# Risk Assessment and Control Strategies in Construction Project Management under the Wave of New Quality Productive Forces

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**Abstract:** The emergence and development of "new quality productive forces," driven by technological innovation, are reshaping the logic of the construction industry's development. They provide support for the industry to overcome resource constraints and achieve the "dual carbon" goals, while also driving improvements in project efficiency and serving as a crucial engine for the high-quality development of the construction sector. However, the mode reconstruction and technological changes brought about by new quality productive forces pose new opportunities and challenges for construction project management. This paper will elaborate on risk assessment and control strategies in construction project management amidst the wave of new quality productive forces, aiming to ensure the smooth implementation of projects and enable the high-quality development of the construction industry in this new era.

## 1. Introduction

Currently, new quality productive forces driven by technological innovation are optimizing construction project management modes. The implementation of technologies such as BIM full-process applications has accelerated the pace of intelligent and lean transformation in the industry, presenting opportunities to enhance project efficiency. However, risks also arise during this transformation, hindering industry progress. In this context, analyzing the new risks in construction projects under new quality productive forces and implementing risk assessment and control strategies are of great significance.

## 2. Risk Assessment Methods in Construction Project Management

Risk assessment in construction project management is a crucial step in identifying the probability and impact of risks. It requires selecting appropriate assessment methods based on technical complexity and project scale. From a practical application perspective, mainstream risk assessment methods can be divided into three categories: qualitative assessment, quantitative assessment, and comprehensive assessment. These methods play different roles in risk management and need to be adjusted according to technological changes in the context of new quality productive forces.

### 2.1 Qualitative Assessment Methods

Qualitative assessment methods focus on experience summarization and subjective judgment, emphasizing risk classification to provide directions for risk management. They are suitable for the early stages of projects. Two common methods are as follows:

Risk Matrix Method: This method constructs a matrix from the perspectives of risk probability and impact degree to quantify risk priorities. In practical application, first, an assessment team composed of supervisors, technical experts, etc., is established. Based on historical cases and construction plans, potential risks such as material shortages are listed. Then, a 5-point scoring system is used to evaluate the probability and impact of each risk. Finally, the risk level is determined according to the product of "probability * impact," and countermeasures are prioritized for high-risk items.

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Delphi Method: This method reduces subjective biases through anonymous inquiries and multiple rounds of feedback, making it suitable for scenarios with complex risk factors. The specific process involves selecting around 10 industry experts from various fields such as supply chain and law. Anonymous questionnaires are distributed to these experts, listing potential risks and soliciting their assessments of risk probability and impact. After summarizing the first-round results, the statistical data is fed back to the experts, allowing them to adjust their judgments based on group opinions. When expert opinions converge, specific risk levels are determined. For example, when assessing whether the performance of green building materials meets standards, multiple rounds of feedback can be used to accurately determine the quality risk probabilities of different brands of green building materials.

### 2.2 Quantitative Assessment Methods

Quantitative assessment methods are based on numerical calculations and data modeling. By quantifying the impact of costs on quality, schedule, etc., they provide reference bases for risk management and are suitable for large and complex projects. Two main methods are as follows:
Monte Carlo Simulation Method: This method calculates risk probabilities and distributions through a large number of simulations and random sampling, making it suitable for scenarios with multiple overlapping risks. In practical operation, professional software is required. The first step is to determine risk variables and their probability distributions based on historical data. The second step is to set the number of simulations. During each simulation, random values are drawn for each variable, and the total project cost is calculated. The third step is to statistically analyze the simulation results to obtain the probability of cost overruns, providing data support for risk response.

Sensitivity Analysis Method: This method is used to identify key factors in risk management. The specific steps are as follows: First, clarify the core project objectives. Then, select risk factors that may affect the project objectives and fix other factors. Calculate the variation range of the objectives when only one factor is changed. Finally, determine the sensitivity coefficient based on the ratio of the factor variation range to the objective variation range. A larger sensitivity coefficient indicates a more significant impact of the factor on the objectives.

