

Construction of Construction Engineering Quality Supervision and Management System Based on BIM

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Abstract. The quality supervision and management of construction projects is an important content in the management of construction projects. The construction quality of construction projects is related to the reputation and image of construction enterprises and the vital interests of residents. If we neglect the quality supervision and management of construction projects, it will increase the quality risk of construction projects and cause very serious consequences. Therefore, this paper constructs the quality supervision and management system of construction projects based on BIM. Because of the huge amount of data in the whole high-rise building project, it is inevitable that data will be transmitted and shared in the model, and storage resources often need to be calculated, processed and deleted. The application of cloud technology can improve the data integration problem. The perfect construction management system of architectural engineering consists of four aspects: ideological guarantee system, organizational guarantee system, work guarantee system, institutional guarantee system and economic guarantee system. During the construction process, BIM related technologies are used to control the quality.

Keywords: BIM; Construction engineering; Quality supervision and management system.

1. Introduction

In recent years, with the rapid development of China's social economy, modern engineering technology is constantly undergoing technological innovation, and the construction quality standards of building projects are constantly developing towards standardization and systematization. The quality supervision and management of construction projects is an important content in the management of construction projects. The construction quality of construction projects is related to the reputation and image of construction enterprises and the vital interests of residents [1]. Against the background of today's highly developed science and technology, the transformation of engineering quality supervision and management into science and technology, modernization and informatization is an important trend of industrial technology progress and development. Only by actively recognizing the technical development trend of this industry and studying the application of information system in the industrial field with a forward-looking vision can the engineering quality supervision and management work keep pace with the times and improve the work quality and efficiency [2]. The construction quality supervision system of building engineering is an important part of building engineering, which is related to the quality and safety of the whole project. The construction unit not only needs to ensure the construction safety according to the relevant construction standards in China, but also needs to strengthen the construction of quality supervision system and thoroughly implement the supervision and management system of building engineering construction [3]. If we neglect the quality supervision and management of construction projects, it will increase the quality risk of construction projects and cause very serious consequences. In view of the problems existing in the quality supervision and management of construction projects, relevant units are required to pay more attention to them. Therefore, this paper constructs the quality supervision and management system of construction projects based on BIM. Before the construction of the project, it is necessary to organize the construction of the information management system for the construction personnel of the project for technical disclosure, and collect and input the information about the construction quality and operation technologies in the construction process [4]. By deeply analyzing the application of BIM technology in the process of project quality supervision and management, this paper tries to solve the current situation of weak supervision power, low

supervision efficiency, single supervision method and backward supervision means in the current supervision system. BIM technology is an information integration and management technology based on three-dimensional building model, and it is a data tool applied to engineering design and construction management. How to use BIM technology in engineering quality supervision and management, and build a systematic scheme to realize the informatization and scientific transformation of engineering quality supervision and management, this paper discusses this topic in detail with specific practice [5].

2. The current problems in the quality supervision of construction projects

2.1 Backward regulatory methods

From the overall situation of construction project management, most construction units still use the extensive quality supervision and management mode of the past. The methods for quality management of construction projects are relatively outdated and the application of modern management tools is insufficient. The construction contracting method in China is a lifelong responsibility system, which means that the construction contractor must ensure the construction quality of the building and bear corresponding legal responsibilities. Therefore, the construction contractor should establish a corresponding and perfect construction project quality Supervisory control management body for specific projects during the construction of the project, and control the project quality as a whole [6]. With the development of the times, regulatory methods and management methods can no longer meet the high-quality needs of the new era, manifested in the following aspects: firstly, empirical judgment is greater than scientific decision-making. In the process of supervision and management, the subjective judgment of regulatory personnel is still the main factor in identifying and handling problems, and there is a lack of comprehensive and effective scientific decision-making methods[7]. The discovery of engineering quality problems lags far behind the construction process, and the detection results lag behind. After the problems are exposed, the site is already hidden or there are often problems discovered during the quality acceptance stage, and then rework occurs[8]. In the quality supervision institutions of construction projects, the quality supervision and management system plays a very important role. Currently, in the construction process of construction projects in China, there is no effective integration with social supervision forces. Therefore, we still need to continuously improve and innovate the construction project supervision and management system, which is a relatively difficult project.

