

Key Points of Site Management of Construction Units under EPC Contracting Mode

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ABSTRACT. *In recent years, the increasing construction projects in China have played a positive role in promoting local infrastructure construction. In engineering construction, management mode is an important content, which must be understood. At present, EPC is a more commonly used project management mode, which has important significance and function in the current engineering construction. The general contractor is responsible for the design, construction, supply, installation and implementation of equipment and supplies until the project is qualified and delivered to the owner. EPC mode has clear main responsibility characteristics, which can stimulate the enthusiasm of the general contractor, make full use of the advantages of the combination of project management and preliminary design, and promote the coordination of cost saving. Shorten the construction period and improve the project quality. Although the EPC mode of China's construction projects started late, with the sustainable development of the company, more and more engineering projects adopt EPC mode for contract construction. EPC contract can effectively reduce the excessive management pressure of the contractor in charge of the contract owner, and greatly reduce the coordination between the design department and the construction department and other project participants. And can quickly manage the safety performance of construction design. There are differences in technology selection and project function. Through PSO algorithm and engineering technology configuration model, this paper makes a series of research and Discussion on construction site management under EPC contracting mode. In addition, it can effectively control the cost and schedule of construction projects. EPC contract management in the whole process of planning, procurement and construction can accurately determine the project cost and construction period, and provide security for the planning and use of project funds. The experimental results show that under the EPC contracting mode, the construction unit needs to have strict requirements on site management in order to make the project smoothly.*

KEYWORDS: *Engineering project, EPC contracting mode, Construction unit, Site management points*

1. Introduction

EPC project general contracting mode refers to the integrated management mode covering design, procurement and construction. Design, procurement and construction are the key of engineering project, among which design includes the design of each part of engineering project and the overall planning; procurement includes the procurement of raw materials and the procurement of large-scale mechanical equipment used in the project; construction includes all sub projects of the project, such as construction process, mechanical equipment installation and commissioning, management and service in the later stage of construction [1]. In the construction management of EPC project, the general contracting company needs to carry out all-round management of design, procurement and on-site construction based on the construction contract, and at the same time manage the project process and project cost involved in this process [2]. Compared with the traditional project management, the construction management based on EPC mode can reduce the construction volume and cost, control the construction period and quality more effectively, and realize efficient, intensive and integrated management [3, 4].

EPC mode has the following advantages. First, responsibilities and rights can be divided correctly. EPC contract mode clarifies the responsibility of hidden quality and safety risks in construction projects, and realizes the "single responsibility system", so as to be more convenient to bear the responsibility. Second, please make the master plan of the construction project more effectively [5]. EPC contract mode can effectively reduce the excessive management pressure of the contractor in charge of the contract, and greatly reduce the construction adjustment between design services and construction services and project participants. And the safety performance of construction design can be dealt with quickly. There are differences in technology selection and project function [6].

In the current construction safety management and project safety management, there are many and detailed studies on the safety management during the construction period. There are special studies on safety culture, system, system, risk identification, etc., and the good research results have been obtained, which can play a corresponding guiding role in the safety management of project construction [7]. At the same time, for the emerging and growing general contracting construction mode of construction project, it also has gratifying research results on its subcontracting management, contract management, construction management and comprehensive project management under this mode, and has been well implemented and tested in actual operation, which has formed the established constraint content [8]. That is, under the EPC mode, how to carry out the management of the above aspects has been basically feasible and gradually mature [9]. However, for the time being, there is no systematic research on the special safety system under the general contracting mode in China. Looking up the domestic information on the safety management of general contracting, we can find that the safety management of general contracting is mostly a sub item of the general contracting project management research, and this kind of research is a summary description of the construction of the general contracting safety management

framework, Or the research on a certain factor in the site safety management system under the general contracting mode can not play a constructive role in the implementation of the general contracting system safety management [10].

