

Application of BIM + Smart Site in Construction Engineering

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Abstract

BIM + wisdom site is currently an advanced support engineering site management information means, relying on the high-level project management practice, construction stage management as the main line, using BIM + wisdom site management mode of new management platform for the quality, safety, production application practice, significantly improve the project parties coordination and field fine management level, realize the comprehensive information technology management. Based on the specific introduction of the platform logic architecture, personnel, equipment, link, monitoring and other modules, the example of the innovative application of intelligent construction technology in the current engineering construction management is demonstrated.

Keywords

BIM; Smart Construction; Digital Management; Smart Construction Site.

1. Introduction

With the rapid development of computers and various advanced technologies, the traditional construction engineering construction management has also faced unprecedented challenges, which makes the concept of digital construction on the stage of history. It includes the process of digitization, dissemination, intelligence and transparency of all the construction data of the project. Its core idea is to solve the problems encountered in the whole way and other main matters of the project with digital means, and maximize the use of information resources to achieve the maximum use efficiency per unit of time.

Based on the relevant research status at home and abroad, it can be found that the research mainly focuses on the application of intelligent construction to engineering project construction, or the adoption research of intelligent construction based on information means. This study is also based on the performance of the project construction in the construction stage, starting from the five management modules of safety, technology, quality, production and cost, based on the actual project, the digital management and traditional construction management.

2. The Concept of Intelligent Construction

In the important stage of the construction industry transformation and under the background of the orderly development of "smart city", Dr. Yang Baoming put forward the concept of smart construction[1]And from the harmonious development of industry and digital nervous system. Summarizing the scholars' relevant research on "intelligent construction" in recent years, the core of intelligent construction is the efficient circulation and effective application of information resources, aiming to establish a complete data flow and information database with the information platform as the project carrier, so as to realize the intelligent project management in the whole life cycle of buildings.

"Wisdom to build" is the big data, network, intelligent, mobile communication, cloud computing, Internet of things and BIM as technical support, integrating project information, overall allocation of construction resources, collaborative project participants, project participants

information sharing and collaboration, create intelligent construction environment, make the construction of intelligent and efficient construction process, building products safe and comfortable a kind of new construction concept.

It mainly contains the following features.

(1) Wisdom construction in a broad sense

Broad wisdom construction is based on the whole life cycle of project construction mode, including project approval, decision-making, design, construction, demolition, wisdom, in each stage of the project need based on information platform, overall project resources, integrate data flow, realize the project lean information management, promote the wisdom of the construction stage to build. It mainly includes the following features:

Objective: To change the production mode to green, industrialization, information and wisdom.

Essence: intensive enterprise management, intelligent project construction, lean project management.

Participants: all participants in the construction project.

Technical support: BIM, Internet of Things, big data, cloud computing, etc.

Safeguard measures: Standardized information service platform.

To realize the cross-platform linkage and cross-professional cooperation among all participants in the project construction. The whole industrial chain is integrated.

(2) Intelligent construction in a narrow sense

In the narrow sense, the smart construction is only aimed at the construction stage of construction projects, which refers to the smart construction stage attached to BIM and the big data. Wisdom building management system construction must have a comprehensive understanding of the development of wisdom building and its origin, deep understanding of the essence of wisdom building, understand the wisdom building system environment and system elements, so this paper will discuss the wisdom building and project whole life cycle, lean building, BIM internal link, for the wisdom of building based on BIM building management system to provide theoretical basis.

3. The Development of Smart Construction

3.1. Digital Construction Phase

There are three kinds of research on digital construction mainly: one is the designed components using CNC equipment manufacturing, the production model is assembled to form a complete building; the second is the CNC equipment for special concrete formwork processing, using special formwork casting components and installation; the third is the digital design, using CNC equipment reading data for production, and accurate positioning and installation. The formation of digital construction mode is based on the mature development of industrial technology, which has promoted the great changes in China's construction industry, but there are still many problems in the process of engineering construction[2]. For example, due to the limited development of information technology and communication technology, it is impossible to make an application of the information model in the whole life cycle of the project construction, resulting in the waste of information resources; At the same time, the video, data monitoring information and model in the engineering construction are difficult to integrate, cannot realize the effective utilization of information resources, and the advantages of digital construction are not fully played.

3.2. Information Construction Stage

On the basis of the continuous development of digital construction and information technology, the application of BIM has well solved the problems existing in the digital construction stage.