2.2 The problem of information silos is widespread

In current construction projects, due to the large scale and large amount of work, many construction units adopt subcontracting or subcontracting methods for construction. The speed of China's economic development is becoming faster and faster, and the level of science and technology has been greatly improved. The traditional quality supervision and management system of construction projects is no longer suitable for the development needs of modern construction enterprises, and a large number of construction drawings, inspection reports, management information, etc. are not processed in a timely manner, making them inadequate. Some parties involved in engineering construction, design, construction, supervision, and other aspects, as well as the construction administrative authorities, have established an information management platform suitable for their own unit's work management from their respective perspectives[9]. The work of engineering quality supervision and management is not an unchanging fixed content, but is in a dynamic development process based on the industry technology development of engineering construction and the practical transformation of engineering project construction[10]. Some contractors with incomplete qualifications and inadequate technical skills are often mixed into the construction team, resulting in problems of cutting corners and operating in violation of regulations during the construction process, increasing the probability of quality problems [11]. However, the standards of each management platform exist independently and operate independently, which cannot

effectively achieve data, information, and other interconnections, leading to information isolation between various quality supervision systems.

2.3 The quality supervision and management system is not sound

At present, most construction engineering units have the problem of focusing on construction but neglecting management, blindly catching up with the construction period and reducing costs in construction. The development of construction engineering quality management starts from the initial self-discipline and self-supervision of the construction unit, to the joint supervision and quality acceptance of the construction unit and the entrusting party, and finally to the government to formulate relevant construction standards, the construction unit carries out construction according to the standards, and the entrusting party carries out acceptance according to the relevant standards [12]. The per capita supervision area of engineering quality supervision institutions has already exceeded 200,000 m², and the per capita supervision area of many districts and counties with rapid development has far exceeded one million m². The supervision power is seriously insufficient, and it is impossible to implement differentiated management and deeply analyze and treat common quality problems. According to the National Analysis Report on the Situation of Construction Safety in Production from 2015 to 2022, the number of deaths in the construction safety accidents in China from 2015 to 2022 can be listed, and the results are shown in Figure 1.

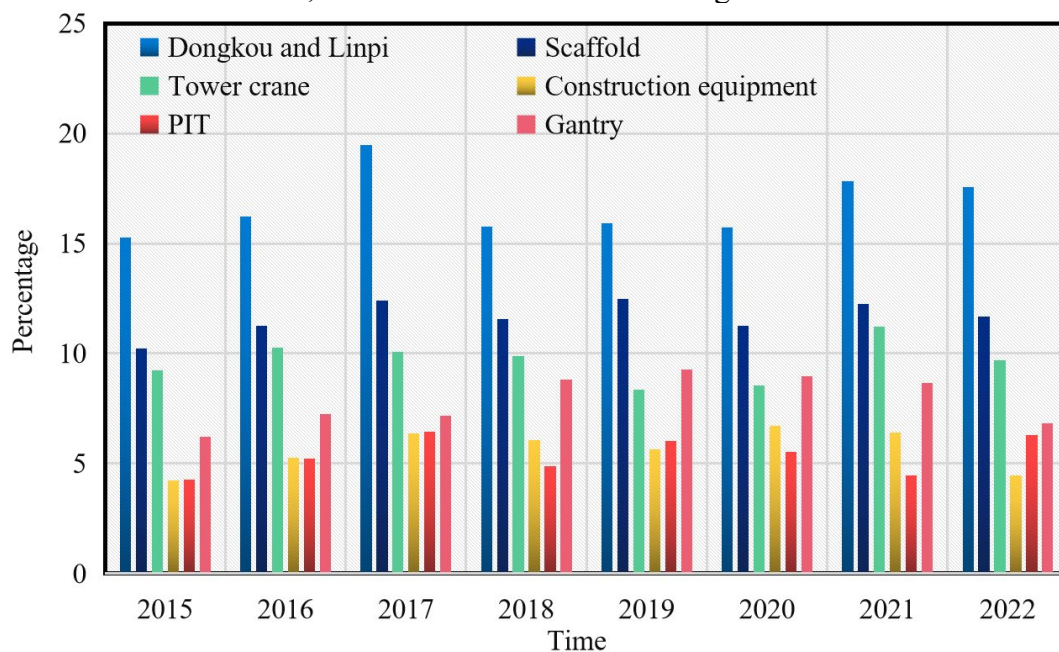


Figure 1 Number of fatalities in construction safety incidents in China from 2015 to 2022

