

# Risk Identification and Evaluation of International Engineering Contracting

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**Keywords:** Engineering contracting, Risk identification, Evaluation model

**Abstract.** On the basis of preliminary exploration of the characteristics of various risks, the risks are classified and summarized. The TOPSIS evaluation method was introduced to comprehensively analyze all risks to ensure the implementation of international engineering contract risk assessment. Finally, corresponding strategies and preventive measures are proposed for various types of risks in various international projects.

## 1. Introduction

The international project construction process is accompanied by numerous risk factors, not only related to the political and economic situation, external relations, foreign exchange control, religious customs, and legal provisions of the countries, but also may encounter different owners, different technical standards, different natures, which make the international engineering contracting companies often take huge risks. If these risks are not considered, they may cause engineering and serious economic losses. China's international engineering contracting needs to identify and evaluate risks and adopt reasonable and effective control measures. In view of the many uncertain factors in the international engineering contracting market, China's international engineering contractors should be committed to finding the risk management methods for the identification, evaluation and response of international engineering contracting risks, and formulate actions to minimize the risk, improving the efficiency of business operations.

According to the risk distribution characteristics around different life cycles, this paper classifies various risk and establishes a project risk hierarchy. Then, according to the Delphi method, the risk indicators of each layer are empowered, and the TOPSIS method is selected to conduct risk assessment, so that the evaluation results are more scientific and accurate. Finally, based on the results of risk assessment, a reasonable and effective risk management is formulated.

## 2. Identification of international engineering contracting risks

### 2.1 International project contracting risk characteristics

#### 2.1.1 Widespread risk distribution in international engineering contracting

International engineering contracting risks exist not only in the project implementation phase, but in the entire life cycle of the project. From the beginning to the end of the project, after many stages such as consultation, investment, bidding, contracting, material procurement, personnel training, construction, supervision, acceptance, and post-maintenance, there are different types and degrees of risks. In terms of quantity, there are a number of problems to deal with; Due to factors such as the political, social environment, economic situation, foreign exchange control policies, laws and regulations of the country, which will lead to the contractor complicated and have a negative impact on them.

#### 2.1.2 Risk identification and assessment in international engineering contracting

Although the risks of international engineering contracting are complex and diverse, each risk is often accompanied by specific signs and has certain preventability. The risks in international engineering contracting are mutually exclusive. There will be multiple endings in the project implementation

process, and the probability of occurrence of various endings is like a zero-sum game. The probability of a kind of ending becomes larger, which leads to the other kinds. The probability of an outcome occurring is small. At the same time, the risks are also superimposed and related to each other. For example, once financial risks occur, management risks often follow. Although the risk occurs with uncertainty, it can be identified and evaluated according to the law of risk occurrence, relevant documents and completion experience, and improve the risk prevention capability.

## **2.2 International Engineering Contract Risk Factors**

According to the characteristics of risk distribution around different life cycles, this paper divides risk into five categories: political risk, market risk, management risk, environmental risk and economic risk.

### *2.2.1 Political risk*

Political risks are mainly divided into diplomatic risk, government default risk, political instability risk, and social security risk.

### *2.2.2 Market risk*

In the process of developing new markets, enterprises may be affected by political environment such as failure to establish diplomatic relations with China, political or social environment instability, limited financial capacity, restrictions on market access or restrictions on personnel access, and legal environment. There may be a risk of not being able to enter the market. Therefore, there are many uncertainties in market risk. This paper divides market risk into business negotiation risk, information acquisition risk, market competition risk, investment risk and contract risk.

### *2.2.3 Management risk*

International engineering is a complex and long-term project. The difficulty in management is much greater than that of domestic engineering. It mainly faces the following risks: subcontracting risk, material procurement risk, human resource management risk, technical standard risk and engineering. Project management risk.

### *2.2.4 Environmental risk*

Environmental risks mainly include frequent risks of natural disasters, harsh risks of natural environment and environmental protection risks.

