Research on the Efficiency Path of Civil Construction Management Engineering Based on BIM Technology

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Abstract: My country’s economic pillar industry is the civil construction industry. With the rapid development of our country, modern buildings have greatly increased the difficulty of construction project management due to complex construction techniques and long construction periods. Therefore, we must improve the traditional. In this way, the management model can better improve engineering efficiency. This article is based on the BIM technology of the civil construction management engineering efficiency path to study, the experiment uses the analytic hierarchy process to determine the weights, in order to evaluate the BIM technology of construction engineering safety management. Three local survey units were selected for the experiment, and the survey form was distributed to each unit according to the experimental procedures and requirements. When handing over the BIM model, it could give the acceptance conclusion of the model. Experimental data shows that the incidence of accidents at the entrance of the cave and the border is the highest, which is the most difficult point in construction safety management. Effective measures should be taken to reduce the occurrence of accidents. The experimental results show that the following problems in BIM application have led to a reduction in the efficiency of civil construction management engineering: 85% of BIM standards are unfamiliar, 79% of BIM technology costs are overused, BIM technology is poorly applied 82%, and BIM-related software is not applied. Mature accounted for 78%, and BIM related management methods accounted for 80%. The use of BIM technology can provide an effective way to improve the efficiency of construction project management. This article conducts in-depth research on BIM technology, hoping to make a meager effort in related fields.

1. Introduction:
BIM stands for Building Information Modeling. The full name is Building Information Modeling. It can integrate the engineering planning, information and resources of an engineering project at different stages in its life cycle into one model, bringing convenience to the construction and maintenance of the project [1-2]. After 3D CAD technology, BIM is another computer information-assisted technology that promotes the modernization of construction engineering management. Unlike 3D CAD technology, it simulates the real information of buildings through three-dimensional digital technology to provide engineering design and construction. The mutually coordinated and internally consistent information model enables the model to achieve the integration of design and construction, and the various disciplines work together, thereby reducing the production cost of the project and ensuring that the project is completed on time and with quality [3-4].

Wayne et al. believe that the safety of building construction can be solved by the automatic safety regulations of the building information model, and the hazard sources detected by the building model...
are automatically analyzed one by one, and corresponding preventive measures are taken against the high-altitude fall accident [5]. The automatic safety detection platform informs engineers and managers of the cause, location, time, safety measures, etc. of accidents that need to be prevented before construction begins. Assaf et al. believe that the characteristics of integrated design and collaboration functions of building information model technology can be used to enhance the safety of construction sites and carry out safe construction planning [6]. Building Information Modeling (BIM) has special properties that can be combined with construction safety management and can prevent hazards. In order to expand the security management in the application of these technologies, and to extend the application of more technologies to the security management, it is necessary to define the functions and advantages of BIM [7].

With the popularization and application of BIM technology and the continuous improvement of national policies, BIM technology is becoming more mature. Through informational means such as model construction and experimental simulation, some problems that may occur in construction projects are predicted, and solutions and improvement measures are proposed to ensure the quality of the project, reduce project risks, and increase the life expectancy of the building. A large number of complex data are classified and statistically sorted, and the actual cost data is entered into the database in time, and then the data is used at any time to conduct rapid and multi-faceted cost analysis of the project, saving manpower, material resources, and financial resources, thereby improving the efficiency of project management [8-9]. The use of BIM technology provides an effective way to improve the efficiency of construction project management[10].