By analyzing and analyzing the types of construction accidents in China from 2015 to 2022, we can obtain the types of construction safety accidents in China in recent years, as shown in Table 1. □

Table 1 Statistical Analysis of Construction Accidents in China from 2015 to 2022

| Time | Accident type | | | |
|------|-------------------------|-----------------------------------|-------------------|--------------------|
| | Falling from height (%) | Accidental collapse accidents (%) | Object Strike (%) | Lifting injury (%) |
| 2015 | 51.23 | 14.23 | 14.25 | 7.56 |
| 2016 | 54.26 | 14.56 | 14.89 | 7.89 |
| 2017 | 55.59 | 13.53 | 14.56 | 7.12 |
| 2018 | 57.14 | 14.25 | 15.62 | 7.56 |
| 2019 | 52.36 | 14.39 | 15.02 | 7.89 |
| 2020 | 55.49 | 13.89 | 14.89 | 8.02 |
| 2021 | 59.52 | 14.57 | 15.26 | 8.16 |
| 2022 | 57.48 | 14.79 | 15.46 | 8.53 |

From Table 1, it can be seen that the main types of construction accidents in China are: high-altitude falling accidents, accidental collapse accidents, object strike accidents, crane injury accidents, and other accidents. Falling from high places accounts for more than half of the safety accident types with 53.22%, making it the most likely type of safety accident to generate safety risks in construction projects from 2017 to 2022.

In 2018, there were multiple major safety accidents in housing and municipal engineering projects. As shown in the figure, the highest proportion of scaffolding and portal edge accidents are 28 percentage points and 36 percentage points, respectively, with a total accident proportion of 64 percentage points.

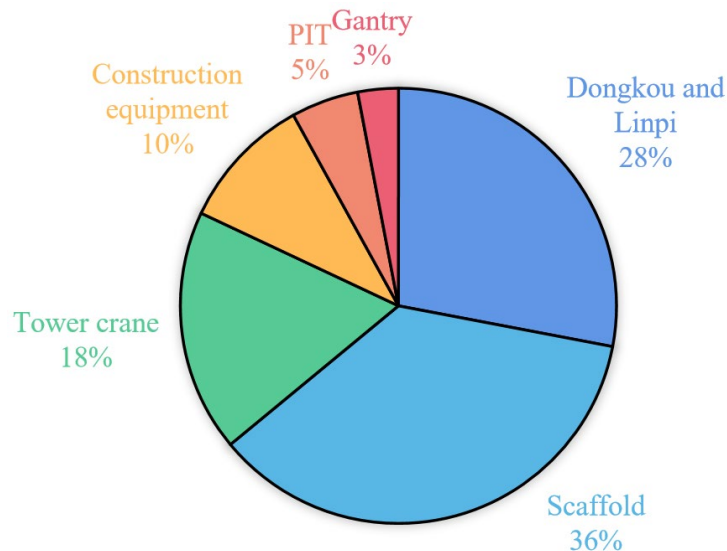


Figure 2 Analysis of the number of major accidents in 2018

If there are some problems in the quality supervision and management of construction projects, the division of responsibilities is not clear enough, and the responsibilities undertaken by various departments are not clear, it is easy to shirk responsibility and kick the ball. There are certain loopholes in daily quality supervision and management, which result in a large number of non-standard behaviors in the actual construction process. Some aspects of supervision are weak or even unmanned, which restricts the effective implementation of construction project quality supervision and management work [13].

