The current application status and development trends of information management in engineering projects

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Abstract: This paper makes an in-depth analysis of the current situation of engineering project information management. Although information technology helps the site data transmission and data management, it is faced with obstacles such as lagging policies and regulations, different technology maturity and difficult change of cultural cognition. The trend of emerging technology integration and standardization integration is prominent. In order to cope with the challenges, it is suggested that the development bottleneck should be broken through policy support, industry-university-research cooperation, and cultural cultivation to promote the comprehensive implementation of information technology, and improve the efficiency of project management and risk control ability.

Keywords: Engineering project; Information management; Technology integration; Standardization

Foreword

Under the wave of digitalization, the information management technology is actively introduced in the field of engineering projects, hoping to improve the efficiency and quality. From the real-time transmission of the site data to the massive data storage and management, the information means have been deeply embedded in the project process. However, many problems emerge in the application process, and it is urgent to sort out the current situation, insight into the trend, explore the optimization path, and promote the benign development of engineering project information management.

1. The implementation of engineering project information management technology

1.1. Combing the basis of information technology

1.1.1. The role of data transmission technology in real-time data return at the project site

Project data transmission mainly relies on wireless communication technologies such as 4G/5G and wired data transmission technologies like industrial Ethernet to function in relatively fixed construction site areas. 4G/5G has a wide coverage area and supports real-time transmission of data such as video surveillance at construction sites, equipment operation status, and personnel attendance. For example, using high-definition cameras combined with video streaming technology can transmit stress and strain monitoring data from key construction projects in real-time to the backend data analysis system via sensors and high-speed data transmission modules. This allows engineers to promptly understand structural safety conditions and issue warnings for abnormalities, preventing engineering accidents and significantly enhancing the safety and controllability of construction projects.

Industrial Ethernet is more stable in fixed areas. Ethernet supports high precision data transmission, and when wiring conditions allow, it can provide high bandwidth and low latency data transmission service^[1]. For example, the Ethernet will send the operation parameters and lifting position information back to the control center in real time to ensure the accuracy and efficiency of the tower crane operation, and also provide a reliable data channel for the remote monitoring and maintenance of the equipment.

1.1.2. Support of cloud storage technology for engineering data management

Cloud storage technology has brought key changes to the storage and management of huge data of engineering projects. From design drawings, geological reports, construction logs and acceptance documents, all the data can be uploaded to the cloud without considering the expansion of storage devices as frequently as traditional local storage. Cloud storage of distributed architecture to ensure the high availability and security of data, data is scattered storage on multiple nodes, even some node fault access, will not affect the integrity of the data and normal access, and cloud storage providers usually have data backup and recovery mechanism, can effectively prevent natural disasters, hardware failure caused by data loss. The cloud platform supports the multi-role coordination of designers, construction parties and supervisors. All participants can access and modify documents through the Internet at any time. All parties can synchronize the latest design changes in real time to facilitate the collaborative work and accelerate the speed of the project promotion. In addition, cloud storage also simplifies the process of data backup and recovery, and enterprises do not need to build their own complex systems, reducing the difficulty of operation and maintenance.

1.2. Major development obstacles

1.2.1. Policies and regulations lag behind

The current policy lacks targeted regulations on the privacy protection of engineering data. At present, the specific norms and standards for the protection of data privacy in the engineering field are not yet clear. Enterprises are worried that the identity information, health data, owners' privacy and other data will be leaked in the transmission and storage, which will lead to legal disputes and reputation damage. At the same time, policies and regulations on cross-border transmission of project data are not perfect. In some transnational engineering projects, some engineering data may need to be transmitted to foreign headquarters for analysis or review. Due to the differences in data protection regulations in different countries and regions, cross-border data transmission faces many uncertainties. Companies are concerned about the risk of high fines and legal proceedings for violating data protection regulations in other countries, so they are cautious of using information management technology for cross-border data transmission. For example, the EU GDPR requires strict localized localization storage, requiring enterprises to invest in additional compliance review costs, and even being fined for violations, inhibiting the application of information technology.

1.2.2. Differences in technology maturity

Project information management involves various technologies, each with varying levels of maturity. For instance, while 5G technology offers significant advantages in data transmission, it often suffers from insufficient network coverage and unstable signals in remote project sites, leading to interruptions or delays in sensor data collection, which affects real-time monitoring^[2]. In contrast, although 4G technology has a wider coverage area, it struggles when dealing with high-bandwidth scenarios such as large-scale HD video data transmission. This disparity in technological maturity creates a dilemma in selecting data transmission technologies, making it difficult to meet the diverse data transmission needs of projects.

In addition, in terms of engineering data security and protection technology, but with the continuous update of network attack means, the existing security and protection technology still has some loopholes. For example, new phishing attacks could bypass traditional encryption protection and steal engineering data. In addition, there are also problems in the compatibility between different security protection technologies. When building a complete data security protection system, it is easy to have poor technical connection, which affects the effect of data security guarantee, and thus hinders the in-depth application of information management technology in engineering projects.

