

Whole-Process Project Cost Management Based on Building Information Modeling (BIM)

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Abstract: The whole-process project cost management based on building information modeling (BIM) is a new management method, aiming to realize the comprehensive optimization and improvement of project cost management through the application of BIM technology. This paper summarizes and analyzes the whole-process project cost management based on BIM, aiming to explore its application and development prospects in the construction industry. Firstly, this paper introduces the role and advantages of BIM technology in engineering cost management, including information integration, data sharing, and collaborative work. Secondly, the paper analyzes the key technologies and methods of the whole-process project cost management based on BIM, including model construction, data management, and cost control. In addition, the paper also discusses the challenges and limitations of the whole-process BIM project cost management, such as the inconsistency of technical standards, personnel training, and consciousness change. Finally, the paper summarizes the advantages and development prospects of the whole-process project cost management based on BIM and puts forward the direction and suggestions for future research. Through the research of this paper, it can provide a reference for construction cost management and promote innovation and development in the construction industry.

Keywords: Building Information Modeling (BIM); Project cost management; Data integration; Information sharing; Cost control

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1. Research background

With the continuous development and application of science and technology, the construction industry is also constantly ushering in new changes. The traditional project cost management mode has been unable to meet the increasingly complex project demand and the pressure of market competition. In this context, whole-process engineering cost management based on BIM came into being^[1].

BIM or Building Information Modeling is a digital technology that integrates architectural design, architectural construction, and operation management. By integrating all the links of the building project, it forms a unified information model and realizes the comprehensive coordination and data sharing in the process of architectural design, construction, and operation. Compared with traditional two-dimensional drawings and

manual calculations, BIM can provide more comprehensive, accurate, and reliable building information, which provides a better foundation for project cost management.

The whole-process project cost management refers to the whole life cycle of the construction project, from the early budget preparation, cost control in the design stage, to the cost analysis and change management, and then in the construction stage, to the later completion final account and operation cost control, the comprehensive management and control of the project cost. This management approach emphasizes coordination and communication at all stages of the project, as well as overall control of costs.

The whole-process engineering cost management based on BIM combines BIM technology with engineering cost management to realize comprehensive information sharing and collaborative management^[2]. Through BIM technology, a comprehensive visualization of building projects can be realized, including building structure, equipment layout, material selection, and other aspects. At the same time, BIM can also conduct simulation and analysis to help engineers and managers to better understand the cost composition and influencing factors of the project to make more accurate decisions.

Whole-process engineering cost management based on BIM can also improve engineering efficiency and quality. Through BIM technology, we can work together among various project participants, reduce the error of information transmission and communication, and improve work efficiency. Additionally, BIM can also simulate and optimize to help engineers find and solve possible problems in the design stage and improve the quality of the project^[3].

To sum up, whole-process engineering cost management based on BIM is an important way for the construction industry to meet technological changes. By combining BIM technology with engineering cost management, it realizes the comprehensive sharing and collaborative management of information and improves the efficiency and quality of the project. In the future, whole-process engineering cost management based on BIM will continue to play an important role in providing better support for the sustainable development of the construction industry.

2. Application of BIM in the whole-process of engineering cost management

The whole-process project cost management refers to a method of effective management of the cost in the whole process of a project. It aims to conduct a comprehensive and systematic control and management of the cost of the project through scientific methods and technical means to maximize the economic benefits of the project^[4].

The goal of the whole-process project cost management is to ensure that the cost of the project is controlled within a reasonable range, and can be effectively managed and monitored in all stages of the project. It involves all aspects of the project, including project approval, design, construction, completion, and later operation and maintenance and other links.

Firstly, in the project approval stage, the goal of the whole-process project cost management is to determine the project budget and cost target and formulate the corresponding control measures. Through the analysis and prediction of the project demand, the budget of the project can be reasonably determined, and the corresponding control measures can be formulated according to the budget to ensure that the cost of the project is within a controllable range.

Secondly, in the design stage, the goal of the whole-process project cost management is to reduce the cost of the project by optimizing the design scheme. Through the comparison and evaluation of different design schemes, we can find the most economical and reasonable design scheme to reduce the cost of the project.

Thirdly, in the construction stage, the goal of the whole-process project cost management is to ensure cost

control and cost saving in the construction process. By making a detailed construction plan, and reasonably organizing the construction process, the construction cost is kept within a reasonable limit.

Fourthly, in the completion stage, the goal of the whole-process project cost management is to calculate and evaluate the actual cost of the project. Through the accounting and evaluation of the actual cost of the project, we can understand the cost structure and cost deviation of the project, and provide a reference for later project management.