3. Research on Construction Engineering Quality Supervision and Management System Based on BIM

3.1 BIM applicable technology

In the construction industry, BIM technology can greatly shorten the information acquisition time of quality inspectors, check the tasks in each construction stage in real time, and record the quality data, which is convenient for quality inspectors to obtain relevant data in the server later [14]. At present, the domestic BIM application software solves a single problem, which is difficult to meet the management mode and scheme design requirements of complex, assembled and EPC projects. At the same time, domestic software such as BIM modeling, model analysis and 3D dynamic simulation are not mature enough or in the research stage, and the practical application is still a software system developed abroad. The work quality management platform that truly meets the national conditions of China needs continuous research and testing. Most of the building materials used in the construction of high-rise buildings are transported from other places. Through this technology, the location of building materials can be obtained in real time. Even after the construction, quality management personnel can obtain relevant data by scanning the QR code on the building materials [15]. Based on BIM model, data and information association, the integration of quality information and management

process is realized, and the engineering quality information management process and supervision system are formed. By using scientific and effective information management means, the quality of supervision work and the work efficiency of supervisors are comprehensively improved. As shown in Figure 3, 70% of construction enterprises have tried to apply BIM technology in construction projects, more than 75% have established or plan to establish enterprise BIM, and 75% of the respondents plan to increase the promotion of BIM, reflecting that the application of BIM technology in construction units has been quite popular. □

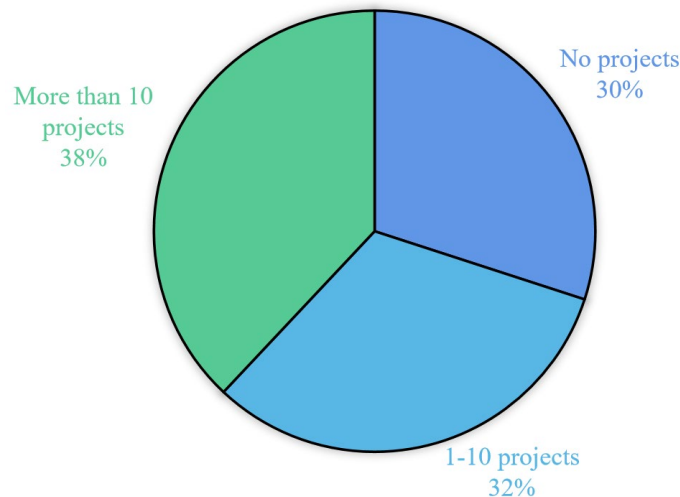


Figure 3 Proportion of Projects Adopting BIM Technology in Enterprises

BIM technology can input the designed model into the collision inspection system to test the existing problems. If there are contradictions in the design drawings, error reports can be output in a timely manner. Designers can modify the design drawings based on the error reports, thereby avoiding the occurrence of errors in the design and effectively avoiding design changes. Due to the huge amount of data in the entire high-rise building project, it is inevitable that data will be transmitted and shared in the model, often requiring the calculation, processing, and deletion of storage resources. The application of cloud technology can improve the integration of data and increase the data clarity of BIM models in engineering quality supervision work.

3.2 Construction engineering quality supervision and management system

At present, some construction units and intermediary agencies use regulatory loopholes to shirk their responsibilities in the process of building projects in China. At the same time, due to the fact that the informatization and modern management system has not yet taken shape, paper documents such as drawings, contracts and reports are not easy to manage, resulting in information loss, and it is impossible to track and retrieve information when relevant documents are needed, and even construction errors caused by human errors affect the overall quality of the project. Quality control based on BIM technology needs to adopt information technologies such as BIM, big data, cloud computing, Internet of Things, intelligence and AR/VR. At this stage, these technologies have achieved remarkable results in other fields, and they have gradually begun to be used in the construction field. Some key projects and demonstration projects in Chongqing use BIM technology for quality supervision and have achieved good results. BIM technology can combine three-dimensional technology with time dimension, so as to simulate the construction situation in each stage. By comparing the actual construction situation with the planned construction situation, it can effectively judge whether the construction progress is delayed, help the construction unit to coordinate all links in the construction, and reasonably control and schedule all elements in the construction, thus effectively improving the construction quality and reducing the cost. How to build a perfect construction quality supervision system is shown in Figure 4.

