The application of general contracting model for engineering, procurement and construction project

Qin Jingpeng

Belarusian State University, Minsk, The Republic of Belarus

Academic supervisor - Yuliya Mamatok, PhD, associate professor of the department of innovation and entrepreneurship, Belarusian State University

Abstract. The engineering project, in general, consists of engineering, procurement, and construction activities, EPC in brief. It means that the general contractor of EPC engineering general contracting project implements the engineering design of the project in according to the contract provisions signed with the owner or investor, equipment and materials procurement, project construction, and project commissioning. The general contracting adopts third-party service type of the project that is fully contracted. The general contractor must also follow the contractual agreement on the quality, safety, and completion of the project on schedule. The project should be fully accountable to owners or investors. To improve the scientific system of EPC project management, the use of talents is a key factor. The competition in the new century is the competition of talents. Especially in large-scale projects, the role of outstanding talents is even more important. Practice has shown that in the actual application of the EPC project general contracting model, most of the problems occur due to human causes. Most of these problems can be avoided and prevented through the optimization and improvement of management methods. From the perspective of the entire enterprise management, human resource management is the focus of management practice.

Key words. Optimization analysis, project management, project cost, human resources, project schedule, construction enterprise.

1. HUMAN RESOURCES MANAGEMENT

In project management, human resources are the hotspots and difficulties of international concern in this field. Therefore, in order to improve the level of EPC project general contracting management, we should first analyze the current status and characteristics of EPC project management at home and abroad, and at the same time, focus on increasing the training of project management talents and improve human resource management.

As a high-end market, the general engineering contracting market started late in China and has a relatively short development time. There are still many problems in the management of general contracting. The core competitiveness of Chinese enterprises is far from that of well-known large international enterprises, and the enterprises have fewer comprehensive talents. In addition, the country's related laws and regulations are not developed, which also affects the normal operation of the project. Due to the special requirements of the general contracting model and the specifics of the engineering industry, one of the keys to the successful operation of the project is whether the human resource management of the enterprise is perfect [3].

The concrete manifestations are in the following two aspects: the transformation of engineering project construction enterprises into full-featured engineering companies is to a large extent restricted by the factors of human resource allocation.

At present, the general contracting business of large construction companies has certain limitations, and is generally limited to the level of design-construction and procurement-construction general contracting [4]. General contracting relatively few really cover the entire design, procurement, and construction project process. Many units are relatively strong in one aspect, but lack overall competitiveness. Although large design institutes have strong design capabilities and good reputation in the industry, they lack practical experience. Obviously, the lack of experience in procurement, construction management and project management, has largely restricted the role of the general contracting model of the project.

The problem of how to gradually integrate the design unit and the construction unit and effectively realize resource sharing has become a key issue for success. The resources include both material resources and human resources. The question is how to effectively solve the problem of human resource allocation and management. In particular, the introduction and recruitment of external human resources and the rational use of human resources are issues that every engineering company must pay attention to and solve [5]. The lack of human resources and the greater mobility of talents also bring certain difficulties to engineering project management.

This difficulty comes from both the contractor and the owner. For contractors, project management talents who can fully grasp modern project management knowledge are relatively scarce. In particular, there are only a handful of comprehensive talents who are proficient in project management, project cost, cooperation negotiation, investment and financing decision-making, and legal management. This greatly restricts the efficiency of project operation and affects the overall benefits of the project.

For owners, there are fewer talents proficient in project management. The main manifestation is that they are not familiar with the operating rules and rules of general contracting projects, and often artificially create some contradictions that should not occur, which results in the delay or even shedding of the master development speed. During the negotiation stage of the general contract, the owner did not understand the professional knowledge of the construction process and project cost. Owners often put forward some obviously low prices and unacceptable liability clauses, which often lead to the suspension or failure of negotiations. In addition, the scarcity is the most expensive. Due to the lack of comprehensive talents, project management is in short supply. Many headhunting companies regard excellent project management talents as their key work targets, resulting in greater mobility of talents [6]. How to recruit talents, retain them, and make the best use of their talents has become an important issue that every engineering company must face and solve.

