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Analysis on Risk Control of Civil Engineering Cost Based on BIM Technology

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Abstract: With the rapid development of my country's construction industry, people's requirements for construction quality and safety control are becoming more and more stringent. However, the results are often unsatisfactory, and the cost risk in civil engineering construction still cannot be effectively controlled. This article aims to study the risk control analysis of civil engineering costs based on BIM technology. This article analyzes the experiment from the perspective of quantification. The Experimental Integration Facility Engineering Center has conducted research on multiple BIM projects and learned about the actual operation status of these projects. Then summarize the actual effect of BIM technology. Experimental data shows that the use of BIM technology can improve the quality of design, quickly determine project cost, control design changes, avoid rework, and reduce costs. The experimental results show that the use of BIM can reduce the time used to estimate the cost to 35%, the accuracy of the estimate is controlled to <5%; the extra-budgetary changes are reduced to 70%; through the discovery and resolution of conflicts, the contract price is reduced by 13%; The project time has been reduced by 10%, and investment income can be obtained relatively quickly. Therefore, the research on construction hazard management and control based on BIM technology can not only promote the development of BIM information technology, but also make up for the inefficient and imperfect defects of hazard management and control, and greatly improve the cost risk of civil engineering.

1. Introduction

BIM (Building Information Modeling) is a new technology that has appeared in the construction industry in recent years. It builds digital information models through software, simulates the real information of buildings, and realizes the design, construction and operation management of construction projects. The modern information technology platform facilitates the horizontal information control and vertical information exchange of all participants, so that all participants of the project can realize data sharing at all stages, and better collaborate and communicate [1-2]. Borrmann et al. found through research that in the past, less than 13% of the people used BIM Technology, while the survey in recent two years showed that about 50% of them had applied BIM Technology. However, 43% of people had never heard of BIM Technology and related software [3]. In the analysis of BIM Technology in project cost risk management, the key task is to limit the actual cost to make it less than the estimated cost.[4] This paper mainly discusses the value of BIM Technology from the aspects of optimizing construction organization design, engineering quantity calculation, project adjustment, settlement progress payment, claim management and so on [5]. With the application of BIM Technology, cost practitioners should keep pace with the times, master BIM Technology, combine



advanced technology with actual engineering situation, innovate cost management mode, and further improve the refinement and informatization level of project management, which is more conducive to improving economic benefits [6].

2. Analysis and Research on Risk Control of Civil Engineering Cost Based on BIM Technology

2.1 Application Value and Advantages of BIM Technology

The increase in construction scale of construction projects will inevitably lead to the application of more complex technologies and methods, and the need for more personnel of different professions, safety management is extremely difficult, and it is easy to cause safety accidents. The visualization and synergy of BIM technology can provide users with powerful technical support, enabling them to realize dynamic and editable hazard management and control. BIM technology has the following characteristics:

(1) Component parameterization

In the process of using BIM to build a model, various primitives and selectable entities need to be expressed by geometric parameters. Only when parameters are used to standardize the model can the model show the most real and concrete architectural reality. Adjust the relevant parameters, the components will change accordingly, which also lays a good foundation for calculation and simulation.

(2) Data relevance

After assigning the parameter information to the components of the BIM model, modifying different parameters will change the associated primitives, without having to modify each part. For example, when the size and position of the windows on the wall are changed, the wall will be automatically connected to the modified window frame, and there is no need to change the primitives of the wall, so as to realize the automatic change of information and increase the relevance of component data.

(3) Model visualization

In the BIM model, information such as components, equipment, personnel, and venues can be displayed intuitively to form a three-dimensional visualization effect. Changed the abstraction and invisibility of 2D CAD drawings. Not only that, the BIM model can also simulate the entire construction process over time, providing a higher-level platform for safety management and control, and laying a good foundation for hazard management and control.

2.2 Countermeasures for Cost Risk Management of Civil Construction Projects Based on BIM

We can know that the use of BIM technology plays a very important role in the whole process cost management in the construction field of our country. The market prospect is very broad, and it will still be the focus of research in the future. Combining with the current problems encountered in using BIM technology in China, the following targeted strategies are proposed:

(1) Change thinking mode

Designers must change their thinking mode, from 2D to 3D, they must gradually adapt, the global construction industry is the same. In particular, many old employees have developed a flat mindset. If you want to adapt to the 3D mindset of BIM, you must achieve it through learning. BIM's 3D design is mainly for modeling in 3D space, and it must be understood in the process of analyzing 3D models. If you master BIM technology, the resistance will naturally disappear.

