

Research on Digital Construction Process of Smart Site

Nana Liu^{1a}, Yetao Pang^{1b*}, Shuangping Cao^{1c}, Jing Yang^{1d}

^ae-mail:ldnnana@sina.com, ^be-mail:pangyetao@sina.com, ^ce-mail:shuangping@sina.com,
^de-mail:yangjing@sina.com

¹Chongqing College of Architecture and Technology, Chongqing, China

Abstract—Due to the scattered construction sites, complex operating environment, labor-intensive, and extensive on-site management, problems related to manpower control, safety, quality control and environmental management at the site have become increasingly prominent. With the vigorous development of the intelligent science and technology, especially network, Internet of things, and popularization and application of digital technology, is to explore the use of a new generation of information technology to change traditional mode of construction, building intelligent control platform construction, in order to improve the safety of the construction site management, quality, cost, time, has become the breach of the digital transformation to speed up the construction engineering company and focus, Intelligent construction site arises at the historic moment in this context. This paper discusses in detail the construction of smart site system platform, smart site evaluation factors and their mutual influence relationship, as well as the level classification of smart site and other aspects, in-depth analysis of the management between the various influencing factors of smart site, to provide reference for the future development of smart site.

Keywords-Intelligent construction site; Digital; Building construction process

1. Introduction

Smart site is the innovative application of digital technology in construction management. Many scholars and professionals have explored and studied smart site construction and made some beneficial progress. According to the management characteristics and practical requirements of the project construction stage, the corresponding management framework system is designed. However, most of the existing studies focus on the implementation case description of smart site construction, and there are relatively few studies on the system architecture and functional requirements used to guide the construction of smart site management platform. Therefore, the author around the key construction project in the construction site of the control requirements, design the system framework of the intelligent construction control network platform, has been clear about the network platform of seven categories covered by the main functions of the technology application characteristics, and on this basis, through the implementation of the pilot project of independent research and development of project management class network platform and corporate level network platform, in order to further promote the intelligent construction construction, and promote the transformation and development of traditional construction enterprises^[1].

2. Construction of intelligent construction site system

Intelligent site management vertically includes the information linking between the construction company's own department and the construction site project department, and horizontally includes the information integration of each management subsystem of the construction site. Therefore, construction companies must design and establish the management system framework of the platform according to the control needs of the construction site, and design the management platform and related subsystems on this basis when constructing the intelligent site management system. Each subsystem can not only coordinate operation, but also can work independently, it can not only ensure the overall stability of the whole system, but also develop in stages.

System architecture level: the basic architecture of the smart site control system is divided into six layers, namely, the feeling layer, the data transmission layer, the data analysis layer, the technical support layer, the operation layer and the lower layer of the system. The sensory layer is mainly composed of the Internet of things sensing terminals, using surveillance cameras, various sensors, radio frequency identification (RFID), audio and image recognition, position orientation, laser scanning and other intelligent sensing equipment, implement intelligent sensing and data collection for important data of construction personnel, construction equipment, hazard sources and surrounding environment, as well as key links, key processes, important processes and key components in the construction process. The communication layer is the main nerve center and brain of the whole system. It uses 5G mobile communication network, wired Internet, wireless network and other intelligent sensing equipment on the site to fuse into animal interconnection, so as to complete the real-time transmission of front-end sensing data. Considering the characteristics of the construction site monitoring platform, as well as the complex wiring, we will choose as far as possible the practicability, good scalability, easy to operate wireless data transmission mode. The big data layer can also set up a dedicated shared database for data analysis and communication.

The unified ID card of the support layer, the configuration of the next generation firewall, VPN gateway, WebGIS service, search engine, report service.

The application layer is divided into seven sections, which are project information, personnel management, special equipment management, placement management, environmental management, material management, characteristic application, etc.^[2].

User level to the project department, corporate headquarters and government departments to the wisdom of the three types of users with multifunctional site service platform, including meet the project level of different function and data differential display platform, enterprise platform screen/desktop/mobile client application service, and according to the requirements of government departments to project level platform related subsystems data access platform for government regulation^[3].

