

BIM in Construction Management of Large Power Transmission and Transformation Projects

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Abstract: With the rapid development of large-scale transmission and transformation power grids, the construction of transmission and transformation transmission lines has reached a climax. General transmission and transformation transmission projects are capital and technology-intensive projects. It is particularly important to strengthen the management of transmission and transformation lines and achieve multiple objectives such as economic development, sustainable energy development and environmental protection. The purpose of this article is to study the application of BIM in the construction management of large power transmission and transformation projects. This paper analyzes the application of BIM in power transmission and transformation engineering construction management, understands the problems that occur in power transmission and transformation engineering construction management, and the main factors that affect the level of construction management. Furthermore, an optimization plan for building construction management is proposed. The experimental results show that the research in this paper can bring further development to the application of BIM technology in engineering. In this paper, through experiments on the main factors of the construction of a power transmission and transformation project, it is found that the most influential factors are the design factors, and the order of importance is 0.085.

1. Introduction

The project management of power transmission and transformation has many similarities with the traditional construction project management, but in view of the specific nature of power transmission and transformation engineering, the construction projects of power transmission and transformation are multi-faceted and involve many cross-border industries [1 -2]. But its management content is different from traditional engineering project management [3]. Studies have shown that in the power industry, the deep application of project management is mainly reflected in large-scale construction projects such as large power stations, large substations, and sensor stations [4]. Most applications are still using enterprise management methods for transmission and transformation project management [5]. In addition, these construction management departments mainly use experience management in project management and cannot adapt to the construction characteristics and rules of transmission line projects. Due to the lack of effective management systems and methods, after the trial operation, due to equipment defects and hidden problems caused abnormal startup and many other problems [6].

Because power companies are capital-intensive enterprises, in the construction of UHV transmission line engineering projects, single investments often amount to billions or even tens of billions of dollars [7]. By strengthening project management and reducing construction costs, it is possible to effectively save state-owned assets, shorten construction cycles, and improve construction quality, and obtain economic benefits in advance and continuously [8]. By adjusting technology, visualization, simulation and optimization, BIM achieves the advantages of 3D simulation, visual inspection, accurate calculation of the number of projects, and more accurate, timely, and appropriate project management information exchange to achieve the above goals [9].

BIM technology is based on information data related to construction projects to construct architectural models, which are suitable for some large-scale sign projects. BIM technology is widely used in construction project management, and application projects in power construction projects are also under continuous development [10]. The application of BIM technology to power transmission and transformation project management is an inevitable choice for industrial development.

This paper analyzes the BIM technology at the level of power transmission and transformation engineering construction management, finds out the problems in power transmission and transformation engineering construction management and the main factors that affect the level of construction management, and then puts forward an optimization plan for building construction management. The experimental results show that the research in this paper can bring further development to the application of BIM technology in engineering.

2. Method

2.1 BIM Technology

The principle of BIM technology is based on the working principle of the database model platform to obtain plane, vertical, slice and perspective effects. In the design and construction process, any part of the model is modified, and all drawings reflecting the information in the construction project can be updated automatically and synchronously. However, the original principle of the above BIM technology has always been the research direction of practitioners in the BIM industry, and it is also the theoretical basis for BIM-related software manufacturers to develop their product functions.

2.2 AHP

(1) Model establishment

The establishment of a risk analysis model mainly uses risk identification as the basis, by grouping different risks identification, and then establishing the corresponding structure according to the model establishment rules and levels. The factor layer is the bottom layer in the hierarchical structure model, and all factors are sorted at this level; the standard layer is at The organization belongs to the middle layer. As a sorting criterion, it plays a role of inheritance and succession. The target layer is the highest level. The factor layer: there are many levels of risk identification factors; the standard layer: the probability of judging factors as a standard and the degree of results produced; the target layer: the goal of quantitative assessment.

(2) The structure of the matrix

After establishing the risk structure model, determine the connection between the superior and the subordinate. Suppose the matrix $A = n \times (a_{ij})n$; if the element factors of the matrix satisfy the condition $a_{ij} + a_{ji} = 1$, then the matrix A is a complementary matrix. By comparing the factors a_1, a_2, \dots, a_n , the following matrix is obtained:

$$A = \begin{bmatrix} a_{11} & a_{12} & \dots & a_{1n} \\ a_{21} & a_{22} & \dots & a_{2n} \\ \dots & \dots & \dots & \dots \\ a_{n1} & a_{n2} & \dots & a_{nn} \end{bmatrix} \quad (1)$$

It can be seen that the matrix $A = n \times (a_{ij})n$ satisfies each row sum $r_i = \sum_{k=1}^n a_{ik}$. Make a mathematical transformation $r_{ij} = \frac{r_i - r_j}{2(n-1)} + 0.5$ to get the fuzzy consistency matrix $R = (r_{ij})_{m \times n}$, and for the matrix R processing, get the ranking weight vector $W = (W_1, W_2, \dots, W_n)^T$ of A:

$$\sum_{i=1}^n w_i = 1, w_i \geq 0, (i = 1, 2, \dots, n) \quad (2)$$

The characteristic matrix of matrix A is $W^* = (W_{ij})_{n \times n}$.

(3) Hierarchical order

Single-level sorting. The vector $W = (W_1, W_2, \dots, W_n)^T$ by definition refers to the relative weight relationship of the elements of the hierarchical structure corresponding to the previous level.

Sort by total level. The ranking of each level is mainly based on the weight of importance before the goal.

