieve greater cost-effectiveness, sustainability, and overall success.

(4) Construction quality control

BIM enables the creation of a thorough construction quality control strategy to guarantee that the project conforms to design standards and specifications [10]. Problems can be found early on and fixed by checking the data as the project is being built.

In summary, BIM helps to ensure that the project is successfully finished by enhancing both the construction process and project management's ability to be controlled. BIM has consequently developed into one of the essential tools of the contemporary construction sector, offering a strong foundation for the success of construction projects.

2.3. Application of BIM in construction operation

The application of BIM in the building operation phase is essential to ensure the efficiency, sustainability and maintenance of buildings. The following are the main applications of BIM in construction operations:

(1) Building Asset Management

A system for managing building assets may be centered around BIM. Maintenance staff can readily access all information about a facility, including construction, equipment, maintenance requirements, and maintenance history, by combining building information models with equipment and maintenance data. This contributes to improved planning and execution of maintenance tasks and increases equipment longevity.

(2) Energy management

BIM integration with energy management systems enables building owners and operators to adopt a proactive stance towards sustainability and energy efficiency. It provides predictive analytics, cost-saving opportunities, and real-time insights while also making a positive impact on the environment. Buildings can function more cost-effectively, efficiently, and environmentally friendly by utilizing BIM for energy management.

(3) Updates and improvements

BIM supports building improvements and updates. Building managers and owners can use BIM to make well-informed decisions, maximize space, improve energy efficiency, and guarantee compliance with changing requirements. It gives stakeholders the power to design structures that are flexible, effective, and important in a world that is continuously evolving.

(4) Maintenance Management

The use of BIM enables maintenance teams to produce thorough maintenance schedules that are connected to building components and systems. In order to minimize unscheduled downtime, maintenance operations can then be optimized depending on equipment usage and maintenance requirements. Create a maintenance strategy concurrently based on advice from the equipment's manufacturer and previous maintenance logs. This enhances the equipment's dependability by assisting in the prevention of equipment breakdowns and unexpected issues.

In the end, by providing reliable building information and data as well as features to support maintenance, energy management, and improvement projects, the implementation of BIM in building operations helps to assure the efficiency, sustainability, and maintainability of buildings. It advances building life-cycle management to entirely new heights.

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2.4. Case study – Dashilar project

Dashilar Project (Referring to figure 1) is a commercial project that carries the culture of Beijing and Dashilar region [11]. BIM was used in the whole process of the Dashilar project to assist the project manager in the integration of design, construction and maintenance of the Dashilar project and specific process as show in figure 2.

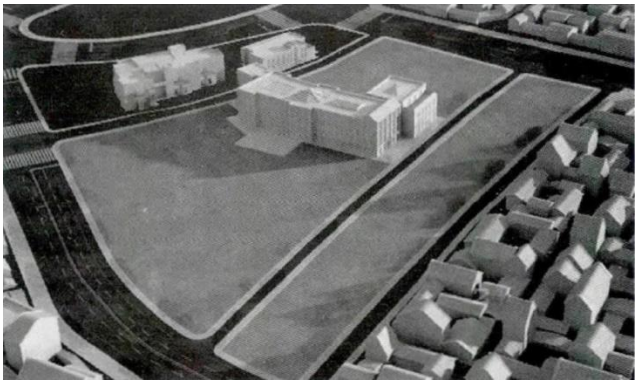

Figure 1. Dashilar project site layout [11].

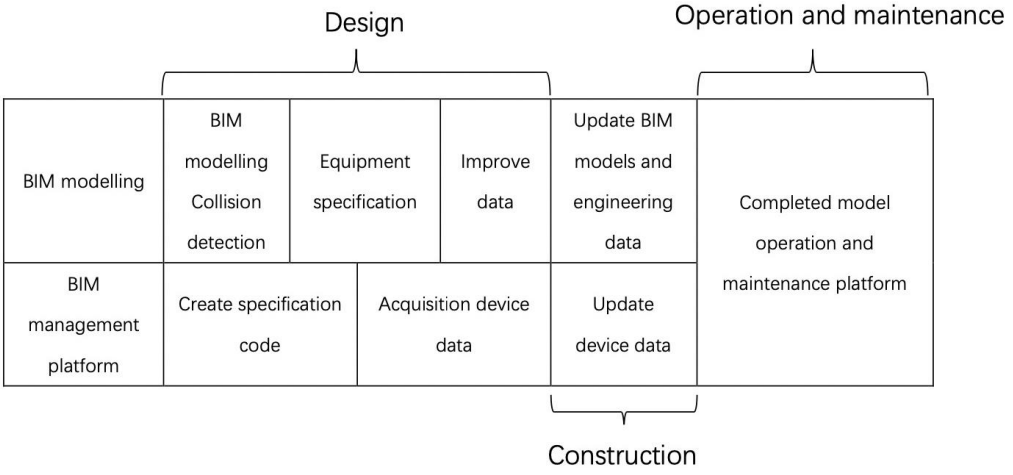

Figure 2. Dashilar BIM process flow chart [11].

(1) Design stage

The Dashilar project adopted BIM technology and produced BIM models for each primary monomer. These models are utilized for performance analysis and problem resolution in addition to coordinating collision detection and synthesis between other specialties. In order to address professional synthesis and mistake difficulties, the BIM model enables communication between the design team and the BIM team. The aim at this point is to leverage BIM technology to prevent design issues from occurring in the first place, improving design quality and minimizing mistakes.

(2) Construction stage

BIM engineers are based in the engineering Department and on the construction site to maintain and update BIM models and engineering databases in a timely manner based on changes and technical approvals. BIM models are used to check for space clashes and other issues, guide building on-site, and quickly change schedules. To assure the control of materials and costs, BIM also regulates the material process. On-site real scene simulation provides on-site real scene simulation video through BIM model to provide intuitive impression to the owner and reflect the project progress. The key of this stage is to realize the guidance and management of BIM model in site construction, and improve the construction quality and efficiency.

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(3) Operation and maintenance stage

The Dashilar project introduced Archibus operation and maintenance management software during the operation and maintenance phase to achieve real-time data synchronisation between the Archibus database and BIM model. Spatial and equipment data from BIM models are established, allowing operation and maintenance departments to manage space allocation and access to equipment ledgers. The operation and maintenance department receives a basic database with complete information from the BIM centre, which increases the effectiveness and precision of operation management.

In summary, the Dashilar project fully applies BIM technology to realize the whole process management of the construction project. From design to construction to operation and maintenance stage, BIM model plays a key role in different stages, improving the quality, efficiency and management level of the project.

3. Conclusion

The paper discusses the use of BIM in project management in China with a particular emphasis on how it affects the phases of project design, construction, and operation. The conclusion of the paper is given below:

(1) BIM offers strong project design capabilities, such as 3D modelling and visualization, spatial and structural analysis, material and cost analysis, collaboration, and information exchange. By enhancing design quality, team efficiency, and project visibility, these elements lower the possibility of misunderstanding.

(2) BIM supports applications in construction management such as engineering visualization and simulation, real-time collaboration, materials and resource management, construction quality control, and others. This contributes to better quality, cost-effectiveness, time management, and resource coordination in engineering.

(3) Building asset management, energy management, updates and enhancements, and maintenance management are all done with BIM in construction operations. It can enhance building sustainability, energy efficiency, and job planning for maintenance, making structures easier to maintain.

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