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Research on Risk Management of Engineering Projects under EPC Mode

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Abstract

As a typical type of general contracting model, EPC (Engineering Procurement Construction) refers to the full process general contracting carried out by the contractor on behalf of the owner, in accordance with the agreement, for the design, procurement, construction and other stages of the engineering project. Compared to other modes, the EPC general contracting mode also faces more risk, with risk factors in each link. This article conducts research on the risk of engineering projects under the EPC mode, mainly analyzing the characteristics of the EPC mode and the risk problems existing in the EPC general contracting mode. It proposes relevant countermeasures to strengthen the risk management of EPC general contracting projects from four aspects: contract, design, procurement, and construction, providing a certain reference for the risk management of EPC projects in construction enterprises.

Keywords

EPC; General Contracting Mode; Project Management; Risk Management.

1. Introduction

In August 2020, the Ministry of Housing and Urban Rural Development, the Ministry of Industry and Information Technology, and others jointly issued the "Several Opinions on Accelerating the Development of New Building Industrialization", proposing that the construction of new building industrialization projects should actively adopt the engineering general contracting model to promote the deep integration of engineering design, production, and construction. The engineering general contracting model is gradually being promoted in China's construction market, but the development of the general contracting model in China is still in its early stages and there are many shortcomings. With the development of the economy, the scale of engineering projects has become larger and longer, and the project environment has become more complex and variable. Risk management is of great significance for an engineering project. As a typical type of general contracting mode, the EPC general contracting mode covers multiple stages of general contracting such as engineering design, procurement, and construction. Compared to other modes, the EPC general contracting mode also faces more risk, with risk factors in each link. Strengthening the risk management of engineering general contracting projects can greatly enhance the core competitiveness of construction enterprises, enabling them to better respond to various opportunities and challenges that arise in the development process.

This article mainly conducts research on project risk management under the EPC general contracting mode, analyzes the characteristics of the EPC mode, the risk problems existing in EPC general contracting projects, and proposes relevant countermeasures to strengthen EPC general contracting project risk management from four aspects: contract, design, procurement,

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and construction, providing a certain reference for EPC project risk management in construction enterprises.

2. Overview of Epc Mode

2.1. Definition of Epc Mode

The EPC engineering general contracting mode, E-Engineering, P-Procurement, and C-Construction, refers to the owner entrusting the entire process of the engineering project, including engineering design, procurement of mechanical equipment and raw materials, and construction, to the general contractor. The general contractor and the owner sign relevant contract terms to take full responsibility for the quality, construction period, and safety of the project [1].

2.2. Characteristics of Epc Mode

Compared with the traditional engineering project contracting model, the EPC model has the following characteristics:

(1) In the EPC mode, the general contractor is fully responsible for the design, procurement, and construction processes of the project. The general contractor can exert greater work autonomy during the project construction process and effectively execute design, procurement, and construction plans, providing guidance for the entire construction process of the project. In addition, these plans have been used and validated in actual construction project management, providing reference for the continuous improvement and further refinement of project management by the general contractor;

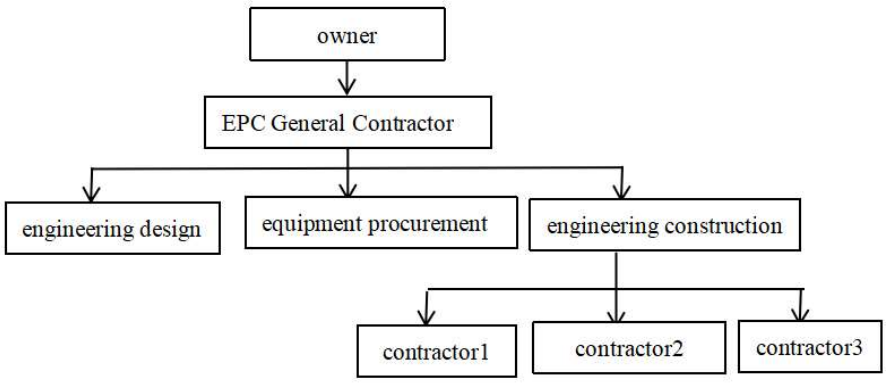

Fig. 1 EPC engineering general contracting mode

(2) In the EPC mode, project construction has shifted from traditional owner management to overall arrangement by professional design institutes, simplifying management processes and involving professional designers throughout the entire process, making the project construction process more professional. In the EPC general contracting mode, the owner only needs to sign one general contracting contract, and the contract relationship is concise and clear, which is conducive to the organization and coordination of the project. It can effectively solve various conflicts during the project construction process and reconcile the relationships between subcontractors, thereby optimizing project management ideas and the relationships between participants, and achieving the goal of improving work efficiency.

(3) In the EPC mode, each project has a clear person in charge, and the quality responsibility subject of the construction project is clear. Throughout the entire construction process, there will be a clear goal and a strict responsibility allocation mechanism, which can better ensure the quality, progress, safety, and cost of the project, and is conducive to holding engineering

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quality responsibility accountable and determining the person responsible for engineering quality responsibility [1].

