Construction Management Strategies Based on Quality Management System

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Abstract: Against the backdrop of high-quality development in the construction industry, engineering quality issues have become the focus of social attention. Traditional construction management models struggle to meet the demands of complex projects. However, construction management measures under a quality management system can effectively enhance management standardization and systematicness. Therefore, the construction industry has begun to actively explore the integration path of quality management systems into construction management. This paper analyzes the importance and basic principles of construction management based on a quality management system and proposes scientific and reasonable management strategies, such as establishing a hierarchical quality responsibility system, implementing whole-process material quality control, using intelligent monitoring technology to improve management precision, strengthening dynamic control of construction processes, and building a continuous optimization mechanism, aiming to provide a reference for the high-quality development of construction projects.

1. Introduction

With the accelerating urbanization process, the construction industry has ushered in new development opportunities. High-rise building projects have emerged in large numbers, significantly improving people’s daily lives and production conditions. However, the expansion of construction scale and the increasing complexity of construction technology have posed severe challenges to construction management. The quality management system, with its advantages of scientificity and standardization, can point construction management in the right direction, adhering to the basic concepts of prevention first and continuous improvement. Deeply exploring construction management strategies under the quality management system has important practical significance.

2. Importance of Construction Management Based on Quality Management System

2.1 Ensuring Project Safety

The introduction of a quality management system into construction management can provide guarantees for safe project construction. The quality management system advocates a prevention-oriented ideology, requiring detailed planning before construction to identify potential safety hazards in advance, formulate corresponding preventive measures and emergency response plans, and shift safety management from passive response to active prevention and control, thereby reducing the probability of construction safety accidents. In addition, the quality management system emphasizes the continuous optimization of construction management. Based on extensive collection and analysis of safety data, construction enterprises continuously optimize safety management systems and processes, forming a continuously optimized safety management closed-loop and promoting the safe and stable development of the construction industry [1].

2.2 Extending Project Service Life

Construction management under the quality management system can extend the service life of

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construction projects through standardized and systematic process control. Quality management emphasizes whole-life cycle management and advocates risk assessment of key processes such as material selection and construction technology, which can enhance the environmental erosion resistance of construction projects from the source. At the same time, the quality management system enables refined control of construction quality, effectively reducing common quality defects in construction, thereby minimizing issues of structural durability loss caused by quality problems, and reducing the need for frequent maintenance during the project’s service phase. Furthermore, the construction quality management model under the quality management system can form a quality traceability closed-loop, with traceability records retained from materialmarch into the arena to completion acceptance, providing reliable data support for later renovation and maintenance of construction projects.

3. Basic Principles of Construction Management Based on Quality Management System

3.1 Prevention First

Construction management under the quality management system should adhere to the basic principle of prevention first, realizing theprepose of quality risk control and establishing an active risk resistance mechanism. This principle requires construction projects to establish a three-level prevention system from the planning stage. During the construction organization design phase, BIM technology should be used for construction simulation and collision detection to identify defects in construction drawings and process conflicts in advance and develop targeted solutions. In the technical disclosure phase, a visual disclosure mode should be adopted, using 3D models and VR technology to demonstrate quality standards to operators, ensuring that technical requirements penetrate into the implementation level. During construction, a scientific and reasonable dual-control prevention mechanism should be established to upgrade traditional construction quality inspections to process parameter monitoring [2]. Intelligent sensors are used to collect parameters such as concrete pouring temperature and steel structure welding current in construction projects, and an automatic correction mechanism is triggered when deviations exceed the allowable range, providing a replicable benchmark template for subsequent construction.

3.2 Full Participation

Construction management under the quality management system must firmly adhere to the principle of full participation, emphasizing that all personnel at all levels of the project, from decision-makers to frontline operators, should participate in quality management as owners, forming a collaborative mechanism of shared quality and shared responsibility.

At the project initiation stage, all personnel must clarify quality standards and individual responsibilities. Management should establish an open communication platform, regularly organize quality analysis meetings and technical disclosure meetings, encourage employees to put forward improvement suggestions, and ensure that each operator masters operational specifications and quality key points. Full participation also requires the penetration of quality culture; construction enterprises can post quality slogans and carry out quality month activities to create a favorable quality management atmosphere.

