

# Reconstruction of Construction Project Management Mode and Analysis of System Adaptability under the Background of Digital Transformation

Zihan Yang

Yangtze University, Jingzhou, 434023, Hubei, China

569014977@qq.com

**Keywords:** Digital Transformation; Construction Project Management Mode; Institutional Adaptability; Management Process; Occupation Standard

**Abstract:** Under the background of digital wave sweeping across various industries, the construction engineering industry is facing profound changes. This article focuses on the research on the adaptability of construction project management mode and system under the background of digital transformation. By combing the relevant theoretical basis, this article analyzes the influence of digital transformation on the management concept, process and organizational structure of construction projects, and discusses the reconstruction strategy of management mode and the optimization path of institutional adaptability. It is found that the digital transformation promotes the management concept to be refined and data-driven, the management process to be changed, and the organizational structure to be flat. At the same time, the existing construction project management system is not adaptable to the digital management model in terms of laws, regulations and industry standards. Based on this, this article puts forward some strategies such as building a management model based on digital technology, perfecting relevant laws and regulations, and updating industry standards, so as to promote the high-quality development of construction engineering industry in the digital age.

## 1. Introduction

In today's era of rapid development of global science and technology, digital transformation has become the key driving force for all walks of life to achieve innovative development and enhance competitiveness [1]. As an important pillar industry of the national economy, the construction engineering industry is also facing profound digital changes [2]. In recent years, emerging digital technologies such as big data, artificial intelligence, Internet of Things and BIM (Building Information Modeling) have emerged continuously, bringing unprecedented opportunities and challenges to the field of construction engineering [3]. On the one hand, these technologies provide powerful tools for improving the efficiency, quality and accuracy of construction project management; On the other hand, the traditional construction project management mode and system gradually exposed a lot of inadaptability in the face of digital wave [4].

In this context, it is of great practical significance to reconstruct the management mode of construction projects and analyze the corresponding institutional system [5]. Theoretically, a deep study of the influence of digital transformation on the management mode and system of construction projects will help to further enrich and improve the theoretical system of construction project management and provide new perspectives and ideas for academic research in this field [6]. From a practical point of view, by exploring the reconstruction path and system optimization strategy of management mode under the background of digital transformation, it can effectively help construction engineering enterprises improve management efficiency and reduce engineering costs; At the same time, enhance the ability of risk prevention and control, and then promote the high-quality development of the entire construction industry.

The purpose of this study is to systematically analyze the specific impact of digital transformation on the management mode of construction projects, deeply discuss the effective strategies of management mode reconstruction, and comprehensively analyze the adaptability of the

current management system of construction projects, and then put forward targeted optimization suggestions. It is expected that this study will provide useful reference for the sustainable development of construction engineering industry in the digital age.

## **2. Related theoretical basis**

The purpose of digital transformation is to transform business processes, business models and management methods by using digital technology in an all-round, multi-angle and full-chain way, so as to realize the fundamental change and innovative development of the organization. Its core covers technological innovation, business model remodeling and organizational culture change [7]. On the technical level, big data and cloud computing provide support for data processing and analysis; In business, new business models are born through digital technology; Culturally, cultivate the digital thinking and innovative consciousness of organization members.

Construction engineering management is based on project management knowledge system, including scope management, time management, cost management, quality management and so on. Through the effective control of the whole life cycle of the project from planning to delivery, the project objectives are ensured to be realized [8]. For example, schedule management uses tools such as Gantt chart and critical path method to arrange the project schedule reasonably; Quality management is based on quality standards, and it is the theoretical cornerstone to ensure the smooth implementation of construction projects by means of quality control.

Institutional adaptability refers to the ability of institutions to maintain effectiveness and coordination through self-adjustment when facing changes in internal and external environment. Its influencing factors include technological progress and changes in the market environment. When the external environment changes, the system needs to be adjusted accordingly, otherwise it will be unsuitable [9]. For example, with the market competition and technological innovation, the enterprise system needs to adjust its organizational structure and management process to maintain a good operating state, which is of guiding significance for analyzing the adaptability of construction project management system and digital transformation.

## **3. Influence of digital transformation on construction project management mode**

### **(1) The change of management concept**

Under the wave of digital transformation, the concept of construction project management is changing from traditional extensive to digital and refined. The traditional management concept focuses on experience judgment and post-processing, while the digital transformation urges managers to establish data-driven decision-making thinking. In the past, managers judged the progress and quality of the project based on personal experience and intuition. Nowadays, with the help of big data analysis, enterprises can accurately grasp the data of all aspects of the project, predict potential problems in advance and realize forward-looking decision-making.

### **(2) The change of management process**

Digital transformation makes the project bidding process more open, transparent and efficient. Traditional bidding requires a large number of paper documents, and the process is cumbersome and prone to human error and black-box operation. The digital bidding platform uses blockchain, electronic signature and other technologies to realize online submission, bid opening and bid evaluation of documents, and all information is recorded in real time and cannot be tampered with.

