Application of Intelligent Project Management Techniques in Residential Projects

Longyun Fan*

School of Urban Economics and Management, Beijing University of Civil Engineering and Architecture, Beijing, 102600, China,

*Corresponding author: FlyFlyFlyhappy@outlook.com

Abstract. The development trend of the construction industry has been converted from the traditional management mode to the intelligent management mode, which makes the project management work more convenient and precise. This paper aims to explore the application of intelligent project management technology in the direction of residential projects and concludes that through the application of IoT technology, BIM technology and big data technology, residential projects can link various subsystems such as personnel management, equipment management, environmental management, safety management and quality management in a one-stop manner, so as to form a project data center. In addition, through AI technology, project risks are intelligently identified and warned. It is of great significance to carry out research on the application of intelligent project management technology in residential projects, which will be more conducive to improving the level of residential project management and provide important technical guarantee for the smooth implementation of engineering projects. With the continuous deepening of the social research on this aspect, the relevant technology and methods are constantly improved, so as to promote and apply more widely.

Keywords: Intelligent construction site; intelligent management technology; BIM technology.

1. Introduction

Engineering management technology is essential in engineering construction projects, which can effectively supervise the construction site, guarantee the quality of construction and the safety of personnel, and ensure the smooth progress of engineering projects. In recent years, the general trend in China's construction industry has been converted from the traditional management mode to the intelligent management mode, which has been optimized and improved in personnel management, equipment management, construction progress management, construction quality management, safety management, etc., which makes the project management work more convenient and precise [1].

Intelligent management technology mainly relies on the intelligent construction site system. The smart construction site system uses Internet of Things technology, BIM technology, big data technology and other informatization means so that the construction site and project management technology are combined, and through the network system platform for display, communication and monitoring, it is easy for managers to find problems and communicate and make decisions in time, in order to ensure the smooth progress of the project [2]. At the same time, the smart site system promotes the development of project management in the direction of digitization, informatization, and greening.2021 The relevant construction departments have introduced policies for technological innovation in housing construction and the creation of smart sites, promoted information management methods, and vigorously implemented the smart site management mode [3]. In terms of research, Xia Jingyi and other scholars studied and analyzed the importance of smart site construction for the transformation of project management from traditional mode to digital management from different perspectives such as government, enterprise, supervision, audit, etc. Hong Zhishan scholars conducted a study on the role of intelligent project management, the application of intelligent information systems, which provides references and lessons for the improvement and optimization of the smart site system [4,5]. In the above background, in recent years, the relevant intelligent management technology has been applied to construction progress management, quality management,

safety management, personnel management, equipment management, environmental management and other aspects of residential projects.

On this basis, this paper analyzes the application of intelligent management technology in residential projects and combines the research status quo, extending and summarizing the current intelligent management problems as well as the outlook.

2. Application of Intelligent Management Technology

2.1. Definition of intelligent construction site

The smart construction site is an innovative means to carry out intelligent management of engineering projects based on information technology, through the Internet, big data, BIM technology and other information technology on the site construction of the management of personnel, progress, quality, safety, environment and other aspects of the management, to achieve good management cooperation and accurate decision-making integrated information system [6]. The smart construction site system is characterized by linkage specialization, platform intelligence, technology intelligence and application integration. Its main purpose is to comprehensively use information management technology to manage the personnel, materials, equipment, environment and other basic elements of the construction site, so as to make the construction site more secure, digital, refined and intelligent [7]. It plays a great role in improving the quality of construction projects, strengthening construction safety management, as well as improving the construction site management ability.

2.2. The role of intelligent management technology

Intelligent management technology opens up the data chain from construction operations to remote monitoring, embeds the Internet into the construction site, and through offline construction, the system collects various business data such as construction site personnel, environment, progress, quality, materials, etc., and the information system builds, integrates, and links to establish a big data management platform, which is equipped with a visualization interface to display the real-time data and status of the construction site. The smart construction site system uses the platform to interact with the data of each subsystem and synchronize with other management systems in order to help managers and staff better understand the real-time situation of the construction site, realize online supervision and monitoring, data analysis, and provide strong support for construction decision-making [5].

BIM technology is one of the key technologies of the smart construction site, providing technical support for the implementation of all stages of the project, and realizing the whole simulation of the implementation of the site scene for intelligent management by effectively combining with the smart construction site, simulating the site layout in advance, optimizing the construction program, and realizing the most resource allocation through the creation of the BIM model [2，8].