Finally, in the later operation and maintenance stage of the project, the goal of the whole-process project cost management is to control and manage the operation cost of the project. This is achieved by making a reasonable operation and maintenance plan, reducing the operation cost, and maximizing the economic benefits of the project ^[5].

In short, the definition of the whole-process of engineering cost management is to carry out a comprehensive and systematic control and management of the cost of the project to achieve the maximum economic benefits of the project. Its goal is to ensure that the cost of the project is controlled within a reasonable range and that it can be effectively managed and monitored at all stages of the project. Through scientific methods and technical means, the whole-process of project cost management can improve the efficiency of the project, reduce the cost of the project, and provide strong support for the successful implementation of the project.

The whole-process of project cost management refers to the comprehensive and systematic management of the project cost through scientific methods and effective processes in the whole life cycle of the project. The goal of the whole-process project cost management is to realize the economic, efficient, controllable, and sustainable development of the project.

The whole process of process of project cost management can be divided into the following stages: preliminary preparation stage, design stage, bidding stage, construction stage, and completion acceptance stage. At each stage, there are corresponding management methods and tools to ensure reasonable control and management of the project cost ^[6,7].

In the preparatory stage, the focus of the whole-process project cost management is to evaluate and analyze the feasibility of the project and determine the project budget and cost target. At the same time, market research and risk assessment are also needed to provide a basis for subsequent decisions. At this stage, commonly used methods include cost-effectiveness analysis, risk management, and decision support systems, etc.

In the design stage, the task of the whole-process of engineering cost management is to control and optimize the cost of engineering design. This includes the economic evaluation and cost estimation of the design scheme, as well as the evaluation and decision-making of the design changes and optimization scheme. At this stage, commonly used methods include cost estimation model, value engineering, and cost control techniques.

In the bidding stage, the focus of the whole-process of project cost management is to review and compare the bidding documents to ensure the selection of suitable contractors and suppliers. This includes the analysis and verification of tender offers and the evaluation and selection of tender proposals. Common methods in this stage include a bid review model, cost comparison, and supplier evaluation.

In the construction stage, the task of the whole-process of project cost management is to control and supervise the construction process. This includes monitoring and evaluation of construction progress and quality, as well as handling and decision-making on construction changes and claims. Common methods include construction cost control technology, schedule management, and quality management.

In the completion acceptance stage, the focus of the whole-process project cost management is to summarize and evaluate the cost of the project to ensure that the goal of the project is achieved. This includes the accounting and settlement of the project cost, as well as the evaluation and feedback of the project quality

and customer satisfaction. At this stage, the common methods include the project cost accounting model, performance evaluation customer survey, etc.

In general, the process and method of the whole-process of engineering cost management is a system engineering, which requires a comprehensive use of various management technologies and tools. Through scientific methods and effective processes, the whole-process of engineering cost management can realize the economic, efficient, controllable, and sustainable development of the project. This is of great significance in improving the competitiveness and market value of engineering projects.

The purpose of the BIM technology application scheme is to utilize the characteristics of integration, accuracy, and compatibility as guidance for participating parties in cost control to realize the value-added of the project. In this regard, to leverage the strengths of BIM technology and achieve the implementation points, the following principles and ideas are put forward.

According to the goal of construction project cost control, the characteristics of BIM technology, and the differences among various parties, the application scheme of BIM technology in construction project cost control should follow the principle of project value-added, the principle of full participation and the principle of effective information [8]. Project value-added principle: the goal of construction project cost control is to realize the project value-added to the maximum extent, which is affected by the cost control effect of each stage and the degree of cooperation of all parties involved. The application of BIM technology is conducive to strengthening the control of the uncertainty in cost control and optimizing the allocation of project resources. To utilize the benefits, the application of BIM technology must align with the needs of all parties, prioritizing aspects that enhance project value. It encourages considering costs across the entire lifespan to achieve added project value. Principle of full participation: the longitudinal scope of the construction project cost control covers the investment decision of the construction project to all stages of the implementation, and the horizontal scope involves all elements and participants affecting the cost of the construction project. The application of BIM technology is conducive to solving the communication barriers promoting coordination between the parties, and assisting them to complete the corresponding cost control task according to the division of responsibilities. To fully exploit the benefits, it is necessary to build a five-dimensional building information modeling (BIM5D) management platform for all parties to share and provide information within the scope of authority. It is also necessary to adjust the cost control process and improve the cooperative working mechanism and participation of each party involved. Principle of effective information: the cost control of construction projects is accompanied by the generation and processing of a large amount of information and data, which has high requirements on the real-time, security, integrity, and accuracy of information. The application of BIM technology is conducive to improving the reliability of the decision-making basis, strengthening vertical multi-party communication, and realizing dynamic cost control. To capitalize on the advantages, it is necessary to build a BIM5D management platform to reduce the loss of horizontal information, feedback on the progress of project entities in real time, and avoid the problems of information redundancy and information isolation caused by repeated modeling and software differences.