2. PROJECT SCHEDULE MANAGEMENT

Project schedule management is an indispensable part of project management, and has a special important position and role [7]. The EPC power station project is a relatively large project. The EPC power plant project has a long construction period, huge investment, and multiple and complex interfaces. EPC power station project schedule management runs through the entire process of project construction.

The scope of project schedule management includes design, equipment procurement, and on-site construction. The working interface involves all participating units of the project. If the construction period is delayed during the construction period, tens of thousands of dollars will be paid a day only for the interest item. If you consider the loss of postponed power sales and the possible negative impact on the local economy, the loss will be even greater. Due to the above-mentioned characteristics, EPC power station projects put forward high requirements for schedule management, and schedule optimization management is one of the tasks of the EPC power station project management center.

The optimization of project schedule management is to use the scientific methods to determine schedule goals, prepare schedule plans and resources supply plans, perform schedule control, and achieve schedule goals on the basis of coordination with quality and cost goals. In the field of project management, time, cost, and performance are three important metrics, and resources are at the center of this triangle (as is shown in Figure 1). Project progress management is to resolve the contradiction between three metrics, which requires fast progress, low investment and good quality.

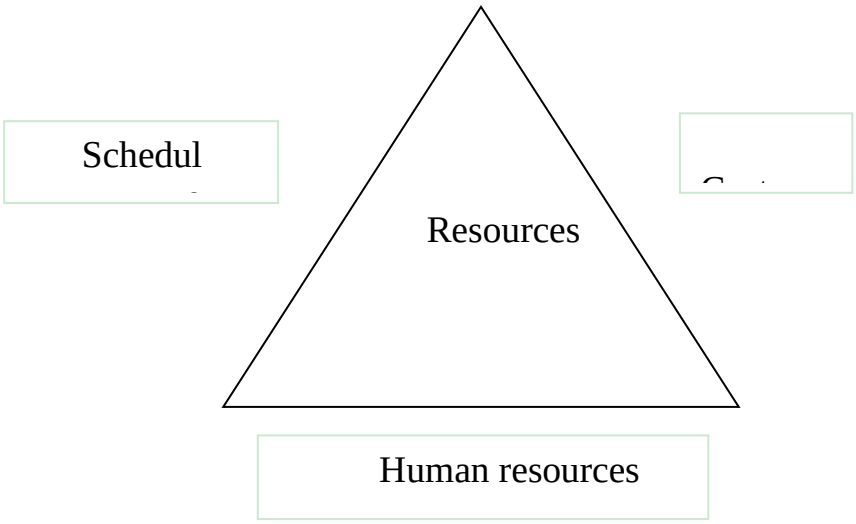

Figure 1.The triangle of project management Source: [7]

3. PROJECT COST MANAGEMENT

At present, there are relatively few researches on cost management of international EPC projects are performed by Chinese companies. The theoretical innovation is slightly insufficient. In recent years, the academic literature is relatively lack of case studies on the cost management of overseas EPC projects.

Therefore, this research uses overseas power station projects as a case to conduct in-depth research and discussion on project cost management, in order to provide the reference to the related research [8]. Facing the international situation and the status quo of Chinese enterprises, it is necessary to answer the question of how to improve the cost management under the EPC engineering mode to improve the competitiveness of Chinese enterprises in overseas markets. It is the great practical significance to study the work experience of EPC general contracting enterprises and

to use the project management ideas to sort out and improve the current EPC project management ideas.

As competition in overseas markets is more intense, cost management is more difficult. There are more influencing factors in the process of project implementation. The manpower, schedule, and cost control level of the project are critical to the success or failure of the project [8].

4. HALFAYA POWER STATION PROJECT

Halfaya power station project is 3×30MW gas-fired power station of CNPC in Halfaya (Iraq). Halfaya Oil Field is situated in the Missan Governorate of Iraq, 35 km southeast of Amarah city. Discovered in 1976, the field is a NW-SE trending anticlinal structure, about 30 km long and 10 km wide, as is shown in figure 2.

