Integrated Strategy of Construction Engineering Supervision in Construction Safety and Environmental Management

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Abstract: This article focuses on the field of construction engineering, focusing on the importance and existing problems of construction safety and environmental management, and deeply discusses the integration strategy of construction engineering supervision in the two. The research uses theoretical analysis method to sort out the related theories of construction engineering supervision, construction safety management and environmental management, and analyzes the reality and problems faced by supervision in construction safety and environmental management. It covers professional knowledge updating, enforcement, management system coordination, information communication and so on. Based on this, this article puts forward integration strategies such as organization and coordination, system construction and technical support, including establishing integrated management team, perfecting unified standards and norms, and using information technology. The purpose of this article is to improve the integrated management level of construction safety and environmental management by these strategies, realize the coordinated development of the two, and provide guidance for the sustainable development of the construction industry.

1. Introduction

As a key force to promote national economic development, the effectiveness of construction safety and environmental management in the construction industry has a far-reaching impact on social stability, public health and the realization of sustainable development goals [1]. In recent years, the scale and complexity of construction projects have been rising, construction safety accidents have occurred frequently, and environmental pollution problems have become prominent, which has sounded the alarm for the development of the industry [2-3]. In this context, construction engineering supervision plays an increasingly critical role in construction safety and environmental management by virtue of its professional supervision and management functions.

Traditional construction safety management and environmental management are often fragmented and lack of organic integration, resulting in waste of resources and low management efficiency [4]. In order to effectively deal with this dilemma, it is urgent to explore the integration strategy of construction project supervision in construction safety and environmental management [5]. By constructing integrated strategies, management processes can be optimized, resource sharing and collaborative operation can be realized, management efficiency can be significantly improved, accident risk and environmental damage can be reduced, and the construction industry can be promoted to develop steadily in a safe and green direction [6].

From the perspective of academic research, there is relatively little systematic research on the integration strategy of construction safety and environmental management for construction project supervision at present [7]. Most of the existing studies focus on a single management field, but pay little attention to the collaborative integration of the two. In-depth research in this field will help to fill the theoretical gap, enrich the theoretical system of construction engineering management, and provide solid theoretical support for subsequent practice.

In practical application, construction enterprises urgently need scientific and effective integrated management strategies to guide practical work. Defining the integration path and method of

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construction engineering supervision in construction safety and environmental management can help enterprises improve their management level, enhance their market competitiveness and achieve a win-win situation of economic and social benefits. Therefore, it is of great theoretical value and urgent practical significance to study the integration strategy of construction engineering supervision in construction safety and environmental management. This article mainly focuses on the field of construction engineering, focusing on the importance and existing problems of construction safety and environmental management, and deeply discussing the integration strategy of construction engineering supervision in the two.

2. Core theory of engineering supervision and safety and environmental management

Construction engineering supervision theory is the basis of supervision work. Based on relevant laws and regulations, technical standards and contracts, it comprehensively supervises and manages the quality, progress and cost of construction projects [8]. Construction project supervision ensures that the project construction meets the predetermined objectives by formulating supervision plans and implementation rules, and using means such as patrol, standing by and parallel inspection. Its core function is to coordinate the relationship between all parties and ensure the smooth progress of the project.

The theory of construction safety management aims at preventing and reducing safety accidents in the construction process. Based on the theory of accident cause, it emphasizes the control of unsafe behavior of people, unsafe state of things and management defects [9]. Construction safety management follows the principle of "safety first, prevention first, comprehensive treatment". By establishing safety management system, strengthening safety education and training, carrying out safety inspection and hidden danger investigation, etc., it creates a safe working environment for construction personnel and ensures the safety of construction activities.

Environmental management theory focuses on reducing the negative impact of construction projects on the surrounding environment. Based on the principles of environmental science and management, it realizes the coordinated development of engineering construction and environmental protection by making environmental management plans, taking pollution prevention measures and promoting cleaner production [10]. Environmental management pays attention to the control and treatment of pollutants such as waste water, waste gas, waste residue and noise in the construction process, so as to protect the ecological environment and maintain the quality of life of surrounding residents. These theories together constitute an important cornerstone of the research on the integration strategy of construction project supervision in construction safety and environmental management.