With the help of BIM technology and Internet of Things equipment, the construction progress management is more accurate. Traditional schedule management relies on regular reports and on-site inspections, and information lags behind. Nowadays, by deploying sensors in the construction site, the construction progress data are collected in real time and correlated with the BIM model. Managers can visually check the progress of the project, and if deviations are found, they can analyze the reasons and adjust them in time. Digital technology provides a more comprehensive means for quality management. Traditional quality inspection is mostly sampling inspection, which has the risk of omission. Nowadays, through unmanned aerial vehicles, 3D

scanning and other technologies, the project can be detected in all directions and without dead ends. Comparing and analyzing the test data with the quality standard can quickly locate the quality problem. Table 1 clearly shows the differences of management processes before and after digital transformation:

Table 1: Comparison of Construction Project Management Processes before and After Digital Transformation

Management Process	Traditional Mode	Post-Digital Transformation Mode
Engineering Bidding	Paper documents, cumbersome procedures, prone to under-the-table operations	Online platform, transparent information, efficient and fair
Construction Schedule Management	Regular reporting, on-site inspections, information lag	Real-time data collection, linked with BIM, precise control
Quality Management	Sampling inspection, risk of missing issues	Comprehensive detection, data comparison and analysis, precise problem identification

### (3) Adjustment of management organization structure

Digital transformation promotes the transformation of construction project management organization from hierarchical to flat and network. In the traditional hierarchical architecture, information transmission needs to go through multiple levels, which leads to information distortion and slow decision-making. With the help of instant messaging tools and project management software, the flat and networked architecture enables information to be quickly transmitted between departments and posts. The project manager can communicate directly with the front-line construction personnel, reduce intermediate links and improve decision-making efficiency. This kind of organizational structure adjustment makes the construction project management more flexible and can quickly respond to market changes and engineering needs.

## 4. Construction project management mode reconstruction strategy

### (1) The principles and contents of the management model based on digital technology

The construction principles of management mode based on digital technology are as follows: data-driven principle, collaborative sharing principle and dynamic adjustment principle.

Digital project planning management makes an in-depth analysis of project site selection and feasibility study with the help of GIS, big data analysis and other technologies. By collecting regional planning, geological conditions, market demand and other multi-source data, it provides a comprehensive basis for project decision-making. At the same time, the digital simulation technology is used to preview the construction period and cost of the project, and the optimal planning scheme is formulated.

Digital management and control of construction process: schedule control based on BIM technology, a digital construction schedule model is constructed, and the total schedule is decomposed into various construction processes, and the actual construction schedule data is correlated. Through real-time comparative analysis, the progress deviation can be found in time and early warning, and targeted measures can be taken to adjust. Intelligent detection equipment, including laser scanners and high-definition cameras, should be adopted to realize all-round real-time monitoring of construction quality. Using image recognition, data analysis and other technologies, quality defects can be automatically identified, and the problems can be fed back to the relevant responsible persons, so as to realize the rapid processing of quality problems. Multiple sensing devices such as temperature sensors, smoke sensors, and personnel positioning sensors should be deployed on the construction site to achieve real-time collection and analysis of safety data. Through the analysis of big data, the potential safety risks are forewarned, and at the same time, the construction workers are trained in safety by using virtual reality and augmented reality technology to improve their safety awareness and emergency handling ability.

### (2) Digital supply chain and resource management

Digital supply chain management platform should be built to integrate suppliers, logistics enterprises and other related resources. Through the platform, the information such as inventory and

transportation status of building materials and equipment can be grasped in real time, and the precise allocation of resources can be realized. Big data technology should be used to make purchasing plans in advance through the analysis and prediction of material demand, thus reducing inventory costs and out-of-stock risks. The comparison before and after the reconstruction of construction project management mode is shown in Table 2:

Table 2: Comparison of Construction Project Management Models Before and After Reconstruction

Management Content	Pre-Reconstruction Mode	Post-Reconstruction Digital Mode
Project Planning Management	Experience-based judgment, simple data analysis	Multi-source data fusion, digital simulation rehearsal
Construction Schedule Control	Regular reporting, manual deviation comparison	BIM real-time linkage, automatic deviation warning
Construction Quality Control	Sampling inspection, manual defect identification	Comprehensive real-time monitoring, intelligent defect identification
Construction Safety Control	On-site patrols, post-incident handling	Real-time sensor monitoring, risk warning combined with training
Supply Chain and Resource Management	Traditional procurement, information lag	Digital platform integration, precise allocation and forecasting

Through the above management mode reconstruction strategy based on digital technology, construction project management can realize the transformation from traditional extensive to modern fine, and improve the overall management level and competitiveness of the project.

## 5. Adaptability analysis and optimization strategy of construction project management system

### (1) Analysis of the inadaptability between the existing system and the digital management mode

The current laws and regulations related to construction engineering are mostly based on the traditional management mode, and there are many gaps in the digital scene. Once a dispute arises, it is difficult to clearly define the responsibility identification and handling methods. In addition, there are no perfect legal norms for the ownership, use and privacy protection of a large number of data generated in the construction process.