(2) Strengthen the research and development of domestic BIM technology products

At present, there is no domestic BIM Technology Software in the domestic construction market, and the foreign BIM Technology products do not meet the domestic construction industry standards. Therefore, it is necessary to strengthen the research and development of domestic BIM Technology products

(3) The government strengthens the promotion of BIM and formulates industry BIM standards

The government should grasp the current development trend of the construction industry, cooperate with relevant scientific research institutions and universities to formulate BIM specifications in line with domestic standards, find problems with the application of BIM Technology in major projects, improve BIM standards, and promote the application of BIM, so as to promote the rapid development of domestic construction industry through BIM Technology.

2.3 Risk Control Model of Civil Engineering Construction

The construction process is a dynamic activity, so the risk control of construction engineering is to continuously update and improve in this dynamic activity. The dynamic control of construction risks in construction projects includes five links: risk identification, risk evaluation, risk countermeasures, implementation decision-making and inspection. According to the structure function of the fault tree, the following minimum cut set of the fault tree can be determined:

$$\{X_1\}, \{X_2\}, \{X_3\}, \{X_4\}, \{X_5\} \quad (1)$$

X_1 represents excessive fatigue, X_2 represents inattention, X_3 represents poor emergency response system, X_4 represents lack of emergency measures, X_5 represents no seat belt.

The analysis of structural importance is to first analyze the structure of the fault tree to determine the importance of each basic event, and then through an assumption method, given a hypothetical condition, set each basic event to have an equal probability of occurrence, and then further analyze each basic event The degree of influence brought about by the occurrence of the top event. The structural importance of each basic event can be calculated by the following formula (2):

$$I_{\theta}(i) = \sum \frac{1}{2^{n-1}} (x_i \in K_j) \quad (2)$$

In the formula: $I(i)$ —the approximate judgment value of the importance coefficient of the basic event; K_j —included cut set (path set);

n —The total number of basic events in the minimum cut set (path set) where X_i is located.

The probability importance of a basic event refers to the rate of change of the occurrence probability of a top event to that basic event, and is calculated according to the following formula:

$$I_g(i) = \frac{\partial P(T)}{\partial q_i} \quad (3)$$

Where: $I_g(i)$ —the probability importance coefficient of basic event i ;

$P(T)$ —Probability of top event; q_i —Probability of occurrence of basic event i .

Using the minimum path set of the fault tree to determine the probability function of the top event occurrence is shown in formula (4):

$$P(T) = [1 - (1 - q)]^2 \quad (4)$$

P represents the probability of an event, and q represents the probability of a single event.

The critical importance indicates the importance of each basic event, and the relative change rate of the occurrence probability of the basic event is compared with the relative change rate of the top event. The calculation formula is shown in (5):

$$I_c(i) = I_g(i) \frac{q_i}{P(T)} \quad (5)$$

Where: $I_c(i)$ —the critical importance coefficient of the i -the basic event;

$P(T)$ —Probability of top event; q_i —the probability of occurrence of the i -the basic event;

$I_g(i)$ —The probability importance coefficient of the i -the basic event.

3. The analysis experiment of civil engineering cost risk control based on BIM technology

3.1 Experimental Design

In this paper, the space required for the establishment of the hazard information database for the construction of the surveyed construction project is not large, and for the consideration of enterprise

cost and the difficulty of personnel operation, the Access software is selected to create the hazard information database. The hazard source information database in this experiment is mainly to lay a data foundation for the management and control of hazard sources, so it includes modules such as construction engineering construction related laws and regulations, norms and regulations, hazard source standard parameters, hazard source evaluation levels and corresponding safety protection measures.

3.2 Experimental Principles

The establishment of the construction hazard information database needs to input the building laws and regulations, department rules and standards into the construction hazard information database. Through comparative analysis, we can judge the design defects or construction faults, and reduce the accidents caused by the failure to take measures against the hazard sources in time according to the standards.