### 2.3 Comprehensive Assessment Methods

Comprehensive assessment methods combine the advantages of qualitative and quantitative methods and are suitable for projects with diverse risks under new quality productive forces. A typical representative is the Analytic Hierarchy Process (AHP). Its application logic is to decompose complex risk problems into a multi-level structure, determine weights through reasonable comparisons, and then calculate risk levels based on quantitative data[1]. The specific steps are as follows: First, construct a target layer, criterion layer, and scheme layer. Second, invite experts to conduct pairwise comparisons of factors at the same level and use the "1-9 scale method" to construct a judgment matrix and test its consistency. Third, calculate the weights of each factor. Fourth, calculate the comprehensive risk value based on quantitative data to determine the overall risk level. For example, in a digital twin project, AHP can be used to simultaneously conduct qualitative judgments on data security risks and quantitative calculations on equipment cost overruns, preventing limitations caused by a single method.

## 3. Risk Control Strategies in Construction Project Management under the Wave of New Quality Productive Forces

### 3.1 Strengthen Risk Prevention and Control Awareness

The mode innovation and technological changes brought about by new quality productive forces have given construction project risks new characteristics. The application of intelligent equipment relies on professional technologies. If managers are not familiar with equipment performance and have insufficient awareness of technological risks, project delays may occur. Meanwhile, digital management involves a large amount of data transmission and storage. If some managers adhere to traditional thinking, potential safety hazards may be introduced into the project. Therefore, it is necessary to strengthen risk prevention and control awareness:

First, enterprises should increase publicity and education efforts. Regular construction project case analysis meetings can be held, and industry experts can be invited to interpret the characteristics of new risks, making managers aware of the importance of risk prevention and control and changing the mindset of prioritizing progress over risks.

Second, risk prevention and control awareness should be integrated into daily management. Managers should be guided to actively identify risks during the project preparation, construction, and acceptance stages. For example, before introducing new intelligent construction technologies, managers should participate in technical training activities to understand potential risks in technology application and formulate targeted response plans.

Third, a risk prevention and control incentive system should be established. Risk prevention and control performance should be incorporated into managers' performance evaluations. Teams and individuals who actively identify and successfully avoid new risks should be rewarded, while those who cause project losses due to a lack of risk awareness should be held accountable. Through a reward-and-punishment system, managers are encouraged to actively enhance their risk prevention and control awareness, creating an atmosphere where everyone talks about risks and prevents risks at all times. In conclusion, while new quality productive forces have injected new vitality into the development of the construction industry, they also bring both opportunities and risks. Only by continuously enhancing managers' risk management awareness can risks be effectively addressed and the high-quality development of construction projects be ensured.

### 3.2 Improve the Risk Management System

Traditional fragmented risk management methods are difficult to effectively cope with the challenges of new risks. Therefore, establishing a comprehensive risk management system can provide necessary guarantees for the steady progress of construction projects[2].Establish a Dynamic Risk Identification Mechanism: In the context of new quality productive forces, the sources of risks in construction projects are increasingly diverse. In addition to traditional safety, cost, and schedule risks, new risks such as fluctuations in the green building material supply chain have emerged. Enterprises should establish a professional risk identification team and use technical research, case reviews, and data monitoring methods to create a risk list covering the entire project life cycle. For example, during project preparation, by analyzing fault cases of similar intelligent projects, potential risks in the collaborative operation of intelligent construction robots and traditional equipment can be identified in advance. The role of digital management platforms should be fully utilized to comprehensively monitor data on building material price fluctuations in real time and promptly capture supply chain risks. Establish a Scientific Risk Assessment System: This is the core link in risk management. Enterprises need to use assessment tools related to new quality productive forces and combine qualitative and quantitative analyses. On the one hand, experts and risk control specialists can be invited to qualitatively assess identified risks and clarify their likelihood and impact. On the other hand, the advantages of big data technology can be leveraged to build risk assessment models, accurately calculate the failure rates of intelligent equipment and losses caused by data leaks, and scientifically classify risk levels[3]. For example, for network security risks in digital management platforms, hacker attack scenarios can be created to calculate the potential economic losses caused by system paralysis, providing data support for effective risk response. Improve Risk Response and Monitoring Mechanisms: Differentiated response plans should be formulated for risks of different levels. For high-level risks such as core technology failures of intelligent equipment, backup equipment should be prepared in advance. For medium-level risks such as delays in the green building material supply chain, a multi-supplier cooperation mechanism should be established. For low-level risks such as minor glitches in digital platforms, dedicated maintenance personnel should be assigned to make timely repairs.