2. Algorithm Establishment

2.1 Particle Swarm Optimization

In PSO algorithm, each particle represents a possible solution, and all particles constitute a population. In each iteration, the velocity and direction of a particle's flight are determined by two extremums. The first extremum is the optimal solution searched by the particle itself, which is called individual extremum; the other extremum is the optimal solution searched by the whole population, which is called global extremum. The iterative formula of individual extreme value is as follows (1):

$$p_{id}^{k+1} = x_i^{k+1}, f(x_i^{k+1}) < f(p_{id}^k) \quad (1)$$

$$p_{id}^{k+1} = p_{id}^k, \text{ other} \quad (2)$$

The global extremum is the optimal solution in the individual extremum. The iterative formula of the global extremum is as follows (3):

$$p_{gd}^k = \min\{f(p_{1d}^k), (p_{2d}^k), \dots, (p_{md}^k)\} \quad (3)$$

In the standard PSO algorithm, the update formulas of particle velocity and position at $K + 1$ are (4) and (5) respectively.

$$v_{id}^{k+1} = v_{id}^k + c_1 r_1 \times (p_{id}^k - x_{id}^k) + c_2 r_2 \times (p_{gd}^k - x_{id}^k) \quad (4)$$

$$x_{id}^{k+1} = x_{id}^k + v_{id}^k \quad (5)$$

In the PSO algorithm, the speed constraint should be satisfied, as shown in equation (6):

$$v_{id}^k = \begin{cases} -v_{max}, & v_{id}^k < -v_{max} \\ v_{max}, & v_{max} > v_{id}^k \end{cases} \quad (6)$$

Where v_{max} is the maximum velocity of the particle.

2.2 PSO Algorithm

Furthermore, the performance coefficient of χ C is improved by adding the PSO algorithm.

$$\begin{cases} v_{id}^{k+1} = \chi[v_{id}^k + c_1 r_1 \times (p_{id}^k - x_{id}^k) + c_2 r_2 \times (p_{gd}^k - x_{id}^k)] \\ x_{id}^{k+1} = x_{id}^k + v_{id}^k \end{cases} \quad (7)$$

In the formula, χ is used to control the flight speed of particles:

$$\chi = \frac{2\mathcal{K}}{|2-\varphi-\sqrt{\varphi(\varphi-4)}|}, \mathcal{K} \in [0,1]; \varphi = c_1 + c_2 \quad (8)$$

The parameter \mathcal{K} controls the balance between the global search ability and the local search ability of PSO algorithm. When \mathcal{K} is large, the convergence speed of the algorithm is slow and the global search ability is strong; on the contrary, when \mathcal{K} is small, the algorithm converges and the local search ability is strengthened.

A scale constraint factor η is added to the position updating formula. The specific mathematical description of the particle position update formula is as follows:

$$x_{id}^{k+1} = x_{id}^k + \eta \cdot v_{id}^k \quad (9)$$

2.3 Strengthen the Management and Audit of Design Change

Generally, the change of design method is to correct the deficiencies in the design planning of the construction project in time, and then improve the design quality of the construction project, reduce the construction error and improve the construction quality. It is the correction and optimization of the design scheme under the EPC contracting mode. Generally, this method can not be avoided. For changing the design method in different stages of construction, the project cost will be different. Therefore, it is usually carried out in the initial stage of the construction project design as far as possible, because the loss is relatively small, especially in the case of large-scale modification of the construction project design plan, by means of preliminary verification. Then the change must be used to ensure the accuracy of fund allocation before and after the change, so as to control the cost of the construction project within a reasonable range.

2.4 Strengthening Risk Management

The main purpose of EPC contracting mode is to transfer the maximum construction risk, and then make good use of the minimum investment of the project. In the project management, we should learn to effectively use their own advantages to eliminate risks. So far, there are many methods of risk sharing in engineering projects, and there are many forms of risks, but most of them are still risk management and contract management methods. The legal management of the contract should pay attention to the scientific division of the bidding part of the project subcontracting, and recognize the responsibility and scope of the contract. After the contract is signed, corresponding explanation must be carried out. We should discuss and solve the problem that the contract interface is somewhat vague, and then file the discussion record.