3. Characteristics of Epc Mode Risk

(1) The correlation of risk. Because EPC covers multiple implementation processes such as design, procurement, and construction of a project, and each process is interrelated, risk have a certain degree of interdependence at different stages of project construction, rather than simply stacking project risk at each stage.

(2) The dynamism of risk. Due to the fact that EPC projects cover multiple stages such as design, procurement, and construction, the corresponding construction content and participants in different construction stages of the project are different, and the corresponding project construction risk are also constantly changing, so the risk are dynamic.

(3) The complexity of risk. Due to the common risk of traditional construction projects and the unique risk of EPC projects, the risk of EPC projects are complex.

(4) The imbalance of risk. Traditional contracts generally adopt the form of risk sharing. However, in EPC contracts, the scope of risk borne by contractors significantly increases, and the probability of obtaining claims is greatly reduced, so risk allocation is imbalanced [1].

4. Risk Faced by Epc General Contracting Projects

Each engineering project has many uncertain factors in the construction process, and the EPC general contracting model covers the entire process of a project. In the process of project decision-making, design, procurement, and construction, due to the constantly changing external environment and the complexity of the project itself, there are certain risk in each stage of project construction.

4.1. Contract Risk

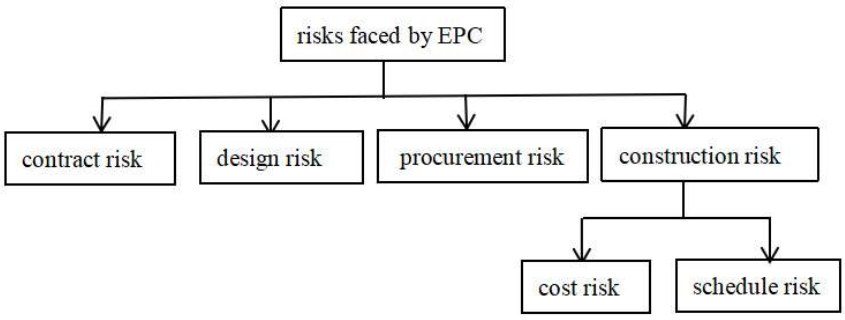

Fig. 2 Risks faced by EPC general contracting projects

The EPC engineering general contracting model generally adopts a fixed total price contract, and the general contracting unit bears the vast majority of the risk of the engineering project. Due to the fact that the general contracting unit is responsible for project design, procurement, and construction, and the bidding stage of the project has not yet formed a complete construction drawing, and even some projects are only based on the preliminary design scheme for bidding. In addition, the long construction period of the engineering project, the large changes in environmental factors, the increase in labor costs, engineering material costs, and engineering design changes during the project construction process, no one can anticipate all the risk in the implementation process in advance, Or there may be loopholes in some of the terms of the contract signed by both parties, which will increase the contractual risk of the EPC project.[2] In the stage of project subcontracting, if the general contracting enterprise does not

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provide a detailed interpretation of the various terms of the general contracting contract before subcontracting, it may lead to problems such as illegal subcontracting and imprecise subcontracting contracts, which may have an impact on the overall progress of the project [3].

4.2. Design Risk

In EPC general contracting projects, the design phase is a critical stage and also the foundation for the smooth implementation of subsequent procurement and construction phases. The selection of design schemes and the feasibility study design account for over 70% of the total project cost. In practical work, there are often design defects caused by inaccurate design basis provided by the owner, lack of project management knowledge, skills, and experience among design personnel, inability to coordinate subsequent procurement and construction, resulting in engineering changes, project delays, and improper design quality control risk. The risk in the design phase usually manifest in the following two aspects: (1) Lack of effective communication and work coordination with other departments during the design phase, which can result in passive work processes and delay the project schedule. (2) The lack of design capability has led to multiple risk in the general contracting project, including risk caused by engineering changes and cost impacts, which will have a significant impact on the subsequent procurement and construction processes.

4.3. Procurement Risk

Procurement is a relatively tedious process that requires developing procurement plans, selecting suppliers, and considering the impact of the market. Insufficient procurement of equipment and materials can lead to the suspension of the entire project and delay the construction period; Excessive procurement can lead to resource waste and increase construction costs, putting significant economic pressure on general contracting enterprises. So it is necessary to develop a particularly rigorous procurement plan to reduce procurement risk. In addition, during the procurement process, if the supplier selection is unreasonable, there may be situations such as insufficient supply and quality issues with the materials provided, which can have an impact on the entire project. Due to market fluctuations, for some large-scale projects with long construction cycles, the market prices of materials and equipment cannot remain stable and may rise or fall. This can lead to significant uncertainty and certain risk in the procurement stage of the general contracting model [2].

4.4. Construction Risk

(1) Engineering cost risk.When implementing the EPC mode, due to insufficient preparation in the early stage and delayed commencement, in order to ensure the overall project schedule, the general contractor will increase investment in manpower, material resources, and financial resources to ensure the smooth progress of the project. The implementation of these measures will not only make business operations more difficult, but also increase the cost of construction. The cost of building materials and labor often fluctuates. In addition, factors such as building material costs, labor costs, and policies and regulations pose significant risk to the cost of EPC projects.