From the numerical control model to the information carrier of the whole life cycle of the construction, from local to the whole, from micro to macro, the industry construction mode has gradually changed from digital construction to information construction. More professional integrated design, virtual construction, construction simulation, VR application of decision, design, construction, operation process management has a great impact, realize the participants of the project information sources, reduce the engineering change, improve the construction quality, strengthen the progress control, improve the decision quality, so as to achieve progress, quality, cost, safety, knowledge and other efficient management goals, improve the management level of the construction industry in China. Nevertheless, there is still a lot of development space for information construction, and the integration of information technology and engineering technology is still lacking, such as the acquisition, transmission and feedback of physical information, which needs to be further studied.

3.3. Smart Construction Stage

The information construction stage has accumulated experience for the development of intelligent construction. With the rapid development of BIM, the Internet of Things, big data, cloud computing and other technologies, Information building continues to develop with the support of these technologies. On the basis of information technology construction, Through the RFID (Radio Frequency Identification, RF identification), NFC (Near Field Communication, Near-field communication), sensors, mobile terminals, video surveillance and other ways to connect entities with the information database, Realize the real-time data collection and transmission, Improve the efficiency of data acquisition; Big data mining mines and sorts out the collected data, Forming the information, Increase the data utilization, Give full play to the advantages of big data; Regular summary of information through cloud computing, Summarized as a knowledge, Decision-makers assist in decision-making through knowledge, Instead of judging by personal experience alone, Improve the efficiency of decision-making; Finally, through feedback and control through the Internet of Things, Solved the problems such as information islands, The participants can work together efficiently, Realize the wisdom of the construction process. Smart construction is supported by information technology and communication technology, and is highly unified with the construction thought of smart city. It realizes the industrialization, informatization and intelligence of the construction industry from the perspective of the whole life cycle. Therefore, the smart construction mode will have an important impact on China's construction industry.

4. Digital Management Platform for Construction Engineering Projects

The digital management system of construction engineering is not a single system, but a unified system related to many related units. It serves the construction units, consulting units and owners related to the project. And through the construction project related matters for control and management, so as to achieve the expected purpose. Based on the relevant information of integrated management, and supported by computer network technology and other intelligent technologies, it serves the construction project of each project element in each cycle, so as to realize the normal operation of each core function.

4.1. Composition of the Digital Management Platform

Because the construction project management platform has its certain particularity, the nature of each participant is different, and the requirements are also different, so each owner has its own particularity, and the construction project management platform should be tailored to their own access interface according to the different departments and units. For construction project management, the most important thing is the owner, so in the process of establishing the project management platform, the owner should be the main object, followed by other users

below. For the particularity of each management platform, not only the different users but the different access interface, but also in different life cycles, its operation mode and the established management platform will be different and different. There are many functions of the construction project digital management platform. This paper lists some common functions.

(1) Project management system

Project management system, generally refers to the integration of various elements in the project operation, which mainly has five elements: cost, construction period, quality, safety and environmental protection. It includes the following two aspects:

1) Establish data management information, the traditional mode is to collect information in the form of documents, with the development of computer technology, now has been realized paperless, the information is stored in the special database in the computer, so that not only save time and effort, the operation is relatively simple, but also can make all kinds of information to achieve rapid sharing. At the same time, the system can also process it according to all kinds of information, and establish a digital management platform.

2) After the establishment of paperless information management, it is necessary to manage the collected information, and study how to establish a management platform to achieve efficient management. Generally speaking, through the computer technology to process the information, the establishment of a special electronic management information system, and effectively combine the various elements, so that each department and each project to achieve timely communication and information sharing. A reasonable communication platform should be established, so that all participants can realize remote communication no matter where. Once problems occur, they can be solved in time, which will bring great convenience to each subject.

(2) Construction data collection system

In the process of construction project management, after collecting all kinds of information and data, the relevant data should be input, that is to say, the input into the computer is convenient for digital processing. In general, the construction data acquisition system, is according to the generated in the construction process of various elements, such as financial expenses, engineering progress and safety monitoring data collection and input, and then according to the data to the digital processing, the results of builders further decision, and according to the data can also be found the problems existing in the construction process in time, is conducive to timely solution.

(3) Office automation system

This system is mainly to collect, test and analyze all kinds of information in the process of office work, and then process these information through some intelligent technologies, and share the processing results as decisions with other cooperative units.

(4) The Public Information Service System

This system does not only refer to the system of an independent subject, but also the information sharing between each project subject. In the process of construction project management, each subject will release the information, such as bidding information, national policy and other information related to the project. Each subject can realize the information sharing through this system.