With the increasing demand for the construction of engineering projects, there are some common problems on the quality management of the construction site in project under construction, accidents occur for its reasons such as personnel management is not in place, the use of equipment management is not standardized, the weak awareness of safety management and other factors [9]. Along with this comes a lot of new problems and new challenges in management. This puts forward higher standard requirements for the technology, quality and progress of the construction industry, especially the quality of residential projects is related to the life and safety of citizens, and it is a safe haven for a family, and the quality and safety of housing is especially important. How to reduce the occurrence of accidents and improve the quality of the project, the application of BIM can be regarded as a systematic way of risk management, which can predict risk and quality control [10]. Through data interaction and visualization platform, the intelligent construction site system will monitor and analyze the construction site personnel, equipment, progress, quality and other elements in real-time

to provide data support for management decisions and create a new intelligent, information-based modern construction site.

3. Application on specific residential cases

Daxing District, as the southern gate of Beijing and also possessing Daxing Airport, is the new name card of Beijing, promoting the use of intelligent construction management technology in the implementation of residential projects. This paper focuses on a residential project in Daxing New City, Beijing, through the application of BIM + intelligent construction integrated management big screen system, one-stop linking of sub-systems such as personnel management, equipment management, schedule management, quality management, safety management, environmental management, material management, etc. to form a project data center, and intelligent identification of project risks and early warning through AI technology to provide a real-time data summary, comprehensive mastery of production process, and project risk assessment for the smooth implementation of the project. It provides a "project brain" that summarizes data in real time, grasps the production process comprehensively, and reduces project risks effectively for the smooth implementation of the project.

3.1. Construction Personnel and Equipment Management

3.1.1 Personnel management

It registers the basic information of the construction personnel, installs cameras at the entrance and exit locations, collects the time of entry and exit, utilizes the real-name system to identify the personnel entering the site, and prohibits the blacklisted personnel or unrelated personnel from entering the construction site, so as to guarantee the security of the site. The labor management platform is a platform for real-name registration, face entry, and personnel entry and exit of on-site laborers within the general contracting unit. Through the labor management system and the smart site system, it displays the information of on-site operating personnel in real time, and realizes the linkage of payroll and attendance. Beijing Construction Site Personnel Management Service Information Platform is a platform where construction site personnel (including construction workers and construction management personnel) engaged in construction activities of house building and municipal infrastructure construction projects within the jurisdiction are required to record their real names, and it is a platform for supervising and standardizing labor management, safety education and training, and safeguarding the rights and interests of migrant workers. Through the labor management platform data and its linkage, it guarantees the real-name management of construction personnel and the payment of attendance and wages. Managers can quickly grasp the data, understand the number of workers, workload, working hours and other information, labor force analysis, and scientific deployment of personnel to avoid the waste of time and labor costs.

3.1.2 Equipment management

Application of intelligent site machinery management system, through the tower crane on the various monitoring sensors, real-time monitoring and display of tower crane amplitude exceeds the limit, hook height exceeds the limit, slewing angle exceeds the limit, overloading torque, wind speed exceeds the limit and other information, reduce management costs. Tower crane monitoring system to put an end to spaced hanging or blind hanging, hook working status visible at any time, the key position of the safety hazards of all-round monitoring, early warning and analysis of the system to use. Application of tower crane anti-collision system, assisting operators to timely discover unsafe operating conditions, and targeted safety management measures. Hook visualization auxiliary operators visual operation, real-time collection of operational data, with sound and light alarm, automatic recording function, and alarm center in accordance with the monitoring warning level prompt warning information to ensure the safe operation of the tower crane.

3.2. Construction progress management

The implementation of the project begins with strict construction progress requirements, and delayed delivery will produce a series of serious consequences in terms of financial compensation, damage to reputation, and impact on the normal life of the owner. Through the application of an information technology management platform, real-time data collection and analysis, and real-time tracking site progress. On-line editing, reporting, comparing and analyzing the project's plan, strictly controlling the progress of nodes, and warning potential risks for slow progress. On-line issuance of plan tasks, filling in the content of the plan, quantifying the completion rate, the analysis of existing problems, and specific improvement measures. With the help of intelligent big screen, the plan is automatically compared with the actual progress, and the visual progress comparison is displayed through BIM model, which completes the intelligent management and control of the construction site, scientifically predicts the construction progress, optimizes the resource allocation, and provides the basis for decision-making, which provides an important technical guarantee for the project to be completed on schedule.

3.3. Construction quality management

Ensuring the quality of construction is the fundamental principle and pursuit of any construction project, for every family is not only a huge capital investment, but also the desire for a better life in the future is an important factor in the security and stability of a country. Before construction, the use of BIM, intelligent site technology simulation in advance, to see whether the construction aspects of the project is reasonable, such as the site layout, material preparation and equipment transportation lines, etc., for unreasonable impact on the construction of the right amount of timely adjustment. After the pipeline is laid, the construction personnel roam the site to check the site, combined with the actual simulation of construction materials, and construction equipment into the construction site, and through the comparison, the most reasonable transportation line is selected. At the same time, the safety management personnel use cell phone apps to take photos and upload the site safety hazards, and send them to the relevant responsible persons through the system in real time, forming a closed loop of investigation, rectification and review, which has significantly improved the efficiency and quality.

