Application and Optimization of Smart Construction Technology in Construction Management of Large Public Buildings

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Abstract: With the development of the construction industry, the construction management of large public buildings is facing new challenges, and the application of smart construction technology has become the key to improve the management level. This article discusses the application and optimization of smart construction technology in the construction management of large public buildings. Through theoretical research methods, this article deeply analyzes the theoretical basis of smart construction technology, including the support of system engineering theory, information management theory and cybernetics. It is found that smart construction technology has many applications in pre-construction planning, construction process management and resource management, but it also faces problems such as data security and system compatibility at the technical level, organizational structure and personnel quality at the management level, policies and regulations at the external environment level and industry standards. Based on this, this article puts forward optimization strategies from the aspects of technical optimization of encrypted data and unified standards, management optimization and adjustment of architecture and training of personnel, and external environment optimization and improvement of policies and unified standards. In order to promote the efficient application of smart construction technology in the construction management of large public buildings.

1. Introduction

As an important symbol of urban development, the quality and efficiency of construction management of large public buildings are directly related to the image and function of the city [1]. With the development of the construction industry, the scale of large-scale public buildings is increasing day by day, and the functions are becoming more and more complex, so it is difficult for traditional construction management methods to meet the needs of modern construction [2]. In this context, smart construction technology came into being, and gradually emerged in the construction management of large public buildings.

Smart construction technology integrates a variety of cutting-edge technologies, such as building information model (BIM), Internet of Things, big data, artificial intelligence, etc., which brings new ideas and methods to the construction management of large public buildings [3]. It can realize the visual simulation, real-time monitoring and precise control of the construction process, and significantly improve the scientific and refined level of construction management [4-5]. Although intelligent building technology has shown great potential in the construction management of large public buildings, its application still faces many problems and challenges. There are hidden dangers of data security and poor system compatibility at the technical level, which limit the cooperative operation between the systems of smart construction technology [6]. On the management level, the unreasonable organizational structure of construction management and the uneven quality of personnel lead to the failure of smart construction technology to give full play to its advantages [7]. At the same time, the imperfection of policies and regulations in the external environment and the inconsistency of industry standards have also hindered the popularization and application of smart construction technology.

It is of great practical significance to study the application and optimization of smart

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construction technology in the construction management of large public buildings. This article aims to comprehensively analyze the application status of smart construction technology, deeply explore the existing problems and challenges, and put forward targeted optimization strategies, hoping to provide support for promoting the wide application and efficient development of smart construction technology in the construction management of large public buildings.

2. The theoretical basis for the application of smart construction technology

The application of smart construction technology in the construction management of large public buildings relies on several important theories. System engineering theory regards construction management as an organic whole, emphasizing the relevance and coordination of each link [8]. With the help of this theory, smart construction technology comprehensively plans the construction process, from site analysis to resource allocation, and realizes the overall optimization. Information management theory is the key support of smart construction technology. In the construction of large public buildings, massive information needs to be processed efficiently [9]. Based on this theory, smart construction technology uses advanced means to collect, store, analyze and transmit information, which provides accurate basis for construction decision. Cybernetics ensures the dynamic adjustment of construction management. Smart construction technology can monitor the key indicators such as construction progress, quality and safety in real time, find deviations in time and take corrective measures according to the principle of cybernetics, so as to ensure that the construction process is always in a controllable state and achieve the expected construction goals.

3. Application of smart construction technology in construction management of large public buildings

In the pre-construction planning stage, smart construction technology uses BIM technology to accurately analyze the site. By establishing a three-dimensional model, the site topography, surrounding environment and other information can be displayed intuitively to assist the construction team in better construction layout [10]. BIM model can be used to simulate the stacking of materials and the parking position of mechanical equipment in the construction site, so as to avoid space conflict. BIM technology can also simulate and optimize the construction scheme, and find potential problems in advance, such as unreasonable construction sequence and complicated construction technology, so as to adjust the scheme and save construction time and cost.

