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Digital Application Objectives and Benefit Analysis of BIM Technology in Large-Scale Comprehensive Development Projects

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Abstract: This paper discusses the digital application and benefit analysis of building information model (BIM) technology in the large-scale comprehensive development project of the Guangxi headquarters base. The project covers a total area of 92,100 square meters, with a total construction area of 379,700 square meters, including a variety of architectural forms. Through three-dimensional modeling and simulation analysis, BIM technology significantly enhances the design quality and efficiency, shortens the design cycle by about 20%, and promotes the collaboration and integration of project management, improving the management efficiency by about 25%. During the construction phase, the collision detection and four-dimensional visual management functions of BIM technology have improved construction efficiency by about 15% and saved the cost by about 10%. In addition, BIM technology has promoted green building and sustainable development, achieved the dual improvement of technical and economic indicators and social and economic benefits, set an example for enterprises in digital transformation, and opened up new market businesses.

Keywords: Building information model technology; Large-scale comprehensive development; Digital application; Benefit analysis

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1. Introduction

The rapid development of the construction industry and the increasing number of large-scale comprehensive development projects put forward higher requirements for a refined and intelligent level of design, construction, and management [1]. In this context, building information model (BIM) technology, with its powerful three-dimensional modeling, simulation analysis, and information integration capabilities, has gradually become a key technical means in large-scale comprehensive development projects. This paper aims to explore the digital application of BIM technology in large-scale integrated development projects and the significant benefits it brings.

As a typical case of this study, the large-scale comprehensive development project of the Guangxi headquarters base integrates residential, office, education, and other multiple functions, and is characterized by diverse architectural forms, numerous single buildings, and complex functional layouts. Faced with such a huge engineering project, the traditional design and management methods have made it difficult to meet the needs of efficient, accurate, and collaborative [2]. Therefore, the project team decided to introduce BIM technology to realize the comprehensive optimization of design, construction, and management through its three-dimensional visualization, collision detection, construction simulation, and other functions.

This paper first introduces the specific application objectives of BIM technology in the project, including enhancing the design quality and efficiency, promoting the coordination and integration of project management, promoting green building and sustainable development, and realizing the fine management of the construction process [3,4]. Subsequently, combined with the implementation effect of the project, the specific benefits brought by BIM technology were deeply analyzed from the two dimensions of technical and economic indicators and social and economic benefits [5]. The digital application of BIM technology in large-scale comprehensive development projects can not only effectively improve the design, construction, and management level of the project, but also bring significant economic and social benefits. The research results of this paper are of great significance for promoting the wide application of BIM technology in the construction industry.

2. Project introduction

This project is located in the Guangxi headquarters base, which is a large and multi-functional comprehensive development and construction project, aiming to build a modern community integrating residential, office, and educational functions. The project covers a total area of 92,100 square meters, with a total construction scale of 379,700 square meters, including 23 independent buildings. The renderings of the project (**Figure 1**), the design, and the planning depth reflect the accurate grasp and unique insight of the concept of the modern urban complex. As the digital cornerstone of project design, BIM technology not only transforms this grand idea into a concrete scheme that can be implemented but also accurately captures and reproduces every detail of the design renderings through its three-dimensional modeling and in-depth simulation analysis technology. On this basis, the BIM model also integrates rich data elements and interactive functions to further enhance the depth and breadth of the design. In addition, the advanced collision detection and optimization design capabilities of the BIM model can effectively identify and solve potential design conflicts and construction problems at the initial stage of the project, laying a solid foundation for the smooth progress of the project. The remarkable feature of the project is the diversity of its architectural forms, covering high-rise residential buildings, office buildings with advanced frame-core tube structures, as well as service centers and commercial facilities carefully built using frame structures. These diverse buildings not only add vitality to the regional skyline but also jointly weave a fully functional and modern comprehensive development area.

Figure 1. Office building renderings

3. Application objectives of BIM digital technology

3.1. Enhancing the design quality and efficiency

In the design stage of building engineering, the three-dimensional visualization characteristics of BIM technology are fully utilized to realize the deep optimization of the building scheme. By building accurate BIM models, the design team is able to visually present design ideas, improve design accuracy, and identify and solve potential design problems at early stages, thus significantly reducing the frequency of later design changes. This process not only shortens the design cycle, but also improves the quality and practicability of the design results, and realizes the double improvement of the design efficiency and quality.