### *2.2.5 Economic risk*

Most of the areas along the Belt and Road Initiative are emerging economies and developing countries. These regions have large demand for infrastructure investment, but they need the support of multiple funds due to lack of funds. According to ADB's latest estimates, the annual demand for infrastructure investment in the Asia-Pacific region is 800 billion dollars. If the funds rely on multi-support, it is difficult to obtain sufficient funds. Therefore, the funding problem has become a constraint factor for the implementation of the project. In addition, when companies have multiple investment projects in multiple countries, diversified currencies are more likely to trigger exchange rate risk. This paper divides economic risks into foreign exchange control risks, funding source risks, and financing risks.

## **3. International project contracting risk assessment**

### **3.1 Establishment of international project contracting risk evaluation index system**

#### *3.1.1 Principles for the establishment of an evaluation indicator system*

The constraint factor of the international project contracting risk evaluation index system is a multi-level dynamic system. Only by designing from multiple angles and levels can it accurately reflect the risks in international engineering contracting. Therefore, in order to ensure to obtain the objective and correct evaluation results, the following principles should be followed: 1) comprehensive principles; 2) objective principles; 3) scientific principles; 4) applicability principles.

### 3.1.2 Evaluation Index System

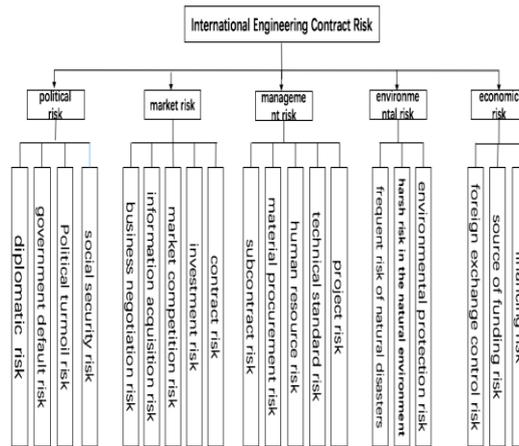


Fig. 1. International project contracting risk evaluation index system

## 3.2 International Project Contracting Risk Evaluation Method Selection

### 3.2.1 Method of Empowering Risk Evaluation Indicators -- Delphi Method

In this study, the quantitative research of the Delphi method was used to determine the weight of the indicators. The 9 members of the expert group are all veterans in the industry, and the data has certain reliability. This study conducted two rounds of expert consultations, all in the form of questionnaire stars, and a summary analysis of the feedback results of each round of expert consultation. The final determination of the weight is based on the results of the Delphi method, using the mean method to calculate the weight of each index, and then from the first-level indicators to the second-level indicators, layered decomposition calculates the combined weight of each indicator.

### 3.2.2 Risk Assessment Method -- TOPSIS Method

The basic principle of the TOPSIS method is to sort by studying and calculating the distance between the alternative and the positive ideal solution and the negative ideal solution. If the alternative has an infinitely close positive ideal solution and is infinitely far from negative ideal solution, then this scheme is the optimal choice; otherwise it is the worst option. The basic steps of the TOPSIS method are:

(1) Indicators are trending

When the TOPSIS method is used for evaluation, all indicators are required to change in the same direction, and the high-quality indicators are converted into low-quality indicators, or the low-quality indicators are converted into high-quality indicators. The commonly used conversion method is the reciprocal method to establish the same trending raw data table.

(2) Normalization

In order to eliminate the influence of the indicator unit of measurement, the measured value of the indicator should be normalized. Let  $(X_{ij})_{n \times m}$  be the same trending indicator matrix, and  $(A_{ij})_{n \times m}$  be the normalized data matrix. Then:

$$A_{ij} = X_{ij} / \sqrt{\sum X_{ij}^2}, j = 1, 2, \dots, m \quad (1)$$

(3) Determine the optimal solution  $A^+$  and the worst solution  $A^-$  in the limited solution

If the original data is unified by the same trend as a high-quality indicator, then:

$$A^+ = (A_1^+, A_2^+, A_3^+, \dots, A_m^+), A^- = (A_1^-, A_2^-, \dots, A_m^-) \quad (2)$$

$$A_j^+ = \max\{A_{ij}\}, A_j^- = \min\{A_{ij}\}, j = 1, 2, \dots, m$$

(4) Calculate the weighted Euclidean distance between each evaluation object and the optimal solution and the worst solution:

$$D^+ = \sqrt{\sum_{j=1}^m [w_j (A_{ij} - A_j^+)]^2}, D^- = \sqrt{\sum_{j=1}^m [w_j (A_{ij} - A_j^-)]^2}, i = 1, 2, \dots, m \quad (3)$$