Figure 2. Location map of Halfaya oil field Source: [9]

In this context, this research takes the Halfaya power station project as an example to deeply study the mode of human resources, schedule and cost management of the project, combined with the analysis of project data, find out the gains and losses in project cost management, and propose the direction of optimization, and the strategies to improve the management level of international EPC power station projects.

This research framework is divided into six parts.

The first part is a brief introduction, to the background and significance of the topic, the current research status, the main research ideas, the research content, and the research questions of this research. The main aim is to optimize manpower, schedule and cost management in EPC project management, and determine the optimization plan through the data analysis.

The second part of the literature review and theoretical framework part introduces the development process of EPC project general contracting mode. This

part describes the concept and characteristic analysis of the EPC project general contracting model. Through the analysis of the concept and characteristics of the EPC project general contracting mode, it points out the double-layer advantages of this contracting mode for the owners and contractors, and compares and analyzes the traditional construction general contracting mode. This part mainly proposes the manpower, schedule and cost optimization of EPC project general contracting.

The third part mainly uses the method of the third part, taking the EPC project management of the 3×30MW gas-fired power station of CNPC in Halfaya (Iraq) as the research object. Through the analysis of specific examples, detailed analysis of human resource management, schedule management and cost management, etc., finally obtains the specific data.

The fourth part is to study the data analyzed in the fourth part. Through analyzing, summarizing, and proposing related strategies, this part focuses on proposing strategies from three perspectives. The first strategy is to analyze the current constraints of human resources and propose suggestions for improving human resources. The second strategy is to analyze schedule management and put forward suggestions for improving schedule management. The third strategy is to analyze the existing problems of cost management and to put forward suggestions for the improving of cost management.

The fifth part is the effect of optimization strategies. This part includes the effect of human resource optimization. It also includes the effect of project schedule optimization and the effect of project cost optimization.

The sixth part is the conclusion and enlightenment. It mainly summarizes the first five parts and proposes further development prospects.

The innovations of this case study are summarized as follow. On the one hand, it combines specific aspects to propose micro-project management to strengthen human resource management, schedule and cost management strategies. On the other hand, the use of advanced management theories combined with the practice of large-scale construction companies to carry out overseas EPC general contracting ensures that the proposed strategies are more practical.

The international construction market is an open system. Chinese EPC companies need to fully understand this and actively integrate with the international construction market. With an open mind, Chinese EPC companies actively learn, innovate, accumulate, and summarize from internationally renowned engineering contractors. Only in this way can Chinese EPC companies truly win in the international engineering contracting market.

The EPC project general contracting mode has become the mainstream mode of the international project contracting market. This EPC model is not a simple addition of design, procurement and construction. This model has rich connotations and needs the support of corresponding management systems and systems. The EPC enterprise must have an internal and external environment that adapts to its development, a clear strategy, a flat and efficient organizational structure, rich and complete business functions, efficient project management capabilities and advanced project management methods.

Only by continuously optimizing the human resources of the project, project schedule and project cost, can we truly realize the orderly and efficient operation of the design, procurement and construction of EPC projects. Only through this method can the overall ergonomics of the EPC project be brought into full play.

5. THE RESEARCH THEORETICAL AND PRACTICAL ASPECTS

Theoretical aspects. Human resources for EPC projects are different from human resources for general projects. They are divided into two categories in terms of sources. One is self-owned human resources, that is, the internal human resources of the engineering company, and the other is external human resources, that is based on engineering projects. All kinds of personnel who need to be recruited from the human resources market. Such a source structure determines that management should be focused on unity and pertinence.

The project team's management methods and institutional settings will have a certain impact on the implementation of the schedule. Generally speaking, when the company’s entity institutes expand their market share, they will form a certain system to formulate consistent standards and requirements for the development of the project. While formulating the milestone key node plan, the first-level schedule, and the second-level/special schedule, the possible problem factors should be considered thoroughly to prevent unexpected situations or changes that are not easy to handle. According to the overall goals agreed in the EPC project general contracting contract, the goals are broken down to formulate control points one by one. The responsible person is clarified. The project progress is analyzed in real time, and preventive and corrective measures are taken in time when there are deviations to ensure the implementation of the schedule.