3. Modeling Method

The cleaned data can not be directly used for cluster analysis, because there are only six basic data in the data, and there is no technical index of the project. However, these technical indicators are the dimensions of data used for cluster analysis.

$$\text{volume}(i) = \log\left(\frac{\text{Volume}(i)}{\text{Volume}(i-1)}\right) \quad (10)$$

$$\text{amount}(i) = \log\left(\frac{\text{Amount}(i)}{\text{Amount}(i-1)}\right) \quad (11)$$

The difference of these different calculation methods is mainly reflected in the forgetfulness of historical data, that is, different aging factors. Generally, the moving average can be expressed by formula (2). Where k is the aging factor of historical data, and the value range of K is any real number from 0 to 1. Here, the smaller the value of K , the faster the historical value is forgotten; the larger the value of K , the longer the influence of historical value on current value.

$$\text{MA}(i) = k * \text{MA}(i - 1) + (1 - k) * \text{Close}(i) \quad (12)$$

$$\text{MA}(i) = \frac{1}{N} \sum_{j=i-N+1}^i \text{Close}(j) \quad (13)$$

Because the design of Psy is too simple, people pay more attention to the m -simple moving average of Psy, that is $pSymA$.

$$\text{PSY MA}(i) = \frac{1}{M} \sum_{j=i-M+1}^i \text{PSY}(i) \quad (14)$$

4. Evaluation Results and Research

This paper considers that many specialties, activities, personnel, environment and equipment are involved in the construction process, and various specialties and activities are crossed, and there are many kinds of equipment and other factors. The safety risk assessment of project risk generally adopts LEC Method. Specifically, for L value, it is generally divided into seven scores, and different scores represent different degrees of possibility, as shown in Table 1. When taking the value, we should fully investigate and compare the value results of the risk factor in other similar environments, and scientifically consider the effect of the current control measures to make a reasonable value.

In the process of using LEC Method, because of the different safety knowledge and skills of personnel, the different environment of hazard source, and the different perception of hazard source, there will be the same hazard source in many cases. Through the evaluation of different personnel, the results may be greatly different. Under the subjective factors, the managers should comprehensively analyze the conditions of the differences, and determine the results uniformly; under the objective factors, for the safety risk assessment of the hazard sources, the existence of the hazard sources in different time and space makes the differences acceptable,

that is, the same hazard source has different assessment results in the same construction project department, The risk status is reasonable. The final score (d) obtained from the application of LEC Method is the defining standard for the implementation of hazard source control. Under this standard, the general contractor shall first determine the allowable lower limit of D value, and then determine the score interval of D value, and make a clear description of the possibility represented by each interval and the control requirements for hazard sources in this area. As shown in Figure 1:

Table 1. Probability of accidents (L)

Number of points	Possibility of accidents
10	It's entirely predictable
6	Quite likely
3	Maybe, but not often
1	It's not possible. It's totally unexpected
0.5	It's impossible. It's conceivable
0.2	Very unlikely
0.1	It's not really possible