Middle managers and technical backbones should deeply understand quality objectives and specifications and translate them into operable operation instructions, ensuring the accurate implementation of process standards through effective disclosure and daily supervision.

In addition, subcontractors and suppliers should also be included in the full participation system. Through clear quality requirement agreements and collaborative management, the quality of input resources is ensured, laying a solid foundation for the quality of the final construction product from the source.

3.3 Quality Priority

Construction management based on the quality management system must take quality priority as

the core principle, establishing a quality goal orientation from the project decision-making stage and placing quality control ahead of factors such as schedule and cost. In specific practice, a three-level quality control system should be built, and dual prevention should be implemented for high-risk projects such as deep foundation pits and high formwork, with BIM technology used to identify quality hazards in advance.

Meanwhile, this principle requires construction units to strictly implement the PDCA cycle (Plan-Do-Check-Act). Before project initiation, detailed quality planning should be conducted in accordance with QMS requirements, and full technical disclosure should be provided to all construction personnel to ensure they fully master process requirements and quality standards. On this basis, regular internal audits should be conducted to systematically analyze weak links in the quality management system and common defects in construction, and formulate and implement effective corrective and preventive measures.

4. Construction Management Strategies Based on Quality Management System

4.1 Establishing a Hierarchical Quality Responsibility System

Construction management under the quality management system should establish a hierarchical quality responsibility system, adopting a horizontal and vertical grid-based control strategy to achieve traceable, quantifiable, and assessable quality responsibilities. First, construction enterprises should divide three-level responsible entities. The strategic decision-making level should establish a Chief Quality Officer system, with the enterprise’s legal representative as the first person responsible for quality, formulating quality strategic policies and annual goals, and holding quarterly quality committee meetings. The process control level, with the project manager as the on-site chief qualityleading official, should establish a quality management team, actively implement the one-vote veto right for quality, and link quality assessment with the project bonus pool. The operation and execution level should establish mechanisms for pre-shift quality disclosure, in-shift process inspection, and post-shift finished product protection, and incorporate information on responsible persons for key processes into building components to achieve whole-life cycle quality traceability.

On this basis, construction management should be supported by clear responsibility investigation systems, assessment and incentive mechanisms, and smooth information feedback channels. Quality responsibilities should be linked to performance, salary, and excellence evaluation, and quality traceability systems should accurately associate problems with responsibility levels, forming a positive cycle where everyone is under pressure and everything has standards, and delivering high-quality construction products based on a solid quality responsibility system.

4.2 Implementing Whole-Process Material Quality Control

Construction management under the quality management system framework should build a whole-process material quality control system, conducting comprehensive evaluation and selecting high-quality suppliers from dimensions such as qualification review, production capacity, and historical performance [3]. Construction enterprises should formulate a source inspection mechanism, conduct on-site audits of key material production bases, verify raw material quality certificates, production process flows, and the effectiveness of testing equipment to ensure materials meet standards before leaving the factory. Materialmarch into the arena requires joint participation of the construction party, supervision party, and supplier in appearance acceptance and verification of quality certification documents. Third-party laboratories should be entrusted to conduct sampling re-inspection of key indicators such as cement strength and mechanical properties of steel bars, and materials can only be warehoused after passing the inspection. Qualified materials should be stored in designated areas, with appropriate storage and protection measures selected based on material characteristics. Construction enterprises should establish a material identification and traceability system, clearly marking information such as material name, specification, andmarch into the arena time to ensure traceability of the source and usage location of each batch of materials.

In addition, quality activities in all links should form clear and complete quality records for archiving management. Construction enterprise managers should regularly analyze material quality data, use corrective and preventive measures in the quality management system to continuously optimize control strategies from management, technical, and process levels, and continuously improve the quality management level of construction materials.