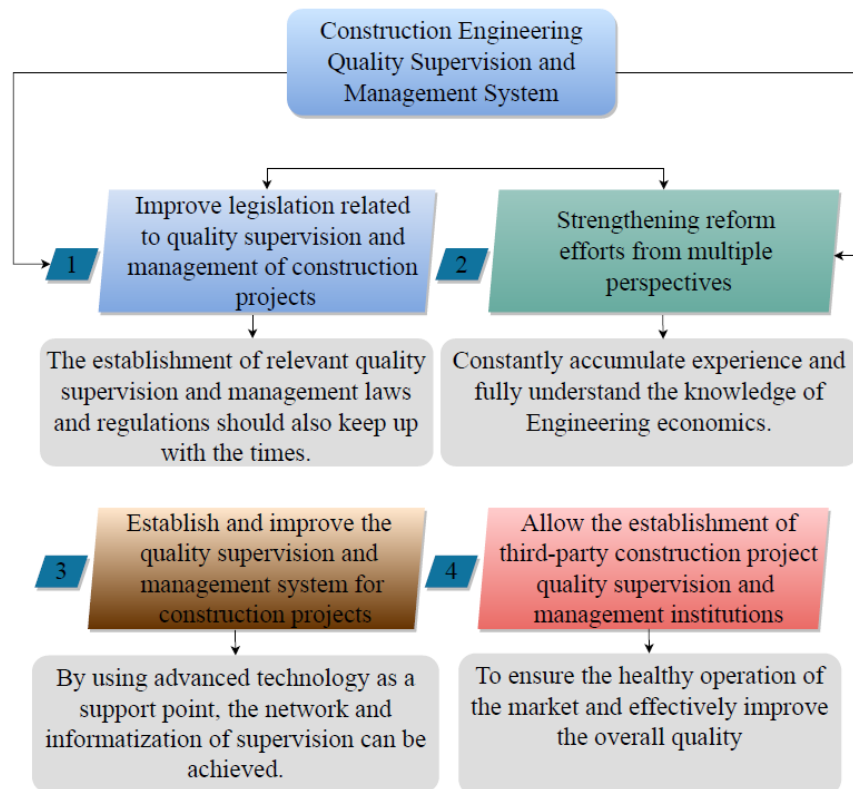


Figure 4 Quality Supervision and Management System for Construction Projects

A comprehensive construction management system consists of four aspects: ideological assurance system, organizational assurance system, work assurance system, institutional assurance system, and economic assurance system. During the construction process, use BIM related technologies to achieve quality control. The formation of construction project quality requires multiple efforts, including survey and design, construction, and other aspects. This requires fundamentally addressing the problem of poor construction project quality, integrating the perspective of system engineering into it, and conducting comprehensive and systematic governance. Finally, some designers did not conduct a detailed survey of the structure and pipelines in the project, and there were pipeline intersections in the drawings Structural collision and other issues.

During the construction process, problems were discovered and design changes were made, which affected the management and guarantee of construction quality and safety. Conduct technical disclosure on the overall structure of the construction project through 3D construction modeling, and observe the intersection points of each steel bar through retrieval by quality management personnel on the data platform. On the basis of continuously improving the information recording, comparison, analysis, rectification, etc. generated in the quality management process, strengthen the quality control role of digital models and informatization processes, including quality data association, quality detection data comparison, on-site entity scanning modeling, and application of entity quality information in the operation and maintenance phase when building BIM models.

4. Conclusions

At present, the speed of China's economic development is constantly improving, and the traditional construction quality supervision and management system has not adapted to the development needs of modernization. In China's current modern construction projects, a perfect construction quality supervision and management system is needed. Therefore, this paper constructs the quality supervision and management system of construction projects based on BIM. In this paper, the whole organization and operation system of project construction quality process management based on BIM technology is established from the aspects of implementation route, organization design and management flow, so as to ensure the organic combination of BIM technology and engineering

construction quality management, avoid the phenomenon that BIM technology is a mere formality or the "two layers of skin" between BIM implementation and site quality management, and give full play to the value of BIM technology. It is an inevitable trend for the technical development and the improvement of the degree of science and technology in the field of engineering construction to carry out the quality management of engineering buildings by means of modern and information-based quality management, and the quality management can only keep pace with the times. The continuous development and practice of construction quality process management based on BIM technology will definitely lift the existing capacity and level of construction quality management in an all-round way, improve the collaborative management efficiency of all parties involved in the project, and promote the all-round development of the construction industry from the aspects of construction quality awareness, establishment of quality management departments, pre-construction inspection, quality monitoring during construction, acceptance verification after completion of construction, and establishment of relevant quality supervision systems.

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