3.4. Construction Safety Management

Construction safety is an important issue concerning personnel safety, smooth progress, social harmony and stability, and the promotion of economic development, and the establishment of a smart construction site safety and quality monitoring system can effectively solve the problem of insufficient project management on construction sites [11]. The project applies the smart construction site system to realize comprehensive safety monitoring of construction site personnel, environment, equipment, and high-risk operation areas through the IoT devices and sensors installed at each key location of the construction site, providing safety monitoring and early warning reminders. Through the wireless network to transmit data to the central control platform, the intelligent management platform automatically generates a variety of data, and accounts, analyzes the causes of hidden dangers, targeted to improve the quality and efficiency of inspection work. Such as the wear of helmets of operators, the operation of construction equipment, the emergence of unauthorized operation, or the risk of electricity, the system detects abnormal events, it will immediately send out early warning information to the platform and the cell phone APP terminal to start the preset emergency response procedures.

3.5. Construction environment and material management

The traditional construction industry is characterized by high pollution, and dust monitoring and meteorological monitoring during construction is a necessary requirement for modern building construction [12]. The project uses information technology to monitor dust and PM2.5 and other data, according to the time period of the environmental information data statistics and analysis, according

to the national regulations to set environmental thresholds, when the PM10 exceeds 150 micrograms per cubic meter, PM2.5 exceeds 75 micrograms per cubic meter, automatically start the dust removal equipment. Intelligent spray fog cannon system and dust online monitoring system to achieve linkage, set the air quality dust thresholds, automatically open the spray dust, real-time monitoring, intelligent linkage, and timely control to reduce on-site dust pollution. And the use of a video monitoring module, you can monitor the site and living area in real time. And using the video monitoring module, it can monitor the construction site and living area in real time. Through remote monitoring, administrators can observe the progress of construction and the dynamics of people's lives, discover and solve all kinds of hidden dangers in time, and ensure the safety of the construction process and the stability of the order of the living area.

Through the combination of hardware and software, the weighbridge system and material management system are set up. Through the weighbridge, cameras and other joint monitoring of weighing and acceptance, to plug management loopholes. The material management system can track the information of material in and out of the warehouse, in and out of the yard, inventory, etc. in real time for traceable management. The intelligent management of materials, it effectively improves the fine management level of project materials.

4. Current Problems and Prospects of Intelligent Management

4.1. Existing Problems

The application of intelligent systems plays an important role in improving work efficiency and reducing the use of human resources, but it also faces problems such as high cost and unsound data integration platforms. System building and procurement of terminal equipment will increase the cost of the project. The more intelligent management system subsystems are applied to a construction site, the higher the building cost is, and the more terminal hardware equipment is procured, the greater the maintenance cost is. For example, the establishment of a safety supervision subsystem can monitor in real-time the construction time, location, and content of the construction workers' activities and in conjunction with this, it is necessary to purchase smart safety helmets for the construction workers, which cost several times more than ordinary safety helmets. At the same time, it is necessary to introduce professional and high-quality technicians to compare and analyze the collected data and maintain the intelligent management information system.

The interface of the integrated platform is unstable and the data interoperability is not strong. At present, most of the intelligent construction site platforms will be a simple integration of the application modules, but the lack of uniform data standards between the modules, resulting in the need to repeat the entry of basic data, data inconsistency is serious, the realization of the whole business, the whole process of information technology control is difficult, the technology needs to be perfected again [13].

4.2. Outlook

The future application of intelligent management systems on residential projects needs to fundamentally improve the high cost, and solve data barriers and data integration technical difficulties. The construction unit needs to start from the actual situation such as project scale and site complexity, and apply each module of the intelligent project management information system in stages and categories. Increase the introduction of professionals to improve system management capabilities, ensure stable and efficient operation of the information system, and improve the management level. In the future, with the further updating and iteration of the intelligent site system technology, it will make a greater contribution to the green and sustainable development of the residential and other construction fields.

5. Conclusion

In this paper, the application of intelligent engineering management technology in residential projects is studied through specific cases. In the context of the new era of engineering construction, it reflects its outstanding technical advantages and management effectiveness. The linkage between the intelligent management platform (big data center) and various subsystems shows the monitoring screen of the construction site in real time through the visualization interface, which can monitor the personnel, the operation status of mechanical equipment, and the construction progress at the construction site. Using the visualization interface to display construction progress, data charts of environmental indicators and real-time engineering models, through real-time monitoring video and data analysis, the management personnel can intuitively understand the situation at the construction site, detect problems in time and deal with them appropriately. The application of information technology not only enhances the administrative efficiency of managers, but also improves the management efficiency of the project but there are still some limitations and shortcomings. In the future, it is also necessary to conduct research on the stability of the interface of the intelligent project management technology support integration platform, effectively realize data interoperability, reduce labor costs, and promote the application in depth.

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