Construction process management is the core link in the application of smart construction technology. In the aspect of schedule control, all kinds of equipment and sensors in the construction site are connected through the Internet of Things technology, and the construction schedule data is collected in real time. Use big data analysis technology to process these data, and compare them with the preset schedule. If any deviation is found, it will be warned in time, and the construction management personnel can adjust the construction arrangement accordingly. In terms of quality control, smart construction technology uses intelligent detection equipment, such as laser scanning and high-definition camera, to monitor the construction quality in real time. In the process of concrete pouring, the temperature and slump of concrete are monitored by sensors to ensure the pouring quality. In terms of safety management, with the help of intelligent monitoring system, real-time identification and early warning of potential safety hazards in the construction site, such as detecting that workers are not wearing helmets and dangerous areas are intruded, will give an alarm in time to ensure the life safety of construction workers. Figure 1 lists the specific application means and technical support of smart construction technology in schedule, quality and safety management:

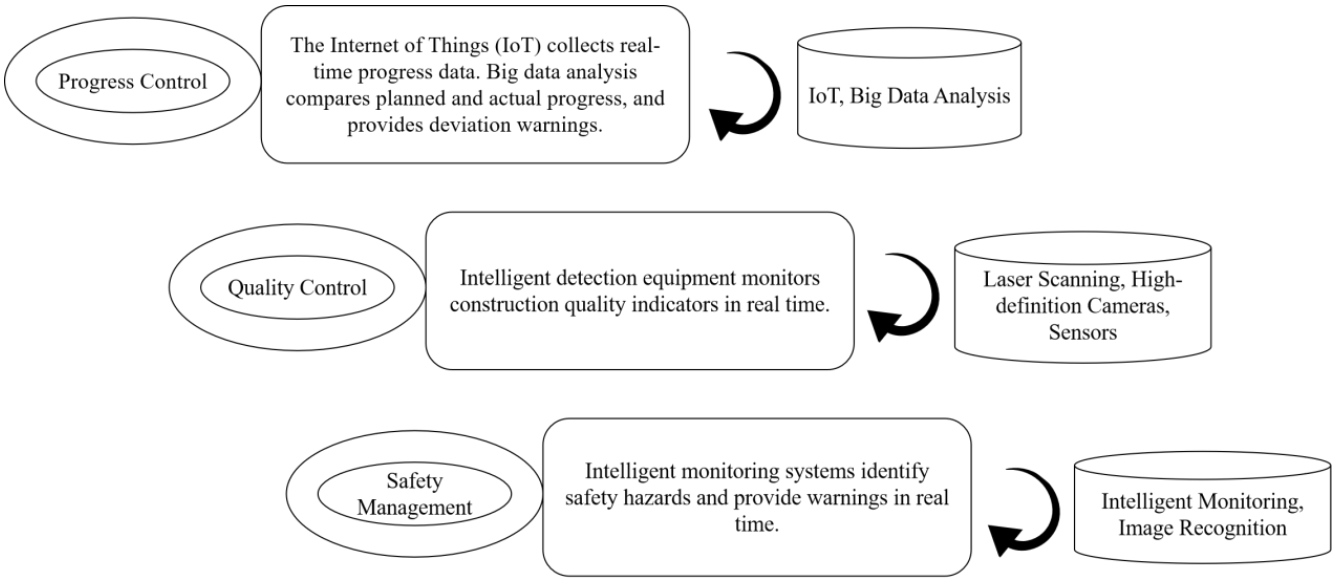

Figure 1 Application Methods of Smart Construction Technology in Each Stage of Construction Process Management

In terms of resource management, smart construction technology has also performed well. Using radio frequency identification (RFID) technology to identify and track building materials, and realize accurate management of materials. From the procurement and transportation of materials to storage and use, it can be monitored in real time through the system to avoid material waste and loss. For mechanical equipment, by installing intelligent monitoring devices, we can grasp the information such as equipment running status and working hours in real time, reasonably arrange equipment scheduling and maintenance, improve the utilization rate and service life of equipment, and ensure the smooth construction of large public buildings.