(2) Project schedule risk.The traditional mode of engineering progress refers to the progress of engineering construction during the construction phase, while the EPC mode of engineering progress includes the progress of engineering construction in multiple stages such as engineering design, procurement, and construction. For the EPC mode, the progress of the previous stage affects the progress of the next stage, thereby affecting the overall project schedule. Project schedule management is an important part of the construction process. Good schedule management can not only improve the overall management level of the general contractor, but also to a certain extent, improve the quality of the project. However, during the implementation process of the project, there are many unfavorable factors that affect the

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project progress. To achieve the target schedule, the general contracting enterprise needs the support of various technologies. The lack of personnel, equipment, and information related to technology will greatly limit the implementation of technical solutions, thereby affecting the construction progress and causing project delays. Due to the long construction period of the general contracting project, there may also be a shortage of material supply, which cannot keep up with the overall progress of the project, resulting in delayed construction period and causing losses to the general contracting enterprise [5].

5. Preventive Measures for Various Risk in the Epc Mode

5.1. Strengthen Contract Management

After receiving the project winning notice, the general contractor should take certain measures in contract management, carefully study the various contents of the contract, have sufficient understanding of the construction requirements of the owner, and formulate a good construction plan. In addition, for the relevant requirements not explicitly stated in the contract documents, the general contractor needs to be able to submit the relevant content to the owner for approval before the project starts, and propose their own construction requirements to the owner. [3]After obtaining confirmation and approval from the owner, further construction operations can be carried out. In addition, during the actual construction process, the general contractor needs to promptly file a claim with the owner based on the owner's requirements for issues such as project delays [4].

The general contractor should develop corresponding subcontracting contracts based on a full understanding of the general contract. Before signing the contract, the qualifications and scope of responsibility of the subcontractor should be reviewed to ensure that the subcontractor is capable of undertaking the corresponding construction tasks. The quantity of work and contract price should be stipulated in the subcontracting contract [2].

5.2. Strengthen Design Management

The design phase is the foundation for the later procurement and construction phases, and EPC general contracting projects should ensure the overall and coordinated design, procurement, and construction of the project. The primary task of strengthening the risk management level during the design phase of the general contracting model is to strengthen the review of preliminary materials, provide training for design personnel, enhance communication and coordination during the design phase, and do a good job in the overall design work. Its main job responsibilities include improving the process of relevant design work, carrying out quota design and deepening design, doing a good job in design disclosure, and strengthening the cooperation of design personnel with construction site work.

Strengthen design control, establish a systematic and scientific design management system, strictly grasp each design stage of project construction, and involve designers in the early decision-making and feasibility study of the project in advance. Effectively achieve the integration of design, construction, and procurement, reduce the risk in the project design stage, and ensure the smooth progress of the project. At the same time, the general contractor should increase the training of relevant design personnel, improve their own abilities, and ensure that the best design scheme is made.

5.3. Strengthen Procurement Management

The EPC general contracting unit shall fully consider the demand, time, batch, etc. of material procurement in accordance with the construction period and progress specified in the contract, formulate a reasonable procurement plan, ensure that materials can be supplied according to the plan, and implement full process management of material procurement. Before procurement, timely inspection of suppliers should be conducted, and multiple qualified

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suppliers should be selected for comparison, with a focus on comprehensive analysis of supplier supply capacity, material prices, technical level, and other aspects, in order to select suppliers with excellent cost-effectiveness. During the procurement phase, attention should not only be paid to the quality and price of materials and equipment, but also to the commercial reputation of suppliers, in order to ensure their ability to fulfill contracts and improve the quality of material procurement work.

5.4. Strengthen Construction Management

(1) Strengthen cost management.The implementation of cost control in construction projects requires strengthening the cost control awareness of enterprise management personnel, grasping the particularity of construction projects under the EPC mode, objectively analyzing the engineering cost risk, to ensure the feasibility and effectiveness of the measures taken. In the cost control stage of construction projects, only by strengthening the cost awareness of management personnel can we effectively connect with the market and overall construction work. In practical work, it is necessary to grasp the specific requirements of cost control, implement cost control based on reality, objectively analyze management needs, and effectively improve the overall level of management work.

(2) Strengthen schedule management.The general contractor should make preparations before the start of the project, analyze various factors that may affect the construction period, and develop response plans to ensure that the quantity and quality of equipment and raw materials required for construction meet the requirements during the construction process, and avoid project delays caused by material issues.

The general contractor should clarify the task of schedule management to individuals, prepare a general schedule plan based on the total construction period specified in the contract, and track the completion status of the plan. In case of uncontrollable emergencies, the project leader should take a global perspective and adjust the construction plan reasonably based on the specific situation of the project to ensure the final construction period [5].

6. Summary

The improvement of risk management level in EPC general contracting projects is crucial for contractors. To reduce the risk in the implementation decision-making process of engineering projects, it is necessary to develop effective risk management measures, make more systematic, scientific, and rational decisions from various stages such as contract, design, procurement, and construction, effectively control risk in each stage, provide a safe and normal operating environment for project implementation, and achieve high-quality and efficient completion of project goals.

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