3. Experiment

3.1 Experimental Subjects

A large-scale power transmission and transformation project is the company's first batch of BIM pilot projects, and has been widely recognized by the owners and participants. This project achieved the construction quality management based on BIM technology by establishing the corresponding quality management system and clarifying the preliminary implementation standards of BIM. The purpose of applying BIM technology in engineering is to solve construction problems, improve the quality management level and achieve project quality objectives, and accumulate management experience of BIM technology promotion and application.

3.2 Experimental Method

By identifying and analyzing the construction management factors of experimental engineering projects, according to the management objectives and management nature of construction project management, they are classified from macro policy, economic and environmental factors, and construction management involves design, construction, contract and other factors. Then establish a hierarchical analysis model of construction management factors of experimental engineering. The construction management factors are shown in Table 1.

Table 1. Construction management factors

Target layer	Risk layer	Content layer
Goal A	Probability of BIM riskB1	Political FactorsC1
		Economic factors C2
		Design factor C3
		Construction factor C4
		Management Factor C5
		Contract Factor C6
		Environmental factors C7

4. Discussion

4.1 Experimental Results and Discussion

The weight is the relative weight between the elements in this layer relative to the upper layer, and the corresponding weight is marked in the hierarchy analysis structure diagram to get Table 2 and Figure 1. The relative weight of each element can be clearly seen from Table 2 and Figure 1. Table 2 and Figure 1 are as follows.

Table 2. Experimental results

Factor	Sort vector
C1	0.056
C2	0.085
C3	0.086
C4	0.064
C5	0.059

C6	0.069
C7	0.068

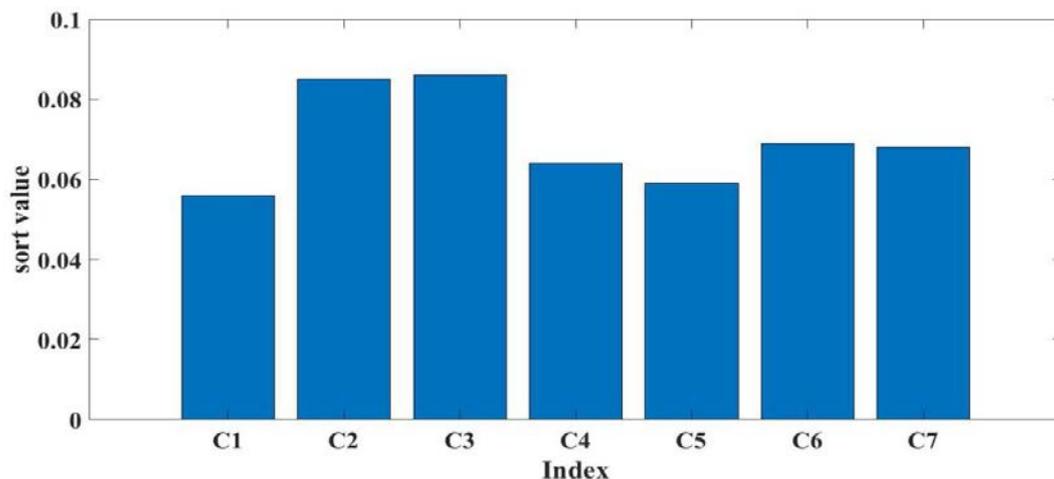


Figure 1. Experimental results

According to the difference of the above calculation results, the weight ordering can determine the key influencing factors of the large-scale transmission and transformation project based on BIM. In order of probability of occurrence, policy changes, low management level, and poor performance are influencing factors; unreasonable policy changes and design schemes are the most important factors affecting construction management losses; when considering related losses and probability of occurrence, the changing policy factors, unreasonable design schemes, low site management, and poor performance are key factors.

4.2 Optimization Suggestions of BIM Technology in the Construction Stage of this Project

(1) Optimization of BIM quality management during construction

By inputting the data formed during the construction into the model, and improving the BIM repository, in order to facilitate the subsequent data call. The completion of the data is faster and more convenient, ensuring the integrity. Navisworks software enters the relevant information of the drawing changes in order to save the drawing change information in the information model for easy search. Record the change number and label change component through Navisworks.

During the modeling process, if there is any actual situation that does not conform to the drawings, it can communicate and negotiate with the owner in time, and feedback to the relevant design unit. Auxiliary design drawings can be revised, and these drawings are clearly found when building the BIM model.

(2) Optimization of BIM safety management during the construction phase

In engineering safety management, time is more important than cycle, sight is more important than hearing, knowledge is more important than approval, and vision is more important. BIM technology can be used to manage the safety of the construction phase, can be used for the layout of field operations, three-dimensional construction simulation, edge safety protection, safety color code management and the use of safety technology.

Conclusion

At present, BIM technology has become an important scientific tool for construction project management and represents the development trend of the industry. With the continuous development of BIM technology, the development of market economy has promoted the continuous deepening of the application of project management based on BIM technology in the construction industry. He and the ministry of rural development are also actively formulating a variety of priority policies to guide the development and application of BIM technology. It is expected that BIM technology will be fully applicable to the overall life cycle management of the construction industry

in the future. The comprehensive development and application of BIM technology in the construction industry will also have an impact on power construction projects. In order to improve the management level of power construction projects, related departments are actively implementing research and application projects. In the process of project construction, multiple participants based on BIM worked together to improve the level of information management, and work efficiency and construction management cost control achieved good results. However, there are still a series of problems that need to be solved in the application, including technical and management, which requires further testing and running in.

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