4. Problems and challenges

At the technical level, data security is the first problem. Smart construction technology will collect and process a large number of sensitive data related to construction projects, including design drawings, construction progress, cost budget and so on. Once these data are leaked or tampered with, it may bring serious losses to the project [11]. Intelligent construction involves a variety of technologies and software systems, and there are differences in data formats and interface standards between different systems, which makes it difficult for data to flow and share smoothly between systems and affects the efficiency of collaborative work. Figure 2 combs the technical problems in detail:

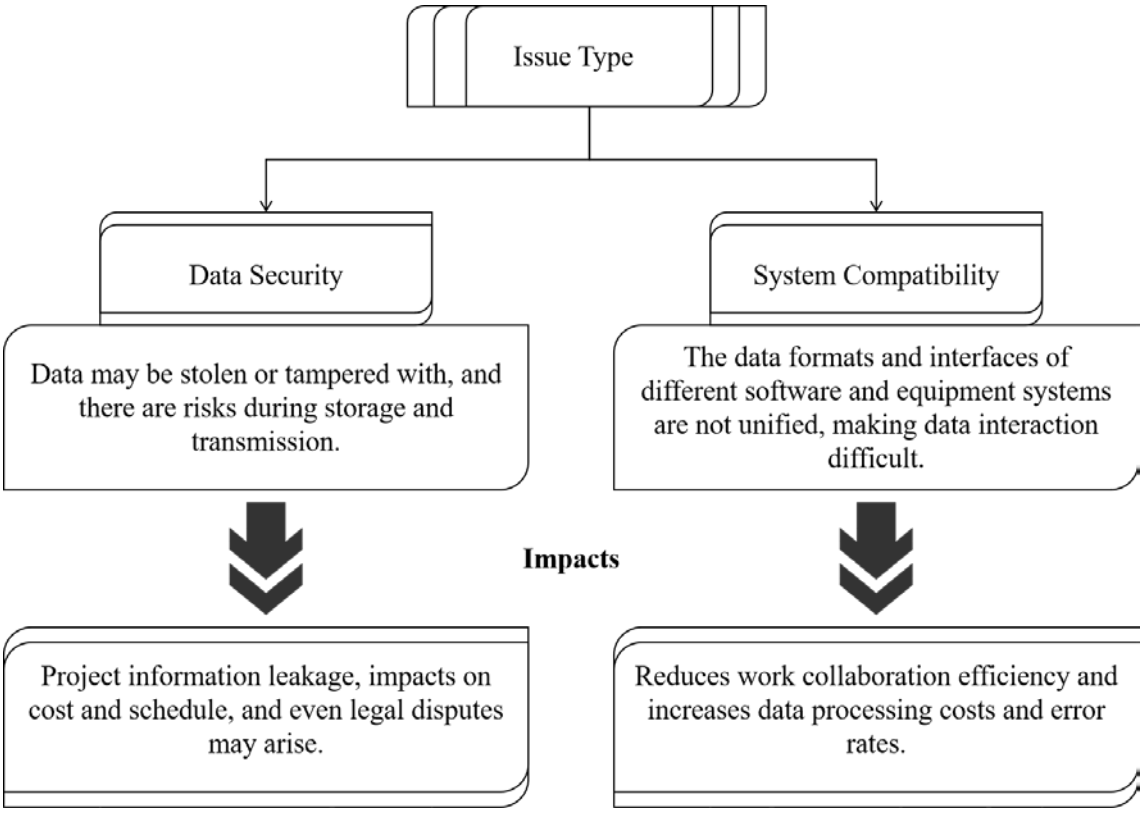

Figure 2 Analysis of Technical Issues in the Construction Management of Large-scale Public Buildings Using Smart Construction Technology

At present, the management organization structure of many construction enterprises is relatively traditional, and the communication and cooperation between departments are not smooth, so it is difficult to adapt to the management mode reform brought by smart construction technology. In the intelligent construction environment, the design, construction, supervision and other departments need to cooperate closely, but the traditional architecture is easy to cause information barriers and hinder the timely sharing of data and information. Uneven quality of personnel is also a key issue. Smart construction technology needs compound talents who know both architectural professional knowledge and information technology, but at present such talents are relatively scarce. Constructors' ability to accept and apply new technologies is limited, which makes it difficult to effectively implement smart construction technology in the construction site.