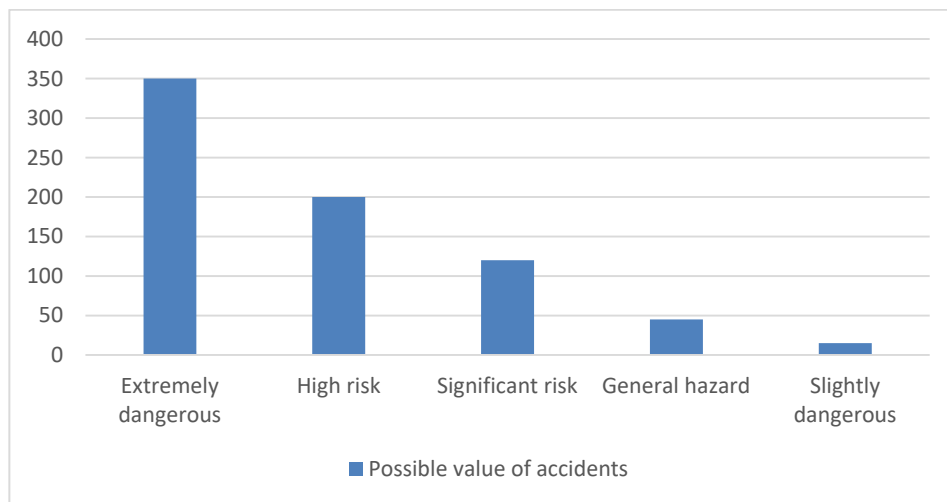


Figure 1. Possible values of accidents

Figure 1 shows that the extremely dangerous risk level is level 1, the high risk level is level 2, the significant risk level is level 3, the general risk level is level 4, and the slight risk level is level 5. On the premise that the risk level has been determined quantitatively, EPC General Contractor shall organize hierarchical management for the identified hazard sources. The basis of classification is the size

of D and the management requirements of EPC general contractor for D to interval. The purpose of classification is to formulate the order of hazard source management measures and the way of measures to be taken. For the contents above high risk in the evaluation, the rectification measures and the implementation of safeguard measures should be organized immediately.

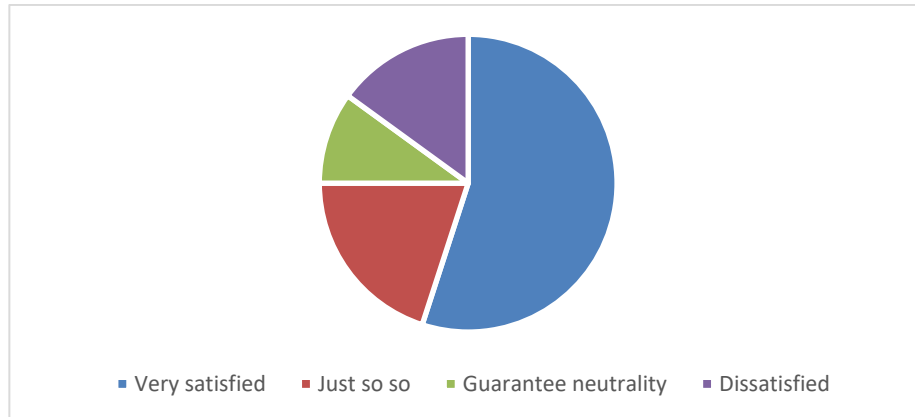


Figure 2. The project side's view on EPC contracting mode

It can be seen from Figure 2 that most people are very satisfied with the EPC contracting mode, because the management under the EPC contracting mode is very good, reducing a lot of burden on the contractor. In the actual EPC project construction, we should be able to pay attention to the mode, optimize the application of the mode, and constantly improve the level of project construction.

5. Conclusion

With the progress and development of society, enterprises will inevitably face many risks when contracting international projects due to different political, economic, legal and other factors. When managing international engineering projects, any enterprise should predict and identify risks from the perspective of EPC, avoid risks by improving engineering technology and contracts, and transfer risks by introducing high-quality risk management personnel, so as to minimize the impact of risks on enterprises and ensure economic benefits and enterprise interests. This paper studies the EPC contracting mode through PSO algorithm and engineering technology configuration model. The results show that the project site management under EPC contracting mode is very orderly. We can understand that the beginning of EPC contracting mode is of great significance to promote the smooth construction of construction projects. In order to ensure the smooth progress of construction projects, we should strengthen the practical application of EPC contracting mode, and need to know a lot of relevant content. As the commencement

involves many construction related contents, it is necessary to strengthen the management of EPC contracting mode, and then improve the construction quality.

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