(5) Calculate the proximity of each evaluation object to the optimal solution

$$C_i = \frac{D_i^-}{D_i^+ + D_i^-}, i = 1, 2, \dots, n, \quad (4)$$

$C_i \in [0,1]$ , the closer is to 1, the closer the  $i$ -th object is to the optimal level, the closer to 0, indicating that the  $i$ -th data is closer to the worst level. The larger the value of  $C_i$ , the better the evaluation result.

The survey questionnaire was mainly concentrated in Africa, Asia (excluding the Middle East, Hong Kong and Macao), Europe, South America, North America, the Middle East, Hong Kong and Macao. The survey form is online answering. 248 questionnaires are retrieved through the questionnaire star. All of them are valid questionnaires. The effective rate is 100%, which basically conforms to the general standards of questionnaire statistics, and ensures the standardization, rigor and representativeness. After sorting out the questionnaire data, the international project contracting risk is evaluated in conjunction with the TOPSIS method. The results are shown in the table:

Table 1. International project contracting risk assessment

risk	sort
political risk	1
market risk	3
management risk	2
environmental risk	5
economic risk	4

It can be seen from the above results that political risks are relatively high in the process of international project contract construction. This is because international engineering contractors are mostly concentrated in relatively underdeveloped countries and regions. These regions have great demand for infrastructure investment. However, due to political instability in the country, imperfect legal systems, the situation of domestic unrest, these risks often cause incalculable losses to the contractor.

## 4. International project contracting risk countermeasures

### 4.1 Risk avoidance

For international engineering contracting, the most ideal countermeasure is risk avoidance, because international engineering contracting requires a lot of funds, and in foreign countries, the environment faced by contractors is much more complicated than domestic ones. Risk avoidance is to interrupt the source of risk in a certain way so that it does not occur or no longer develops, thus avoiding potential losses. However, at the same time as risk avoidance, there may be some problems. First of all, not all risks can be avoided. In most cases, risks cannot be avoided. Secondly, risks and interests coexist. While avoiding risks, they also lose the possibility of profiting from risks. Finally, the avoidance of risks may require huge costs, and the investment of a lot of financial and material resources to eliminate the existence of risks is not worth for the contractor.

### 4.2 Risk transfer

If you have to take risks, you can choose the party that is most capable of risk loss control. The contractor can choose some means of risk transfer to share the risk of serious damage. If the risk transfer is good., it will be a win-win situation for both parties.

There are several forms of risk transfer, non-insurance transfers and formal transfers. The risk in the form of non-insurance may be an agreement in the form of a contract, for example, the exchange rate risk is agreed by the contract, and the owner bears the increase of the cost caused by the exchange

rate fluctuation or the contractor can subcontract the project to other contractors and subcontract transfer the risks of these projects to others.

### 4.3 Risk utilization

There are two kinds of risks: one is pure risk, which can only cause or not cause losses, and the other is investment risk, which may cause losses or provide opportunities for profit. Risk utilization refers to the use of the profit opportunities that they may provide to obtain benefits.

The risk can be exploited. Firstly, the risk can be reduced by the contractor to a minimum. According to the relevant risk protection contract signed with the insurance company and the owner, the contractor has the right to request economic claims from both parties, as long as you are fully prepared, with sufficient evidence, the claim can be successful. Secondly, in terms of economic risk, some risks are huge business opportunities, such as material procurement risk. The local government mandates contractors to purchase raw materials and equipment at local prices. Local prices and international prices are very different, and contractors can seize this opportunity to import some of the corresponding raw materials from their countries and sell them to earn the difference.

## 5. Conclusion

This paper studies the risk identification and evaluation of international engineering projects. Compared with domestic engineering, the risk factors involved in overseas engineering contracting are more diverse. In order to avoid risks and obtain greater benefits in the whole project, it is necessary for contractors to comprehensively predict and analyze a variety of potential risks, and to elaborate an effective risk management plan.

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