The application level of BIM technology depends on the degree of meeting the needs of all parties and also determines the effectiveness of cost control. Therefore, the purpose of the BIM technology application scheme is to achieve demand transformation with the help of the technology, form value attraction to promote the active cooperation of all parties in cost control, and provide a direction for the realization of value-added projects [9]. According to the priorities, content, and attributes of different requirements, BIM technology is applied to solve them in different ways. According to the analysis of BIM technology and requirements, optimize the application of BIM technology in construction engineering cost control based on the principles of project value-added, full

participation, and effective information. Specifically, build a BIM5D management platform to solve technical problems and meet the needs of function expansion and technical upgrading, such as strengthening visualization and analog features, improving graphic recognition rate, and supporting data linkage to ensure the effectiveness of information. Moreover, adjusting the cost control process to solve the problems of the organization and management level, and meet the needs of multiple cooperation and coordination, such as obtaining information according to authority, ensuring information security, and ensuring full participation. Among them, the BIM5D management platform is the basis for improving the cost control process, and the cost control process is a means to play the value of the BIM5D management platform, both of which are value-added services for the project.

BIM plays an important role in engineering cost estimation. It provides more accurate and reliable data, provides more efficient and visual tools, and can also provide a more comprehensive and sustainable analysis. However, its application still faces some challenges and limitations. Therefore, we need to further promote the development and application of BIM technology, strengthen training and education, and establish relevant standards and norms, in order to realize the maximum potential of BIM in engineering cost estimation. Only in this way can we make better use of BIM technology, improve the efficiency and quality of engineering projects, and promote the development of the construction industry ^[10].

Firstly, BIM technology can provide three-dimensional models of building projects, which provides intuitive and visual tools for project cost analysis. Through the BIM model, engineers and cost engineers can have a clearer understanding of the various parts of the construction project, including the structure, equipment, materials, etc. This allows them to more accurately assess the cost of the project and predict and adjust at different stages of the project. Simultaneously, the BIM model can also be integrated with other software, such as architectural design software and construction management software, to realize data sharing and collaborative work, and improve the efficiency and accuracy of project cost analysis.

Secondly, BIM technology can realize the information sharing and collaborative work of construction projects. Project cost analysis needs to involve many related parties, including architects, structural engineers, equipment engineers, suppliers, and so on. Traditional cost analysis often requires the exchange and sharing of information through paper documents or spreadsheets, which is easy to lead to inaccurate and incomplete information. BIM technology can realize the centralized management and sharing of building project information, and each relevant party can input and view the data on the same platform, thus reducing the error and time cost of information transmission. This makes the project cost analysis to more accurately reflect the actual situation of the project and provides a more reliable basis for the project decision-making.

Thirdly, BIM technology can also realize the simulation and optimization of building projects. In the project cost analysis, it is necessary to evaluate and compare the various schemes of the construction project to determine the most economical and reasonable scheme. Traditional cost analysis often requires manual calculation and hypothetical scenarios, which is cumbersome and error-prone. BIM technology can digitally simulate and optimize different schemes by building models and applying simulation software to quickly get the best scheme. This not only improves the efficiency of the project cost analysis but also reduces the impact of human factors on the results, making the decision-making more scientific and reliable.

In general, BIM technology plays an important role in engineering cost analysis. By providing an intuitive and visual three-dimensional model, it realizes the comprehensive and accurate project cost analysis. Furthermore, it improves the efficiency and accuracy of the project cost analysis through information sharing and collaborative work. Simulation and optimization of building projects produce a more scientific and reliable cost analysis. With the continuous development and application of BIM technology, it is believed that it will play a more important role in the future of engineering cost analysis.

3. Conclusion

The conclusion of whole-process engineering cost management based on BIM is based on the management and control of the whole-process of project cost based on the building information modeling (BIM). BIM is an integrated digital technology that enables information to be shared and work coherently during architectural design, construction, and operation. The whole-process of project cost management refers to the process of comprehensive management and control of the cost in the whole life cycle of the project. Through the whole-process project cost management based on BIM, the accurate prediction, efficient control and optimized management of the project cost can be realized. This management mode can improve the efficiency and accuracy of project cost management, and reduce the risk and cost of the project. Therefore, the whole-process engineering cost management conclusion based on BIM has practical significance and research value. Through the application and case study of the actual engineering project, this conclusion can be further verified and improved, and provide a scientific basis and guidance for the practice of project cost management.

Disclosure statement

The author declares no conflict of interest.

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