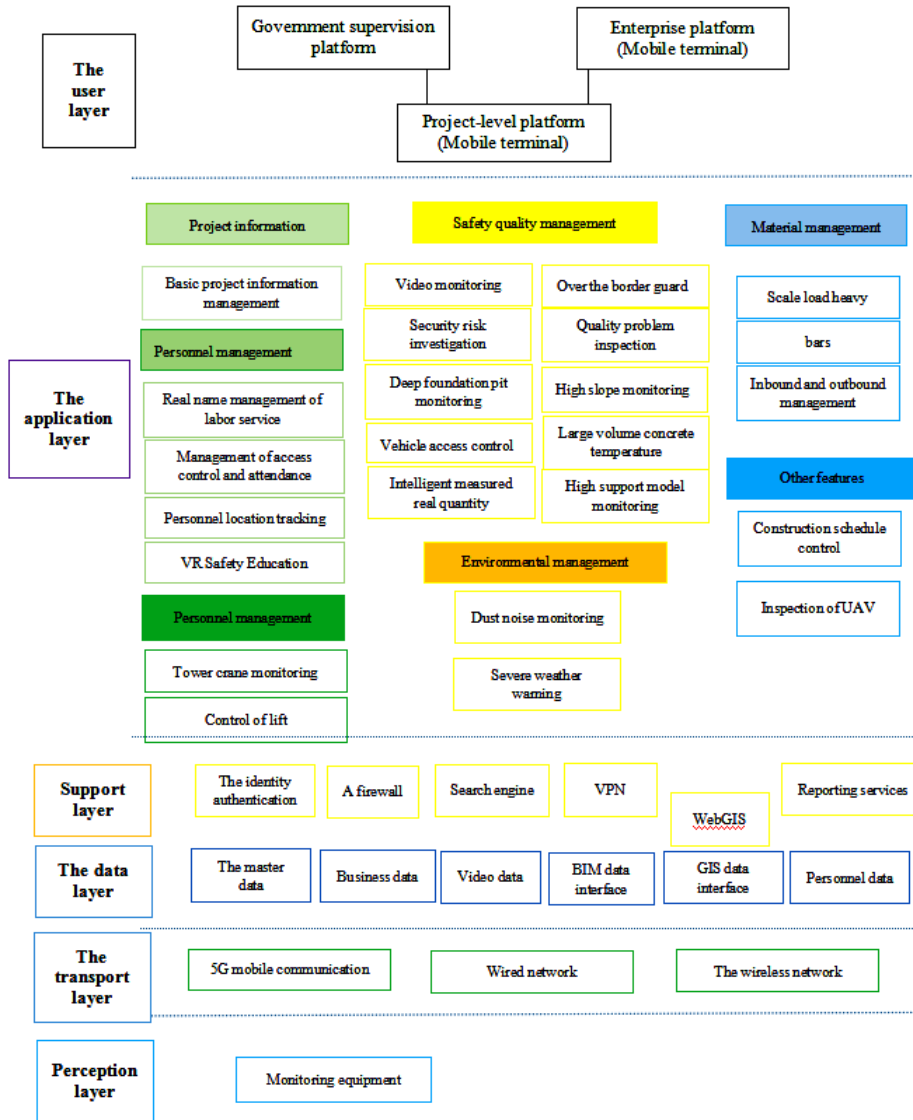


FIG. 1 System architecture of intelligent site management platform

On top of the above six layers of architecture, a sound technical standard management system, data security management system and information operation guarantee system should be developed to ensure the orderly collection, storage, use and sharing of information, and improve the standardized level and security of data management and application of information platform.

3. Evaluation criteria for digital construction of smart site

According to DEMETA method ^[8], mathematical graph theory and matrix design tools are used to carry out the analysis of the evaluation elements of smart site. Through the logical relationship between the basic elements in the system, the influence of each element on each other is judged. At the same time, the ISM method is used to reveal the relevant features in the complex system, analyze the direct influence relationship matrix between the elements in the system, and then calculate the reachable matrix through the operation of Boolean logic, and finally clarify the internal structure of the whole system ^[11].