4. Analysis and discussion of civil engineering cost risk control based on BIM technology

(1) If analyzed from the perspective of quantification, the Experimental Integration Facility Engineering Center of this article has conducted research on a number of projects using BIM to understand the actual operating conditions of these projects, and then summarize the actual effects of BIM technology: it can estimate The time spent on the construction cost was reduced to 35%, and the accuracy of the estimation was controlled to <5%; the extra-budgetary changes were reduced to 70%; the contract price was reduced by 13% through the detection and resolution of conflicts; the project time was reduced by 10%. Obtain investment income relatively quickly. The specific data is shown in Table 1 and Figure 1.

Table 1. The actual effect of BIM technology

Types of	Change range(%)
Time to estimate the cost	-35
Estimated accuracy control	<5
Extra-budgetary changes	-30
Contract price	-13
Project time reduction	-10

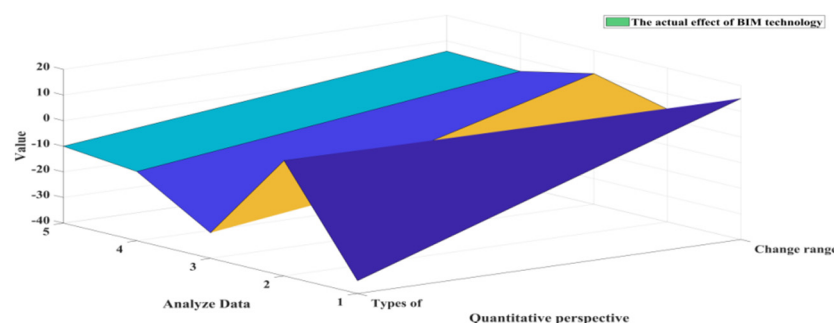


Figure 1. The actual effect of BIM technology

(2) In this paper, the experimental results are shown in Table 2. Through comparative analysis, we can draw a conclusion: BIM can help improve the efficiency of construction projects and improve their management level, which has great advantages. The use of BIM technology can improve the quality of the design, quickly determine the project cost, control design changes, avoid rework, reduce costs, and can greatly avoid the risks encountered in design, bidding and execution of the contract.

Table 2. Cost adjustment after using BIM

	Change range(%)
Coordinated design	-5.6
Help everyone understand the project	-1.9
Handling their conflicts	-3.5
Through automatic connection to the property management database	-26.4
Improve the efficiency of property management	-11.3

5. Conclusion

The occurrence of civil engineering construction safety accidents is closely related to the hazard sources in the building construction. This article uses the visualization and synergy of BIM technology to conduct dynamic information management and control of the hazard sources in building construction to reduce risks, optimize construction plans, and improve The purpose of safety and efficiency in construction production. The experimental results show that the use of BIM can reduce the time used to estimate the cost to 35%, and the accuracy of the estimate can be controlled to <5%; reduce the extra-budgetary changes to 70%; through the discovery and resolution of conflicts, the contract price is reduced by 13%; The time is reduced by 10%, and investment income can be obtained relatively quickly. BIM technology collects, identifies, analyzes, manages and controls hazard information, which can reduce the probability of accidents due to the failure of timely identification of hazards and the failure to eliminate hidden dangers during the construction process, and promote efficient and safe production in the construction industry.

References

- [1] Zhang Jianping, Li Ding, Lin Jiarui, Yan Gangwen. Application of Bim in engineering construction [J]. Construction technology, 2012,41 (16): 10-17
- [2] Romuald Szeląg. The Use of BIM Technology in the Process of Analyzing the Increased Effort of Structural Elements. 2017, 172:1073-1076.
- [3] Borrmann, Andre, Markus et al. BIM in Industrial Prefabrication for Construction[J]. Building Information Modeling (Technology Foundations and Industry Practice), 2018, 10.1007/978-3-319-92862-3(Chapter 25):413-420.
- [4] Su-Ling Fan, Heap-Yih Chong, Pin-Chao Liao, et al. Latent Provisions for Building Information Modeling (BIM) Contracts: A Social Network Analysis Approach. 2019, 23(4):1427-1435.
- [5] Salehi, Yitmen. Modeling and analysis of the impact of BIM-based field data capturing technologies on automated construction progress monitoring[J]. International Journal of Civil Engineering, 2018, 16(12):1-17.
- [6] Sy-Jye Guo, Taibing Wei. Cost-effective energy saving measures based on BIM technology: Case study at National Taiwan University. 2016, 127:433-441.