2. Research on the efficiency path of civil construction management engineering based on BIM technology

2.1 Features of BIM
(1) Visualization features
Modern buildings have complex shapes and different forms, which people cannot imagine completely through their brains. However, BIM with visual characteristics can allow flat, line-like objects to be displayed in front of people as a three-dimensional three-dimensional physical image. However, the visual feature of BIM technology is a feature that can be linked with different parts and can be fed back. Using BIM technology, the entire life cycle of a construction project can be visualized. Therefore, BIM can not only display renderings, generate reports, but also communicate in the entire construction process, discuss and make decisions in a visual state.
(2) Features of drawing available
The drawings of BIM are not the usual design drawings of the Architectural Design Institute, but the following drawings that help the owner obtain the following drawings after visual display, dynamic simulation, and optimization and coordination of the building information model:
1) Comprehensive pipeline diagram (after collision detection and modification, there is no error);
2) Hole diagram of comprehensive structure (pre-embedded casing diagram);
3) Collision inspection report and suggestion improvement plan.
(3) Coordination characteristics
When designing, inadequate communication between various departments often results in collisions between different parts of the work, such as piping for heating, ventilation, air conditioning, etc., each department can only be responsible for completing its own construction drawings. When laying pipelines in actual operation, there may be structurally designed beams and other components in this place, which hinder the laying of pipelines. This is a common collision problem. Solving this kind of problem should not be solved after a problem occurs. The coordination feature of BIM can solve such problems in advance. In the early stage of construction, BIM technology is used to coordinate collisions between various departments and provide coordination data. Solving the collision problem is not the only function of BIM coordination. Coordination of elevator shaft layout, fire zoning, underground drainage layout and other layouts can also be done through it.
2.2 AHP Method to Determine the Weight

In this paper, a multi-level fuzzy comprehensive evaluation method is used to study the safety management evaluation of construction projects based on BIM technology. First, the analytic hierarchy process is used to determine the weight.

(1) Determine goals and evaluation factors

P evaluation indicators, as shown in formula (1):

\[ u = \{u_1, u_2, \ldots, u_p\} \]  

(1)

(2) Construct a judgment matrix

Using its reciprocal scaling method, the judgment matrix is obtained as shown in formula (2):

\[ S = (u_{ij})_{p \times p} \]  

(2)

(3) Use Matlab to calculate the maximum eigenvalue \( \lambda_{max} \) of the judgment matrix and its corresponding eigenvector \( A \). This eigenvector is the order of importance of each evaluation factor, that is, the distribution of weight coefficients. In order to check the consistency of the judgment matrix, the consistency index needs to be calculated as shown in formula (3):

\[ CI = \frac{\lambda_{max} - n}{n - 1} \]  

(3)

(4) Determine the scope of the comment rating

Each level corresponds to a fuzzy subset as shown in formula (4):

\[ v = \{v_1, v_2, \ldots, v_p\} \]  

(4)

(5) Determine the weight vector of evaluation factors

Determine the weight vector of the evaluation factor. The element \( a_i \) in the weight vector \( A \) is essentially the membership degree of the factor to the fuzzy subset, as shown in formula (5):

\[ A = (a_1, a_2, \ldots, a_p) \]  

(5)

2.3 The Effective way of BIM Technology to Improve the Efficiency of Civil Engineering Management

(1) Project decision-making.

In the design stage of a construction project, the influence of environmental factors on the later engineering operations should be considered, and the location of the building should take into account the effects of factors such as geographic location and topography. BIM technology is different from traditional terrain simulation analysis. It can directly and effectively simulate and calculate the on-site environment, efficiently analyze the constraints of terrain, wind speed and other factors on the building structure, comprehensively and completely analyze and organize information and data, and optimize engineering project assumption. And improving the experience played an important role.

(2) Project design and implementation.

When the construction project is still in the design stage, BIM technology can digitize the complex spatial structure and environmental factors, informatize and systematically organize the structure of the project, and also virtualize and visualize large-scale physical projects. More intuitive manufacturing data model instead of keeping the design concept in paper graphics. BIM technology can automatically check whether the design conforms to the plan, and can analyze the sunlight conditions, energy consumption and heat transfer status of the external maintenance structure within a certain range. In the process of project implementation, it can also refine the problem and guide the project to be completed more efficiently. In the process of project handover, BIM embodies the advantages of data sharing, effectively avoiding the repeated entry of data and information, and ensuring the connection between the design, structure, and equipment of the project. In addition, BIM technology can also dynamically manage the resources of the construction process. According to the BIM systematic classification and statistics of project costs, the construction volume of components, the consumption rate of materials, human resources and the utilization rate of machinery can be uniformly calculated and calculated. Analyze, make a dynamic comparison with the budget, and
timely feedback to the project management department to realize the dynamic management of resources.

