A Comparative Study of The Cost Risk of EPC Models for Engineering Construction at Home And Abroad

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Abstract. EPC projects with large engineering and procurement volumes, long construction cycles and management difficulties, the risks faced are also more complex and vary than in other contracting models. This paper establishes a risk index system by documentary method and evaluates and calculates the cost risk in two different environments at home and abroad by hierarchical analysis, so as to find the similarities and differences and propose countermeasures to provide a basis for risk management in China's EPC contracting model.

1. Introduction

The EPC model refers to the owner's selection of a general contractor to be responsible for the design, procurement of equipment and materials, construction and commissioning of the entire project [1]. This model emphasizes the unity of technical design, project management, engineering consulting and general contracting [2]. In order to keep up with international project management, since 2003, China has been encouraging enterprises with engineering survey, design or construction general contracting to carry out EPC business within the scope of licensed qualification levels. In recent years, more and more enterprises in China have begun to shift to the EPC model, which transfers many of the risks that should be borne by the owner to the contractor, and the contractor has to deal with more complex and diverse risks. At the same time, more and more enterprises are exploring overseas markets. However, the environments at home and abroad are not the same, and the risk factors that contractors should pay attention to in the face of cost risks also differ, so it is very important to study the cost risk of the EPC model. This paper establishes the EPC project cost risk index system by reading the literature and calculates the weights of risk factors in both domestic and foreign environments through questionnaire survey and hierarchical analysis, and proposes countermeasures.

2. Cost-risk comparison of the EPC model

2.1 Establishment of a cost-risk indicator system

In this paper, we identify the risk factors that occur frequently in the course of a project and are likely to have a significant impact on the project cost through literature and questionnaires, and on this basis we establish a project cost risk index system for the EPC general contracting model [3-10]. The system mainly includes 4 risk items and 14 risk factors, as shown in Table 1.
Table 1. EPC project cost risk index system

| Risk item A | Risk Factor B |
|-------------|---------------|
| External risk A1 | Climatic conditions, geological and hydrological B1 |
| Inflation risk B2 |
| Interest rate changes B3 |
| Technology risk A2 | Incomplete survey information B4 |
| Design errors or changes B5 |
| Unreasonable construction program or technical measures B6 |
| Differences in design concepts or standards B7 |
| Procurement risk A3 | Cost of labour, materials, equipment B8 |
| Transportation costs B9 |
| Material procurement or quality defects B10 |
| Errors in bidding prices B11 |
| Managing risk A4 | Insufficient capacity to coordinate design, procurement and construction B12 |
| Inadequate management of construction plans and organization B13 |
| Communicate with owners, supervisors, subcontractors, suppliers B14 |

2.2 Evaluation findings and analysis

This paper uses hierarchical analysis, in accordance with the opinions of participants in the questionnaire survey and 1 to 9 scale method of assignment, the formation of two-factor comparison of the judgment matrix, normalization process, all judgment matrix meet the consistency test.

Analyzing the risk factors with a cumulative weight of 80%, the risk factors affecting the cost of domestic projects include: design errors or change risks B5, labor, material and equipment costs B8, unreasonable construction plans or technical measures B6, errors in bidding prices B11, differences in design concepts or standards B7, and transportation costs B9, as shown in Figure 1.

Risk factors affecting the cost of foreign projects include: labor, material, and equipment costs B8, incomplete survey information B4, differences in design concepts or standards B7, design errors or change B5, errors in bidding price B11, material procurement or quality defects B10, communication with owners, supervisors, subcontractors, suppliers B14, and inflation risk B2, as shown in Figure 2.

Figure 1. Domestic project cost risk weights

Figure 2. Foreign project cost risk weights

2.2.1 Identical risk analysis. The quality of design affects more than 75% of the project cost and is directly related to the profit of project contractors. Geological survey mistakes, insufficient design capability, compressed design time, design can’t meet the requirements of the owner and other factors
will cause design errors and design changes. Foreign Projects are also faced with inconsistent design specifications and standards, and the project costs and schedule changes caused by design errors or changes should be borne by the contractors themselves.

Designers are usually stuck in some kind of stereotype, have inadequate communication links with other departments, and fail to consider the contractor and can’t provide technical support for subsequent procurement, construction, and other activities. There are differences between domestic design concepts, design methods and design documents and those of foreign countries, resulting in designs that do not meet the requirements of the contract and are difficult to obtain the owner's approval. At the same time, Chinese contractors have not entered the international market for a long time, and the influence of Chinese standards has not yet been fully established. Owners require the use of local standards or European and American standards, Designers unfamiliar with the relevant standards can lead to design errors and increased costs.

The outcome of the design directly determines the procurement cost, and whether the specifications, quantity and quality of the materials and equipment required for the project meet the requirements will directly affect the cost of the entire project. The wrong choice of large equipment models or wrong estimation of material quantities by designers can cause costs to get out of control. In addition to professional knowledge, procurement personnel in foreign projects should also have knowledge of purchasing, transportation and international business.

Contractors in domestic projects often use the low-bid strategy to win bids. In order to successfully win the bid, they will also cut costs and blindly quote prices in an attempt to make up for the losses caused by low bids through engineering changes and engineering claims in the foreign project. However, the profit gained through engineering changes and claims during the actual implementation of the project is not large, and errors in bid pricing may result in even larger losses.

2.2.2 Different risk analysis. Risk factors with greatest impact is unreasonable construction program or technical measures (10.4%). EPC projects are often highly specialized, with demanding project designs and complex construction techniques, and this risk has a greater impact on costs when new technologies are used.

The second is incomplete survey information (-6.7%). The FIDIC Silver Book states that the contractor shall be responsible for verifying all relevant information provided by the owner regarding site geological and hydrological conditions, and the owner shall not be responsible for the accuracy, adequacy, or completeness of such information. If the contractor follows the information provided by the owner without verifying the accuracy of the survey information, the contractor is responsible for the cost of any errors in the information. It is very different from the situation in domestic projects, where the owner is responsible for the information provided, and the contractor shall compensate the contractor's losses according to the actual workload of the contractor.

The third is material procurement or quality defects (-5.1%). Failure to meet the specifications, quantity and quality of materials and equipment required for the project will directly affect the cost of the entire project. Foreign projects are usually located in less developed areas, where the quality of equipment and materials produced by suppliers does not meet the project needs, and re-procurement of materials and equipment causes unnecessary cost increases.

3.Solution

The general contractor should fully understand the climatic, geological and hydrological conditions of the construction site in the early stages, grasp the accuracy of the survey data, and if necessary, entrust the survey to professional personnel.

Cultivate high-level, professionally skilled designers and strengthen the interface between design and procurement to reduce costs and increase profits.

Purchasing personnel to purchase multi-quotation comparison, choose the mechanical equipment suitable for the project, contracting foreign projects in international business, foreign languages,
transport customs and other knowledge of training, and establish cooperative relations with local suppliers.

Selecting the right machinery and equipment for the project when purchasing and establishing partnerships with local suppliers.

The contract price should be reasonably estimated at the bidding stage and not blindly quoted.

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