3.2. Promoting the collaboration and integration of project management

As a key tool for project management, BIM technology has effectively promoted information sharing and efficient communication between different stages and participating units. Through the BIM platform, the project team can access and integrate the project data in real time to ensure the accuracy and consistency of the information. This management mode of coordination and integration enhances the timeliness and scientificity of project decision-making, improves the overall execution efficiency, and provides a strong guarantee for the smooth progress of the project.

3.3. Promoting green building and sustainable development

In the background of green building and ecological construction, BIM technology plays an irreplaceable role. The BIM model can accurately simulate the performance of buildings under different environmental conditions, such as energy consumption, lighting, ventilation, etc., providing a scientific basis for green building design. In addition, BIM technology also promotes the rational selection and recycling of building materials and reduces the impact of buildings on the environment. Therefore, the application of BIM technology is helpful in promoting the construction industry in the direction of more energy saving, environmental protection, and sustainable development.

3.4. Realizing the fine management of the construction process

During the construction stage, BIM technology provides strong technical support for fine management. Through the collision detection function, BIM can identify and solve the potential conflicts between design and construction in advance, and reduce the site changes and rework phenomenon. At the same time, the construction scheme simulation and the four-dimensional visual management of the construction progress enable the project team to intuitively understand the construction process and progress, and optimize the resource allocation and construction plan. The implementation of these measures not only improves construction efficiency and safety but also effectively reduces construction costs and improves the overall economic benefits of the project.

4. Implementation effect

4.1. Technical and economic target

4.1.1. Design efficiency and quality improvement

Through the application of BIM technology, the efficiency of the project design stage is significantly improved. The three-dimensional visualization feature of the BIM model enables the design team to intuitively show the design idea, discover and solve potential design problems in time, reduce the number of design changes, and

shorten the design cycle by about 20%. The design quality has also been significantly improved. The precise modeling and simulation analysis function of the BIM model ensures the feasibility and practicability of the design scheme, reduces the rework and material waste caused by design errors, and improves the overall economic benefit of the project.

4.1.2. Construction efficiency and cost saving

During the construction stage, the collision detection function of BIM technology identifies and solves the potential conflicts in the construction in advance, reduces the on-site changes and rework phenomenon, and improves construction efficiency by about 15%. Through the construction simulation and four-dimensional visual management of the BIM model, the resource allocation and construction plan are optimized, the construction cost is effectively controlled, and the total construction cost is saved by about 10%.

4.1.3. Improved management efficiency

The BIM platform promotes information sharing and efficient communication between different participating units at different stages of the project and improves the coordination and integration of project management. Project decisions were more timely and scientific, and the overall execution efficiency was improved by about 25%.

4.2. Socioeconomic performance

4.2.1. Promoting the digital design level of enterprises

The application of BIM technology has significantly improved the level of digital design of enterprises, making the design process more refined and efficient. Through the BIM model, the seamless connection from conceptual design to construction management, and the practicability and feasibility of the design results are greatly improved.

4.2.2. Enhancing the core competitiveness of enterprises

Mastering BIM technology significantly enhances the core competitiveness of enterprises in the construction industry. Enterprises can undertake more complex and more difficult engineering projects, and show higher professionalism and innovation in the design and construction management.

4.2.3. Improving the social influence of enterprises

Through the successful application of BIM technology in this project, the enterprise has set up a model of digital transformation in the industry and attracted the attention and learning of many peers. The brand image and social influence of the enterprise have been significantly improved.

4.2.4. Developing new market business

The application of BIM technology opens up new markets for enterprises. With the advantages and experience in BIM technology, the company has successfully undertaken a number of engineering projects of similar scale, which has further consolidated the market position and expanded its business scope.

5. Conclusion

This study deeply analyzed the digital application and benefits of BIM technology in the large-scale

comprehensive development projects of the Guangxi headquarters base. Through the three-dimensional modeling, simulation analysis, collision detection, and four-dimensional visualization functions of BIM technology, the design efficiency and quality of the project are significantly improved, the design cycle is shortened, and the design changes are reduced. In the construction stage, BIM technology effectively reduces site change and rework, improves construction efficiency, and saves costs. At the same time, the BIM platform promotes the collaboration and integration of project management and enhances the scientific and timeliness of decision-making. In addition, the application of BIM technology also promotes green building and sustainable development and improves the digital design level and core competitiveness of enterprises. The digital application of BIM technology in large-scale comprehensive development projects has brought significant technical, economic, and social benefits, and is an important trend in the future development of the construction industry.

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Disclosure statement

The author declares no conflict of interest.

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