(3) Acceptance and operation and maintenance after the completion of the construction project

BIM technology has brought great convenience to the data collection in the early stage of decision-making, design, and construction, for the later acceptance check and operation and maintenance. For detailed problems that may occur after the completion of the construction, the information feedback of the database can be used to find the crux of the problem more quickly and conveniently, and solve the problem more effectively. Prior to this, the application of BIM technology in the completion and acceptance phase of construction projects actually effectively improved the accuracy and scientificity of the inspection, and reasonably avoided the problems that would arise in later maintenance.

3. Experiment on the efficiency path of civil construction management engineering based on BIM technology

3.1 Experimental Research Objects

The experiment clarified the final questionnaire based on the preparation work of the survey, selected three local survey units, and distributed the questionnaire to each unit according to the requirements of the survey unit, and gave timely answers to the problems caused by the ambiguity of understanding during the survey process. Retrieve the questionnaire within a period of time, check the validity of the questionnaire, and summarize and analyze the content of the feedback.

3.2 Experimental Procedure

(1) Check the consistency between the actual construction and the BIM model, issue corresponding inspection reports and supervise rectification;
(2) Review the results of BIM construction schedule simulation and BIM construction special plan simulation submitted by the contractor, propose amendments, and supervise the implementation;
(3) In the acceptance of each sub-item, corresponding inspection reports and acceptance conclusions must be issued based on the BIM model;
(4) At the time of completion acceptance, extract the final delivery model and check whether the model is true or not. At the same time, when the BIM model is handed over, the acceptance conclusion of the model is given.

4. Discussion on the efficiency path of civil construction management engineering based on BIM technology

(1) It can be seen from Table 1 that the main locations of construction safety accidents in the survey area are: openings and borders, tower cranes, scaffolding, formwork, foundation pits, etc. Among them, the incidence of accidents at the entrance and the border is the highest, which is the most difficult point in construction safety management. Effective measures should be taken to reduce the occurrence of accidents.

| Area | Entrance and rim | Tower crane | Scaffold | Template | Foundation pit | Other |
|------|------------------|-------------|----------|----------|----------------|-------|
| 1    | 18.99            | 10.03       | 12.67    | 7.66     | 8.87           | 41.78 |
| 2    | 21.67            | 12.97       | 11.78    | 7.66     | 7.13           | 38.79 |
| 3    | 23.98            | 13.08       | 13.87    | 5.22     | 8.94           | 34.91 |

(2) BIM technology has been recognized by all participating units in the process of promotion and application, but the value of BIM technology has not been truly reflected. BIM technology is not a model application in a certain stage or process of the construction process. For example, the display of
three-dimensional models or pipeline collision detection, BIM technology is a collaborative management process that runs through the life cycle of the project, and interactively integrates the project parameterized model with the project management process, so that each participating unit can achieve high efficiency based on a unified platform. The sharing of resources, truly realize the digital management of the project. During the investigation process, various regions stated that the following problems still exist in the application process of BIM, as shown in Table 2:

| Question type                                                                 | Specific manifestation                                                                 | The proportion% |
|------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|-----------------|
| **The relevant laws, regulations and standards are not sound, and they are not familiar with BIM standards** | 85                                                                                    |
| **BIM technology is too expensive to use, mainly including related supporting facilities and professionals** | 79                                                                                    |
| **BIM technology is more likely to be applied in complex projects, but is less applicable in general projects** | 82                                                                                    |
| **BIM related software applications are immature, mainly reflected in the conversion between different software** | 78                                                                                    |
| **There is a difference between the current management model and the BIM technology supporting situation** | 80                                                                                    |

5. Conclusion

Through research in this article, it is found that the following problems in the application of BIM lead to a reduction in the efficiency of civil construction management engineering: 85% of BIM standards are unfamiliar, 79% of the cost of BIM technology is excessively high, 82% of BIM technology is poorly applied, and BIM-related software applications immature accounts for 78%, and BIM-related management methods account for 80%. Through research, a BIM-based construction safety management model for construction projects has been obtained. The application of BIM technology to construction safety management of construction projects is conducive to improving the current level of safety management in the field of construction and reducing or avoiding the occurrence of safety production accidents. People’s lives and property are lost, thereby achieving the goal of construction safety management.

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