The cost control at the design stage is mainly reflected in the comparison and selection of plans, the use of value engineering theory to analyze and compare the design plans, and select the best technically feasible and economically reasonable plan. At the procurement stage, we must pay attention to the selection of suppliers, and establish cooperative relations with suppliers who choose the best. Through the exchange and cooperation between the two parties, the value space for joint acquisition is greater, which can reduce the project cost and improve the project schedule for the general contractor. In the construction phase, the optimal construction subcontractor should be selected through bidding and bidding for professional construction subcontracting, construction management should be refined, detailed plans formulated, the earned value method should be used to effectively monitor the project, and the cost of the construction phase should be strictly controlled.

Further research directions

In terms of human resources, how to optimize existing human resource management systems and methods is related to the characteristics of specific projects and the selection and experience of project managers. It also needs to be studied and demonstrated in light of the specific project background and construction conditions.

Do a good job of schedule management to achieve a win-win situation for all parties involved in the construction. Through the reasonable planning and preparation of the EPC project schedule, and then carry out hierarchical management, dynamic tracking and analysis, take preventive and corrective measures, design and construction are interspersed, and specific work is started in advance, etc. The agreed construction period is completed and handed over. For EPC enterprises, it not only delivers a satisfactory project to customers on time, but also wins its due profits and credibility for its own company. Fulfilling the contract agreement guarantees the profit of the EPC project. If the project is completed ahead of schedule, it will be rewarded with the corresponding construction period, and the task indicators will be completed on time, so that the non-labor costs will be controlled within the planned target. The same is true for subcontractors. For customers, the planned commissioning of production has also brought economic benefits. It can be seen that the win-win situation of the partners in the EPC model still needs further discussion and research.

Regarding the cost control of EPC projects, the research only does some preliminary research, and there are many issues that need to be further studied and discussed:

1) how to determine the probability of the influencing factors of the cost target, so as to reduce the cost of the EPC project and control the subjectivity of the probability of occurrence;

2) how to formulate a reasonable loss reference level, according to the EPC general contracting project management level and the specific conditions of the project, so that the evaluation of the project based on the loss degree is more scientific;

3) how to build an EPC model of information platform construction and use modern network technology to fully share information platform resources to improve the informatization of EPC project general contractor cost control;

4) how to avoid the big-pot doctrine of cost control in the past based on the responsibility cost contract signed by the enterprise, clarify the responsibilities and rights of EPC project managers, and build an EPC project that can quantify and decompose cost control from top to bottom Responsible person's management system.

References

1. *Zhang Xueli.* (2012). Research on engineering project management under general contract mode. North China Electric Power University, (JUN.): 56.
2. *Xie Donghui.* (2011). Research on Human Resource Management of Engineering Project. Tsinghua University, (MAY.): 42.
3. *Wang Jianjun.* (2005). Discussion on several related issues of general contracting methods. Engineering Construction and Design, (MAR.): 17.
4. *Li Youguo.* (2008). Feasibility analysis of EPC management mode, Shanxi Architecture, (FEB.): 26.

5. *Qi Jianyong.* (2009). Strengthen contract management and improve EPC general contracting project management level. China Mining Engineering, (APR.): 12.
6. *Zhang Yangliu.* (2012).The characteristics of engineering project human resource management and its comparison with general human resource management. Engineering Manager, (MAY.): 17.
7. *Han Xiaojun*, (2017). How do construction companies do EPC project general contracting management. Home of Project General Contracting, October (JUL.): 3.
8. *Guo Li.* (2001). PMP and modern project management. China Engineering Consulting, (MAY.): 15, 16.
9. *Zhang Kun.* (2012). Research and implementation of project contract management based on the EPC general contracting model of overseas power stations. Shanghai: Shanghai Jiaotong University, (MAR.): 12.