### 3.3 Design Risk Transfer Schemes

In the wave of new quality productive forces, the construction industry is moving towards digitalization and intelligence, and projects face new risks such as data security leaks and failures in the application of green technologies. In such cases, relying solely on internal prevention and control cannot fully avoid losses. Scientifically designing risk transfer schemes can reasonably transfer some risks to third parties, making them an indispensable risk control measure in construction project management[4]. Use Insurance Tools to Transfer New Technology Risks: This is the premise and foundation of risk transfer schemes. Under new quality productive forces, traditional engineering insurance cannot fully cover new risks such as those in digital systems. Enterprises need to selectively purchase special insurance products. For example, "comprehensive insurance for intelligent engineering equipment" can be purchased for high-cost intelligent equipment such as BIM technology platforms to cover repair or replacement costs caused by equipment failures. Before purchasing insurance, it is necessary to fully communicate with insurance companies to clarify the scope of insurance liability for new risks and avoid subsequent claim disputes[5].

Transfer Partner Risks through Contract Clauses: Construction projects involve multiple cooperation entities such as suppliers and construction subcontractors. Risk responsibilities of all parties should be clearly defined in contracts to improve the rationality of risk allocation. For example, when signing contracts with intelligent equipment suppliers, technical adaptation clauses can be added. If equipment compatibility issues lead to project delays, the supplier should bear the losses caused by the delay and equipment modification costs. For risks such as fluctuations in the green building material supply, "price adjustment and alternative supply clauses" can be set in contracts with suppliers. That is, when building material prices rise significantly, the supplier is responsible for coordinating alternative resources or bearing part of the additional costs. Transfer Technology Application Risks through Strategic Cooperation Models: For risks in the application of cutting-edge technologies such as green building technologies, enterprises can establish risk-sharing mechanisms with technology leading enterprises. For example, when using new prefabricated building technologies, a joint application agreement can be signed with technology research and development enterprises, stipulating that both parties jointly invest resources to support technology application. If technology application fails and causes project losses, the costs should be shared according to the agreed ratio.

### 3.4 Improve the Risk Network Information System

In the wave of new quality productive forces, construction projects exhibit dynamic characteristics. Traditional manual risk management cannot meet the requirements of high efficiency. A well-established risk network information system, which builds a full-process risk management platform with the help of artificial intelligence technology, is an important way to enhance project risk control capabilities. Build a Global Data Integration System: This is the basic condition for improving the network risk information system. Enterprises should break down information silos and use unified data interface standards to integrate information scattered in various links into a centralized management platform[6]. For example, by associating BIM model data with structural stress data collected by intelligent sensors, the safety status of building components can be monitored in real time and comprehensively. A data cleaning and standardization mechanism should be established to ensure the uniformity, authenticity, and reliability of risk data accessed by the system, providing data support for subsequent risk analysis.

Develop an Intelligent Risk Early Warning Module: Relying on artificial intelligence algorithms, this module analyzes the integrated risk data from multiple perspectives to identify and grade-warn risks in advance. Special early warning modules should be set up for new risks brought about by new quality productive forces. For example, machine learning algorithms can be used to analyze the historical fault data of intelligent construction robots to predict possible fault types and times and send maintenance reminders in advance[7]. Establish a Collaborative Response Mechanism: The risk network information system should have cross-entity and cross-departmental collaboration functions to achieve efficient linkage in risk disposal. The system should set up a graded response process. When a general risk warning occurs, project site managers are automatically assigned to handle it. When a major risk such as intelligent system paralysis occurs, information is simultaneously pushed to the enterprise's risk control department, insurance companies, etc., and a multi-party collaborative emergency response plan is promptly initiated.

## 4. Conclusion

In conclusion, the wave of new quality productive forces has brought new opportunities and challenges to construction project management. Risk assessment and control should keep pace with the trends of the times. Risks can be effectively addressed by enhancing risk awareness, designing risk transfer schemes, and improving information systems. In the future, continuous innovation in strategies and in-depth integration of technology and management are required to effectively control risks and assist the construction industry in achieving sustainable development in the wave of new quality productive forces.

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