Through DEMETA element analysis, the assignment analysis of all components in the sorted smart site management platform system was carried out, and 40 elements including basic information collection, video surveillance and personnel data were counted, including 10 central elements such as information collection, report service and quality problem detection and 30 common elements.

In addition, the smart site management system is divided into 6 levels through the ISM model ^[9] which are user layer, application layer, support layer, data layer, transmission layer and awareness layer from top to bottom. The user layer and the application layer are the basis of the smart site system, and the correctness of any of them will have a great impact on the management of the smart site, while the other layers are the support layer of the system, helping the application layer to achieve corresponding functions ^[10].

The influencing factors of smart site development include management factors, personnel factors, economic factors, smart site development factors, government factors, serious factors, technical factors, etc ^[12]. The influencing relationship model among them is shown as follows:

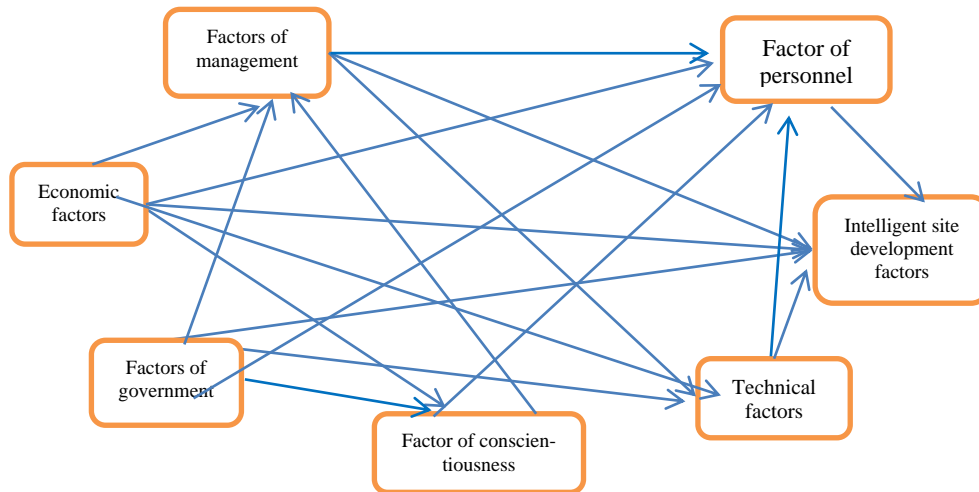


FIG. 2 Relationship model of influencing factors of smart site development

4. Research on the evaluation of smart site construction

According to the Chongqing 2020 "Smart Site" Construction Work Plan released by Chongqing Municipal Construction Commission, it is proposed that Chongqing will promote the classification and classification of "smart site" construction coverage before the end of 2020, and the "smart site" is divided into three levels.

Level 1 "smart site" should have the personnel real-name system management, video surveillance, dust noise monitoring, construction lift safety monitoring, tower crane safety monitoring, greater risk of the division of the project safety management, project supervision report, project quality acceptance management, building materials quality supervision, engineering quality testing supervision, wage special account management, BIM (information technology model Technology, also known as "virtual construction") construction and other 12 elements.

Secondary "smart construction site" should have personnel real-name system management, video surveillance, dust noise monitoring, construction lift safety monitoring, tower crane safety monitoring, dangerous branch project safety management, project supervision report, project quality acceptance management, building materials quality supervision, project quality inspection supervision, wage special account management and other 11 elements.

The three-level "smart construction site" should have six elements, such as real-name management of personnel, safety management of dangerous sub-projects, project supervision report, project quality acceptance management, quality supervision of building materials and special account management of wages.

5. Smart site digital construction safety application

The platform of the engineering layer is configured on the engineering site, and the functional units should be configured selectively according to the requirements of the engineering site. Local area network (LAN) should be established and data client/application server should be configured to provide data support and service for the engineering layer platform. The computer local area network should carry on the security protection, including but not limited to configure the legitimate antivirus program, configure the next batch of firewalls, establish the two-factor verification system of the network, etc. Through comprehensive application, integration and coordination, intelligent construction site can integrate all kinds of fragmented information systems, coordinate and use all kinds of independent information systems that are not related to each other, and realize the overall function. Wisdom site is a data system, carries on the information to each other, realize the information collection, integration and data sharing, part of the site system integration the wisdom project information, project team has set up a platform data, each organization staff to work at a glance, information symmetry, is conducive to a more reasonable management decisions. To create great economic and social benefits for the construction of the construction industry, promote the transformation and upgrading of the industry. As far as the main members of the project are concerned, the smart project adopts real-time, information-based and visual modes to assist the on-site managers to improve their efficiency. With the help of a unified network platform, the main members share data, improve the quality of information communication, and prevent the delay in information communication from hindering the development of the project. Assist government departments