4.3 Using Intelligent Monitoring Technology to Improve Management Precision

Construction management under the quality management system needs to achieve whole-life cycle quality control through in-depth integration of standardized processes and intelligent technologies. Construction enterprises should deploy intelligent sensor clusters using IoT technology, installing stress-strain sensors, temperature and humidity sensors, and 3D displacement monitoring devices at key nodes of building structures. Millisecond-level data transmission should be achieved through 5G networks, and technologies such as drone tilt photography and BIM model lightweight engines should be integrated to establish a three-dimensional monitoring network. At the same time, construction enterprises should train deep learning models based on historical quality defect databases and deploy intelligent cameras on construction sites to conduct real-time scanning of key processes such as steel bar binding spacing and formwork verticality.

In addition, construction management can deeply integrate intelligent monitoring into the PDCA cycle of QMS, optimize construction plans and quality control plans based on data analysis results, and clarify more precise monitoring indicators. Intelligent monitoring systems should replace a large number of traditional manual inspections to achieve uninterrupted and blind-spot-free objective inspections and generate digital quality reports. All data in the construction process should be automatically recorded and archived to provide tamper-proof data evidence for quality traceability and accident analysis, driving the continuous improvement of the construction quality management system.

4.4 Strengthening Dynamic Control of Construction Processes

Dynamic control of construction management under the quality management system should focus on process control to achieve refined control of all elements and the entire cycle. Construction enterprises should subdivide construction processes into minimum management units such as sub-projects and inspection batches, formulate standardized operation instructions, and clarify quality standards, acceptance criteria, and responsible persons for each link. For example, in the concrete pouring process, key parameters such as slump test frequency and vibration time should be specified. Meanwhile, the establishment of a dynamic risk early warning mechanism should be based on historical data to build a quality risk database, using AI algorithms to analyze trends in construction parameter deviations. When indicators such as concrete strength and flatness deviate from control lines, early warnings should be automatically triggered and rectification work orders pushed [4].

Construction management should strengthen process verification and correction, establish a material quality traceability chain, implement a one-item-one-code management model for key materials such as steel bars and cement, and use blockchain technology to achieve data sharing among suppliers, logistics, and construction parties to ensure full controllability of material quality. More stringent dynamic monitoring should be implemented for key processes affecting structural safety and service functions. Before construction, personnel qualifications, equipment status, and operating environment must be inspected to meet plan requirements, implementing a conditional acceptance and signature release system. Whole-process parameter monitoring should also be implemented to continuously monitor and record process parameters during construction, ensuring they remain under control and guaranteeing traceability of process quality.

In addition, early warning lines should be set for common quality defects and key control indicators in construction. Before problems occur, warning signals should be sent to managers, weak links should be identified at the system level, and resource deployment and management priorities should be adjusted to truly achieve advance risk prevention.

4.5 Building a Quality Data-Driven Continuous Optimization Mechanism

Construction management under the quality management system should build a quality data-driven continuous optimization mechanism, focusing on whole-life cycle quality control and realizing dynamic collection, intelligent analysis, and closed-loop application of quality data through digital means. First, construction enterprises should implement an intelligent analysis closed-loop of quality data, using machine learning algorithms to conduct cluster analysis of historical quality defect data, identify high-frequency problem scenarios and correlation factors, and build quality risk prediction models. On this basis, construction enterprises should build an analysis center to convert raw data into valuable information, establish an integrated project management information platform to automatically aggregate structured and unstructured data from various sources, and use visual dashboards to dynamically display trends, distributions, and compliance status of key construction quality indicators, achieving transparent management.

In addition, construction management can link quality data with performance assessment to incentivize all parties to improve quality behaviors. Regular data reviews should be conducted to identify systematic improvement opportunities and incorporate them into continuous improvement plans, thereby flexibly adjusting construction processes and management flows.

5. Conclusion

In summary, construction management strategies based on the quality management system are the foundation for ensuring project quality. The application of the quality management system can effectively improve construction quality levels and reduce quality hazards and safety accidents. Therefore, construction enterprises should establish a hierarchical quality responsibility system, implement whole-process material quality control, use intelligent monitoring technology to improve management precision, strengthen dynamic control of construction processes, and build a quality data-driven continuous optimization mechanism to provide support for the sustainable development of the construction industry.

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