(5) Visual management system

Users may expect to see the expected model of the project before the construction project is completed. The visual management system allows you to predict ongoing engineering projects. However, the prediction is not come out of thin air. The management system should be used to make scientific prediction according to the current project progress and quality requirements.

(6) Video conference system

Some engineering projects have a large design scope and a large regional span, which may be multinational projects, but in the process of construction projects, not lack of communication due to regional reasons. In view of this situation, a teleconference system can be established, and each project management subject can timely communicate and express opinions no matter where.

(7) Intelligent decision-making system

The owner collects all kinds of information and data, and digitized these information and data. In order to ensure the scientific and rigor of these processing results, the intelligent decision system can solve this problem. When a factor is unqualified, the system will give hints so that users can correct it in time.

(8) Monitoring and management system

With the progress of science and technology, the remote monitoring system is becoming more and more advanced, users want to understand the construction site frontline work situation, without on-site guidance, in the office can guide the work, but also can always monitor the site, once found any problems, can be solved in time.

(9) Communication management system

In the process of construction project management, each owner and each personnel should realize constant communication, and the establishment of communication management system can make each personnel communication at any time, so as to facilitate information transmission and data security.

4.2. Functions of the Digital Management Platform

4.2.1. Production Management

This project manages the site daily production schedule based on the production management system, distributes and tracks the site production tasks online, and collects the relevant hardware and software data. Finally, form a multi-dimensional chart analysis of people, material, machine and progress, and automatically generate construction logs and other documents. Related production data can support the use of regular project digital meetings.

4.2.2. Technical Management

In the technical management module, to provide a BIM model as the support for the engineering project, drawing change management, technical disclosure, scheme management and other contents[3]. In terms of technical scheme management, planning, tracking and review, technicians record drawing changes, drawing review, engineering negotiation and ledger, and associate drawing changes with relevant drawings and models to realize automatic reminders, technical disclosure of technical solutions based on BIM model, project technicians can consult and download relevant node models and process videos in the platform to improve the disclosure efficiency.

4.2.3. Quality Management

Quality management is an important part of project management, The project personnel shall timely record the site construction quality problems in the platform to form a graph, assist the site personnel to analyze the causes of the quality problems, and conduct the on-site quality inspection and acceptance through the mobile terminal, and issue the quality rectification notice online. The platform keeps management records, and conducts common quality problem analysis, causes, rectification efficiency analysis and responsibility subject analysis based on big data.

4.2.4. Safety Management

After the safety personnel of the project find the problem, they will notify the relevant responsible person online based on the platform, and the responsible person will organize the

rectification and problem review on site. After the review, the problem will form a closed-loop treatment[4]. On-site security personnel can also use the mobile terminal to investigate hidden dangers, take photos and record the problems found on the site, and upload, rectify and review the whole process on the mobile terminal, so as to reduce the existence of on-site safety problems and improve the rectification efficiency.

4.2.5. Cost Management

During the whole construction process, using the BIM technology of the dynamic system management[5]The construction schedule can be compared with the actual situation of the construction site data, timely adjust the deviation in the project, effectively reduce the number of construction changes, and ensure the accuracy of the project cost. At the same time, the information integration platform of BIM model is used to realize real-time communication, real-time change, data transmission and information sharing of all in the construction renovation project participants, check the engineering changes at any time, make a response in time, and control its influence within a controllable range.

5. Smart Construction Site Practice and Application

Smart site platform is based on the Internet of Things, cloud computing and other emerging technologies to build a project collaborative environment according to the needs of project management, integrate project participants and project engineering data, break the "information island", so that the work process and data can be effectively connected. This project wisdom site platform is mainly composed of perception layer, network layer and application layer, and considering the project scale, many internal supporting settings, high comprehensive requirements, so the functional architecture fully considers the data security, upload speed, process clarity, clarity of operation, and local backup and other dimensions, convenient for the participants through the platform to achieve cross-organization collaboration, fast information transmission, and dynamic data control, etc.

5.1. Intelligent Monitoring

The on-site video monitoring system is connected to the platform to monitor the on-site situation of key parts, key production areas and main construction points of the construction site for 24h, and dynamically understand the real-time situation on the site. Emergency measures can be taken immediately if abnormalities are found to eliminate the hidden dangers existing in the project in the first time. At the same time, the mobile terminal can be viewed in remote real-time under the network state, to improve the on-site prevention and control strain capacity and ensure the normal development of the project construction.