Imperfect policies and regulations make the application of smart construction technology lack of clear norms and guidance. As for the quality acceptance standard and responsibility definition of intelligent construction project, the relevant policies have not been clearly defined, which brings certain uncertainty to the project implementation. The inconsistency of industry standards has also brought troubles. Different regions and enterprises may adopt different technical standards and specifications, which makes smart construction technology face obstacles in cross-regional and cross-enterprise cooperation, which is not conducive to the wide promotion of smart construction technology. The application of smart construction technology in the construction management of large public buildings requires joint efforts from technology, management and external environment to overcome these problems and challenges, so as to realize its greater value.

5. Optimization strategy of smart construction technology in construction management of large public buildings

Technology optimization is the basis of improving the application efficiency of smart construction technology. In order to solve the problem of data security, encryption technology should be adopted to encrypt the transmitted and stored data, and a strict access authority management mechanism should be established. Different levels of data access are set for people at

different levels, and core data is only allowed to be accessed by project leaders and key technicians. In order to solve the problem of system compatibility, the industry should jointly formulate a unified data standard and interface specification. Software and equipment developers develop systems according to this specification to ensure smooth data interaction between different systems. Table 1 details the specific technical optimization measures:

Table 1 Technical Optimization Strategies for Smart Construction Technology

Issue Type	Optimization Strategy	Implementation Steps
Data Security	Employ encryption technology and access permission management.	Select advanced encryption algorithms to encrypt data.
		Set different access levels based on personnel responsibilities and permissions.
System Compatibility	Establish unified data standards and interface specifications.	Industry associations organize relevant enterprises and experts for discussions.
		Determine common data formats and interface standards.
		Supervise developers to update systems according to the standards.

Management optimization is the key to ensure the effective implementation of smart construction technology. Construction enterprises should adjust the management organization structure, build a flat management model with the project as the core, reduce intermediate levels, and promote information circulation and cooperation between departments. Construction enterprises can set up an inter-departmental intelligent construction special group to be responsible for coordinating the application of smart construction technology in the project. Enterprises should strengthen the training of personnel and formulate multi-level training plans. For managers, focus on improving their strategic understanding and management ability of smart construction technology; For front-line construction personnel, it focuses on training practical operation skills.

The optimization of external environment is the guarantee for the wide application of smart construction technology. Government departments need to speed up the improvement of policies and regulations, clarify the key contents such as quality acceptance standards and responsibility definition of intelligent construction projects, and provide clear policy guidance for project implementation. Trade associations should actively promote the formulation and implementation of unified industry standards, organize exchanges and cooperation between enterprises, and promote the standardized development of smart construction technology. Government departments can hold industry seminars regularly, share successful cases and technical experience, and guide enterprises to jointly follow unified standards. Through the collaborative optimization of technology, management and external environment, the application of smart construction technology in the construction management of large public buildings will be smoother, which will inject strong power into the intelligent transformation of the construction industry.

6. Conclusions

This article focuses on the application and optimization of smart construction technology in the construction management of large public buildings, and has achieved practical guiding results through in-depth exploration in many aspects. In application, smart construction technology runs through all key links of construction management of large public buildings. In the pre-construction planning, BIM technology is used to realize accurate site analysis and construction scheme optimization; In the construction process management, real-time monitoring and effective control of progress, quality and safety are carried out through technologies such as Internet of Things and big data. In resource management, RFID and other technologies are used to achieve accurate management of materials and equipment. These applications have significantly improved the scientific and refined degree of construction management. However, smart construction technology has exposed a series of problems in practical application. On the technical level, data security and system compatibility problems limit its effectiveness; On the management level, the lack of traditional organizational structure and personnel quality hinders its popularization; At the external

environment level, imperfect policies and regulations and inconsistent industry standards have brought many troubles. In order to solve these problems, this article puts forward targeted optimization strategies. Technically, encrypt data, unify standards, and build a cornerstone of security and compatibility; In management, adjust the structure, train personnel, and improve management and execution capabilities; In terms of external environment, improve policies, unify standards and create a good development environment.

Through this study, I hope to provide strong support for the application of smart construction technology in the construction industry. This article hopes to help construction enterprises break through the existing difficulties and promote the wider and deeper application of smart construction technology in the construction management of large public buildings. The purpose of this study is to lead the construction industry to move steadily in the direction of intelligence and efficiency, and to open up a new path for the construction and management of large public buildings in the future.

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