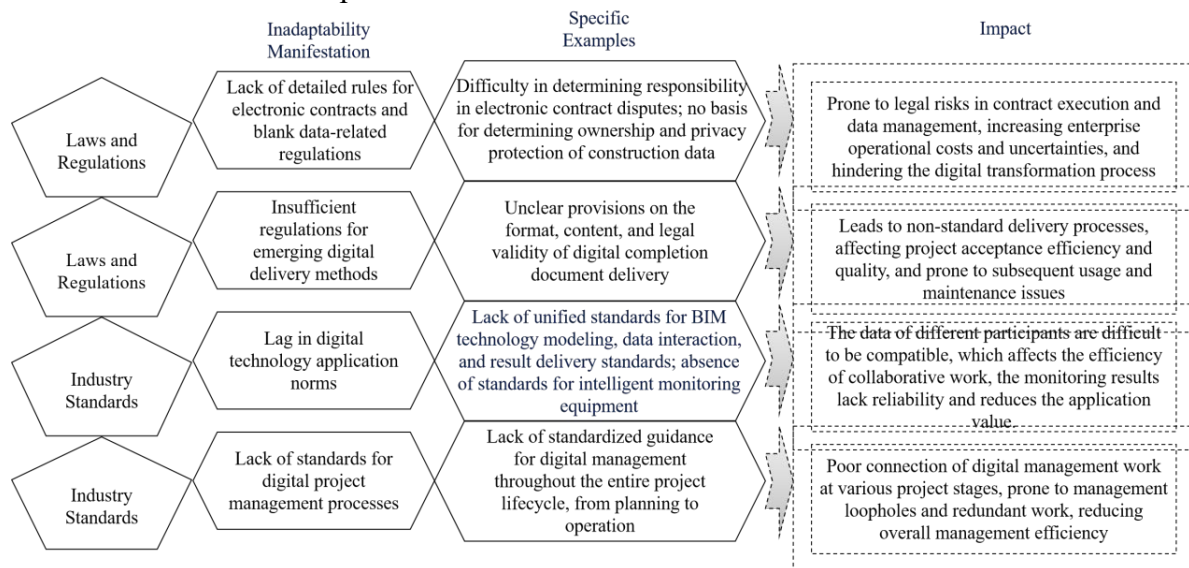


Figure 1 Analysis of the inadaptability of the existing construction project management system

The existing industry standards are relatively lagging behind in the application of digital management technology. Taking BIM technology as an example, although it has been applied in some areas and projects, it lacks unified modeling standards, data interaction standards and results delivery standards. BIM models created by different enterprises and teams are different in data format and information depth, which affects data sharing and collaborative application. In the application of intelligent monitoring equipment, there is also a lack of standard provisions on equipment accuracy, monitoring frequency and data quality, which makes it difficult to guarantee

the reliability and comparability of monitoring results. The analysis of the inadaptability of the existing system is shown in Figure 1.

#### (2) Optimization strategy of institutional adaptability

The legislative department should speed up the formulation and revision of laws and regulations related to digitalization of construction projects. Laws and regulations should clarify the specific rules of electronic contracts in the conclusion, modification, performance and dispute settlement of all aspects of construction projects, and ensure that electronic contracts and paper contracts have the same legal effect and clear operating norms. Special regulations should be formulated for the management of construction data, clarifying data ownership and usage rights, standardizing data collection, storage, transmission, and sharing processes, and strengthening data privacy protection measures.

Industry associations and related standardization organizations need to take the lead in improving the industry standards of digital management technology as soon as possible. A unified BIM technology application standard should be developed, which should cover modeling rules, data dictionaries, and model delivery depth to promote the universality and sharing of BIM models across the industry. For intelligent monitoring equipment, detailed performance indicators, accuracy requirements, monitoring frequency and data quality standards are formulated to ensure the accuracy and reliability of monitoring data and promote the adaptation of construction project management system to digital management mode.

## 6. Conclusions

This article deeply discusses the reconstruction of construction project management mode and institutional adaptability under the background of digital transformation. In terms of management mode, digital transformation has brought all-round influence. The management concept has changed from traditional extensive to digital and refined, and data-driven decision-making has become the core orientation. The management process has been transformed with the help of emerging technologies in bidding, construction progress and quality management, and the management efficiency and accuracy have been significantly improved. The management organization structure has also been adjusted from hierarchical to flat and networked, which has enhanced the efficiency of information transmission and decision-making.

At the level of laws, regulations and industry standards, the current construction project management system is not suitable for the digital management mode. There are gaps in laws and regulations in electronic contract details and data specifications, and industry standards are relatively lagging behind in the application specifications of digital technology. In view of these problems, this article proposes to optimize the management mode based on digital technology, improve laws and regulations, and update industry standards. Through these strategies, it is expected to realize the effective adaptation of construction engineering management mode and system, enhance the overall competitiveness of the industry, and push the construction engineering industry to conform to the trend of digital development and move towards a new stage of high-quality development.

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