5.2. Material Management

This project conducts statistical analysis of the material entry situation through the material management system, accurately grasps the supply deviation of the site materials in real time, and queries the material type, manufacturer, license plate and other information through monitoring and material sheet, realizes the transparent and fine control of the acceptance link from entry to exit, and improves the efficiency of the on-site acceptance management.

5.3. Labor Management

The management personnel of this project can always know the personal information of labor workers, on-site attendance and the number of personnel at each post, so as to facilitate the overall management of labor personnel. The system has been connected with the Construction Commission and meets the requirements of the real-name labor system.

5.4. Epidemic Prevention Management

The intelligent access control system is connected to the site server through the wired network, and the security management personnel is responsible for the information input, face recognition, withdrawal statistics and salary management in the system. In addition to the epidemic problem, the system is also connected with the automatic temperature measurement function, which can traditionally data to the cloud platform for unused masks and abnormal temperature identification, effectively supporting epidemic prevention and control.

5.5. Aerial Aerial Photography

For the project site overall construction progress, each construction section, the professional construction progress and civilization construction, drone aerial photography, shooting each time, work area site image progress, auxiliary project general layout and working face coordination, strengthen the regulation of the labor force, according to the site situation to adjust the construction arrangement, optimize the construction organization design, improve the efficiency of working face management.

5.6. QR Code Management

Based on the BIM platform, make safety, quality, technology, production solutions, pictures, video QR code, arrange the QR code display wall on the project site, and the project team members and external visitors scan the QR code through their mobile phones to easily and quickly understand the relevant engineering data.

5.7. Tower Crane Monitoring and Work Efficiency Analysis

Through the BIM + smart site platform, the Internet of Things technology (IOT) and BIM technology are combined to visually present the operation situation of the field tower crane, and display the multi-dimensional monitoring data such as the lifting weight and wind speed in real time, so as to realize the multi-directional monitoring of the operation state of the tower crane. Once a hidden danger is found on the site, a voice alarm is made immediately, to prompt the equipment operators to avoid risks, and the alarm information will be pushed to the mobile terminal of the project management personnel, so as to urge the site construction personnel to rectify and avoid safety accidents.

5.8. High-Branch Mode Monitoring

All the monitoring data will be transmitted to the remote cloud computing center, which can organize, calculate and analyze the monitoring data, and display the analysis results in the form of data through the cloud platform, whose functions include monitoring abnormal statistics, data processing and reporting, monitoring trend data viewing, and monitoring project warning and alarm.

5.9. Temperature Measurement of Mass Concrete

The internal heat of the construction concrete is more difficult to emit, and the external surface heat distribution is more fast, and the internal and external thermal expansion and cold contraction process will correspondingly produce tensile stress on the surface of the concrete. The temperature difference is large to a certain extent, the concrete surface tensile stress exceeds the ultimate tensile strength of the concrete at that time, in the concrete surface will produce harmful cracks, sometimes even through the crack.

Mass concrete temperature measuring system consists of temperature sensor, wireless temperature collector, wireless repeater and management software, mainly used for high-rise buildings in the process of mass concrete pouring temperature change of automatic monitoring, all data will be uploaded to the platform data center, automatic analysis, timely warning, to ensure the safety of construction.

5.10. Power Saving Management

This project uploads various power consumption situation of the project to the data platform, statistics the electricity consumption situation according to different times, gives abnormal warnings such as power failure and short circuit, and also statistics the change trend of cable temperature. It not only achieves safe and energy-saving construction, but also responds to the national carbon neutral policy.

6. Conclusion

Using the new management mode of BIM + smart site and based on BIM technology + Internet of Things, the intelligent management platform realizes comprehensive information management, which can significantly improve the coordination and site management level of all parties in the project, ensure the progress and quality of the project, and has practical significance for promoting the development of information management of high-level projects. Management Benefits. The project management efficiency, engineering risk control and emergency response ability have been greatly improved. Through 3D construction process visual simulation, plan construction organization plan, improve the construction quality and efficiency, identify online and offline quality and safety problems, ensure the safe operation through equipment data monitoring and early warning and labor data through real-name service system, and improve the real-time emergency situation and dynamics through remote online video monitoring.

2.Social Benefits. The project is based on green construction management based on the smart construction platform. Through the construction site equipment data collection, the weather, noise, dust and other environmental data are monitored in real time, and achieve timely alarm, reduce the impact on the surrounding areas of the project in the construction process, and meet the requirements of green and civilized construction. The project regularly organizes external personnel to conduct intelligent site exchange, and shares the application of practical experience and implementation effect, which is unanimously recognized by the industry, and promotes the technical exchange in the industry and the benign development of the construction industry.

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