3. Present situation of engineering supervision and safety and environmental management

In the field of construction engineering, construction safety and environmental management are very important, and construction engineering supervision bears key responsibilities in this process. However, there are many practical problems in the current supervision work in these two aspects, which need to be solved urgently. At present, although the construction project supervisor has taken some measures in construction safety management, there are still some shortcomings [11]. Supervisors will inspect the safety facilities of the construction site, such as safety helmets and safety nets, and will also supervise the regular maintenance and operation specifications of construction machinery. However, some supervisors' professional knowledge is not updated in time, and they don't know enough about the safety risks brought by new construction technology. In some projects that use prefabricated building technology, supervisors lack effective identification and control of new safety hazards in the process of component hoisting. Futhermore, the implementation of supervision in safety management is uneven. In some projects, although the supervisor found potential safety hazards, due to factors such as the lack of positive attitude of the construction party and the pressure of the construction period, the rectification was not strictly urged, which made the potential safety hazards exist for a long time.

In the aspect of environmental management, the construction project supervisor is mainly responsible for supervising the dust, noise, wastewater discharge and other issues in the construction process (see Figure 1). The Supervision Committee will require the construction site to sprinkle water regularly to reduce dust, limit the operation time of construction equipment with high noise, and check the operation of wastewater treatment facilities. However, there are still many loopholes in actual implementation. Some supervisors' awareness of environmental management is weak, and their grasp of environmental laws and standards is not accurate enough. For some pollutants produced by special construction techniques, effective supervision has not been carried out according to the latest environmental protection requirements. The technical means of supervision in environmental management are limited, so it is difficult to find and deal with some hidden environmental pollution problems in time.

Figure 1 Problems in the construction process

Construction engineering supervision faces many obstacles in the integration of construction safety and environmental management. There are differences between the construction safety management system and the environmental management system in terms of goal setting and process specification, which makes it difficult for the supervisor to effectively integrate resources and workflow in actual operation. The information transmission between the safety management department and the environmental management department is not timely and accurate, which makes it difficult for the supervisor to fully grasp the engineering dynamics and make scientific decisions in time. Safety accidents may cause environmental pollution, but the relevant information was not shared in the two management fields in time, which delayed the formulation of countermeasures. Compound supervision talents who know both construction safety and environmental management are scarce, and it is difficult for existing personnel to grasp the requirements of integrated management as a whole. See Table 1 for the summary of problems in construction safety and environmental management of construction engineering supervision:

Table 1 Summary of Issues in Construction Safety and Environmental Management by Construction Engineering Supervisors

Management Area	Main Issues	Specific Manifestations
Construction Safety Management	Inadequate updating of professional knowledge	Insufficient identification of safety risks associated with new construction techniques
Construction Safety Management	Inconsistent enforcement	Ineffective supervision and rectification of identified hazards
Environmental Management	Weak environmental awareness	Inaccurate understanding of environmental regulations and standards
Environmental Management	Limited technical means	Difficulty in promptly identifying hidden pollution issues

Integrated Management	Uncoordinated management systems	Significant differences in objectives and processes between safety and environmental management systems
Integrated Management	Poor information communication	Untimely and inaccurate information transmission between safety and environmental management departments
Integrated Management	Insufficient professional competence of personnel	Scarcity of composite supervisory talents

There are a series of practical problems in construction safety and environmental management of construction engineering supervision, which seriously affect the smooth progress and sustainable development of the project. It is urgent to solve these problems and build an effective integration strategy.