and agencies to carry out efficient supervision. For construction company, the implementation of intelligent construction technology can help the enterprise to monitor all construction projects, the implementation of the construction scope covers the time limit for a project, quality, personnel, materials, environment, such as the target, and can discover all construction projects the main risk nodes in time, in a timely manner to monitor specific problems, and puts forward treatment measures. Assist construction enterprises to automatically collect first-line financial data of construction from the bottom up, build a big data analysis network platform for enterprises, and accumulate data analysis assets. In a word, the implementation of commanding construction can completely change the development mode of China's construction industry, and form a huge economic and social benefits.

6. Conclusion

Management platform will make the decision makers and managers of the project can at any time, with the direct observation of the status and production situation of construction, improve and perfect the construction projects for the engineering quality, safety and civilized construction and environmental health management capacity, improve production efficiency and management level of construction project site and decision-making power, And then achieve the electronic management of engineering construction, fine and intelligent. According to the management needs of the construction site, this paper studies and summarizes the system framework of the intelligent construction site management platform, and analyzes the construction safety application according to the specific situation, hoping to provide reference for the establishment and implementation of various intelligent construction management systems.

References

- [1] Liu Y Y. Design of intelligent construction site management information security Monitoring System based on Web [J]. Science and Technology Information, 222,20(16):15-17+80.]
- [2] Li J, Sun J, Zhao L. Research on on-site epidemic prevention and control of traditional power engineering based on "Internet Plus" technology [J]. Electric Power Survey and Design, 2022, (07):76-80.
- [3] Zhu Junquan. Research on Curriculum Reform and Practice of Intelligent Construction Technology in Higher Vocational Colleges under the background of "Digitalization" [J]. Modern Commerce and Trade Industry, 222,43(18):245-246.
- [4] Tong Guangquan, Shi Jun, Ge Xiaoyuan, Yang Yang, Li Yajun, Zhou Tianyu. Application of mechanical and electrical assembly construction technology in Guangcheng Project [J]. Installation, 2022, (07):50-52.
- [5] Liu Lei, Sun Weikang. Large-scale safety management of thermal power construction projects based on EPC general contracting mode [J]. Popular Standardization,2022,(14):69-71.
- [6] Pan Renyou, He Lixia, Su Yuan. Practice and exploration of quality supervision of Ningbo water conservancy construction project under the new situation [J]. Zhejiang Water Science and Technology, 222,50(04):27-29.

- [7] Wang Karmic, Tang Liang, Zhang Lele, Li Jianhua, Gao Quanlong. Application of BIM+ Smart site decision-making system in an airport project [J]. Smart Building and Smart City, 2022, (07):112-114.
- [8] Gabus A, Fontela E. Perceptions of the World Problematique: Communication Procedure, Communicating with Those Bearing Collective Responsibility. DEMATEL Report No.1[M]. Battelle Geneva Research Centre, Geneva, 1973.
- [9] Suresh M, Mahadevan G, Abhishek R D. Modelling the factors influencing the service quality in supermarkets[J]. International Journal of System Assurance Engineering and Management, 2019, 10(6):1474-1486.
- [10] Zheng X, Xu F, Feng L. Analysis of driving factors for extended producer responsibility by using Interpretative Structure Modelling (ISM) and Analytic Network Process (ANP)[J]. Sustainability, 2017, 9(4).
- [11] Chi B H, A study on the evaluation of Smart Site Construction from the perspective of government [M]. Shandong Jianzhu University,2022.06.
- [12] Guo H L.Research on Influencing Factors and Strategies of Intelligent Construction Site Development[M].China University of Mining and Technology,2022.05.