1.2.3. Difficulty of cultural cognitive transformation

The engineering project industry has formed the traditional management mode and working habits for a long time, which leads to the difficulty of changing the cultural cognition. Many engineering managers and construction personnel have relied on paper records and oral communication for a long time, and have low acceptance of electronic tools such as mobile terminal attendance and electronic logs. Some old employees of the construction personnel are not skilled in operation, mistakenly think that the information system will increase the work burden, the information management system aversion, unwilling to take the initiative to use. This traditional thinking leads to the superficial application of information technology, which is difficult to get a comprehensive and effective application within the enterprise, which limits the digital transformation process of enterprises.

2. The development trend of technology-driven engineering project information management

2.1. Emerging technology convergence trend

Driven strongly by technology, AI and BIM are deeply integrated, bringing great importance to the engineering field. AI deeply mines BIM model data, realizes intelligent design optimization, quickly generates and screens schemes according to performance indicators, and greatly shortens the design cycle. At the same time, with the help of AI image recognition, automatic collision detection can intelligently identify the potential collision points between components, greatly improves the design accuracy, and significantly improves the engineering efficiency and quality. The immovable chain storage of blockchain technology ensures data security, realizes the whole transparent traceability in the supply chain, effectively reduce risks and optimize the cooperation of all parties.

2.2. The trend of technical standardization and integration

In the current field of engineering projects, the industry is in urgent need of unifying information technology standards to break data islands. Relevant organizations at home and abroad are actively promoting the formulation of BIM and engineering data management standards, aiming to clarify data storage, exchange and interface standards and effectively solve technical compatibility problems. At the same time, various management tools are accelerating the transformation to an integrated platform, organically integrating project progress, cost, quality and other management modules, and then building a unified data interface, which can realize cross-department real-time collaboration and whole life cycle data, and significantly improve decision-making efficiency and collaboration efficiency.

3. Strategic suggestions for optimizing the information management of engineering projects

3.1. Policy suggestions of the government and industry associations in terms of technical support and subsidies

The government and industry associations can provide policy guidance to encourage financial institutions to provide special loans for the research and development and application of engineering project information management technology, or lower the loan threshold, give preferential interest rates, ease the financial pressure of enterprises, and help small and medium-sized enterprises to participate in technological innovation and upgrading. The second is to set up information management technology demonstration projects, led by the government and industry associations, select typical engineering projects, invest funds to build information management model, give technology selection, system construction and actual operation guidance and support, and organize the industry enterprises to observe and learn after success, give play to the demonstration and driving effect. Finally, for the enterprises involved in the formulation of information management technical standards, appropriate policy preferences should be given, such as appropriate extra points in the project bidding, to encourage more enterprises to actively participate in the improvement of industry standards and promote the unified process of technical norms.

3.2. Strategies of enterprises in technology introduction, training of professional talents, work innovation, etc

When introducing technology, enterprises can establish industry-university-research cooperation relations with universities and scientific research institutions, and jointly carry out technology research and development and project practice, so that the cutting-edge research results of universities can be quickly transformed into enterprise productivity. At the same time, the practical needs of enterprises also provide a direction for scientific research. In terms of talent training, the enterprise has set up an information management training college, and cooperated with training institutions to customize systematic courses such as technical practical operation, interpretation of the latest industry trends, and cross-field knowledge integration, so as to build a compound talent team. Finally, in terms of encouraging innovation, try to establish an incubation mechanism for innovation projects, provide start-up funds, site equipment and other support for potential information management transform them into the actual benefits of the enterprise^[3].

3.3. Countermeasures to shape the cultural cognition of all staff in information technology and promote the innovation of management ideas

In order to further deepen the cultural cognition of information management for all employees, enterprises can organize employees to visit the advanced enterprises of information management in the industry, personally feel the efficient working mode and operation results brought by information management, and enhance the intuitive cognition of employees on information reform. In terms of management concept innovation, information management consulting experts can be invited to enter the enterprises, combined with the business characteristics of each department, one-to-one department guidance and customized information management transformation plan. Cross-cross-department information management seminars can also be organized to promote experience sharing and collaborative innovation after breaking departmental barriers, ensure that the full management concept follows the pace of the information age and promote the reform of enterprise information management in an all-round way.

4. Epilogue

In summary, the opportunities and challenges of information management in engineering projects coexist. The integration of emerging technologies and standardized integration points the way forward. All parties must collaborate to implement optimization strategies, overcome existing obstacles, and fully leverage the advantages of information management. This will drive the engineering industry towards efficient, intelligent, and sustainable development, giving it a competitive edge in the fierce market competition

About the author

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