4. Strategy of engineering supervision and safety and environmental management

Establishing a unified integrated management organizational structure is the key. Set up an integrated management team led by the project leader and attended by professionals such as safety management and environmental management. Clarify the responsibilities of each member in the group to avoid management confusion caused by unclear responsibilities. Enterprises can set up a special safety and environment coordinator to communicate safety and environmental management to ensure smooth information flow; Optimize the workflow and break down the barriers of safety and environmental management. In the construction scheme formulation stage, safety and environmental management personnel participate together to ensure the synergy between construction safety and environmental protection from the source.

Enterprises should also improve the integrated management system and formulate unified standards and norms covering construction safety and environmental management. Clarify the safety and environmental protection requirements of various operations in the construction process, such as the safe distance and environmental protection requirements of materials piled up on the construction site, and avoid repeated regulations or conflicts of regulations. Enterprises should establish a strict supervision and assessment mechanism, and conduct regular assessment of supervisors and construction units. Based on the assessment results, the units and individuals with outstanding performance will be rewarded, and those who fail to meet the standards will be punished, thus encouraging all parties to actively implement integrated management.

Enterprises can use the technology of building information model (BIM) to simulate the whole life cycle of a building project, find out the construction safety and environmental problems in advance, and formulate countermeasures. Futhermore, the Internet of Things technology is used to monitor the safety and environmental indicators of the construction site in real time, such as noise, dust concentration and equipment operation status, so as to take timely measures. Advanced monitoring technology, such as unmanned aerial vehicle monitoring, is introduced to conduct a comprehensive inspection of the overall safety and environmental conditions of the construction site, so as to find out the hidden safety hazards and environmental pollution problems in hidden areas in time. See Table 2 for the key points of the integration strategy of construction safety and environmental management of construction engineering supervision:

Table 2 Key Points of Integration Strategies for Construction Safety and Environmental Management by Construction Engineering Supervisors

Strategy Category	Specific Measures	Implementation Points
Organizational Coordination Strategy	Establish an integrated management team	Clearly define member responsibilities and appoint a coordination specialist
Organizational Coordination Strategy	Optimize workflows	Collaborative participation during the plan formulation stage
Institutional Development Strategy	Improve unified standards and specifications	Clearly define safety and environmental protection requirements for various operations
Institutional	Establish a supervision and	Regular assessments with clear rewards and

Development Strategy	assessment mechanism	penalties
Technical Support Strategy	Utilize information technology	BIM simulation and real-time IoT monitoring
Technical Support Strategy	Introduce advanced monitoring technologies	Comprehensive drone inspections

By implementing a series of integration strategies, including organization and coordination, system construction and technical support, the problems faced by construction project supervision in construction safety and environmental management can be effectively solved. The implementation of these strategies will help to improve the management level of construction project supervision, and then realize the win-win situation of construction safety and environmental protection. In the end, it can push the construction industry forward steadily towards sustainable development.

5. Conclusions

This study deeply analyzes the current situation and problems of construction engineering supervision in construction safety and environmental management, and puts forward targeted integration strategies, which is of great significance to promoting the development of construction industry. It is found that the current construction project supervision has their own shortcomings in construction safety and environmental management, and the integrated management faces many challenges. In the construction safety management, the professional knowledge of supervisors is lagging behind and the enforcement is uneven; In environmental management, supervisors have weak environmental awareness and limited technical means. Problems such as uncoordinated safety and environmental management system, poor information communication and scarce compound talents also seriously restrict the effect of integrated management.

Based on this, the integration strategy proposed in this article starts from three aspects: organization and coordination, system construction and technical support. Break down the barriers of safety and environmental management by establishing an integrated management team and optimizing the workflow; Improve unified standards and norms, establish a supervision and assessment mechanism, and provide institutional guarantee for integrated management; Use information technology and advanced monitoring technology to improve management efficiency and accuracy. By implementing these integration strategies, it is expected to significantly improve the integrated management level of construction project supervision in construction safety and environmental management, effectively prevent safety accidents, reduce environmental pollution, and realize the sustainable development of construction projects. Future research can further explore how to accurately apply these strategies in different types of construction projects, and how to provide more targeted and forward-looking guidance for the construction industry in combination with the new development trend of the industry.

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