

Research on Key Issues Related to Investment Control in Guangzhou Metro EPC Mode

-- Taking the 18/22 line of Guangzhou Metro as an example

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Abstract. The development of the city is often accompanied by the construction of infrastructure. Various models also impact the Chinese construction market. As a kind of contracting and forwarding model, EPC has a positive effect on improving the level of engineering construction, so it is gradually applied and implemented extensively in China. However, there may be problems with the project getting out of control during the operation. Guangzhou Metro Line 18/22 is piloted by this model. This paper uses the method of research on the contract terms of Guangzhou Metro Line 18/22 to analyze the project control rights allocation, contract risk sharing and flexible clauses. To identify the key elements of investment management and control of the Guangzhou Metro 18/22 line project, and to enhance the success of the metro project construction management under this mode by strengthening the investment control of the owner under the EPC model.

Keywords: EPC mode, Guangzhou Metro Line 18/22, investment control, case analysis.

EPC mode In the unique environment of China, the general contractor is responsible for the project design-procurement-construction, in order to achieve the purpose of saving investment, improving quality, saving time and transferring risks; but because the owner cannot fully trust the general contractor, he does not want It takes advantage of the superior position of the entire project to obtain too much benefit, so the owner will retain some control over the project to achieve supervision of the general contractor and project management. The trust environment and risk culture in China's scenario are still not mature. The owner's distrust of the general contractor and the attempt to transfer the risk to the general contractor may lead to the unequal risk sharing and responsibility of the general contracting project. Induced investment out of control. Therefore, investment control using the EPC model for subway construction in China is a key issue in construction.

1. Literature Review

1.1 Literature Review of General Contracting Model

Compared with the traditional model, the EPC (Engineering Procurement Construction) general contracting model strengthens the general contractor model to strengthen the control of the contractor's project while also taking on more risks, which is conducive to the overall planning and coordination of the project, which is conducive to the progress, Quality, cost objectives. However, due to the unsound laws and the different levels of contractors in the actual process, when adopting the EPC model, the owner's investment management of the project is strengthened and the owner's goal is achieved without interfering with the contractor's contractual rights. 1.2 Literature review of investment management and control of construction projects

1.2 Literature Review of Investment Management and Control of Construction Projects

Investment control of construction projects is a complicated task [1]. In the domestic, most of the urban infrastructure projects are controlled by the cost, quality and time of the project, and the stakeholders of the project interests are properly allocated. [2] Wei Hongjuan [3] believes that the project general contracting project is a system in which multiple objectives are brought together to maximize the comprehensive benefits through investment control throughout the life cycle. In the construction mode of BOT+EPC, Chen Weijun [4] designed the supervision and passive initiative,

and strived to achieve investment control of the general contracting project through strict and cautious review activities, achieving the highest efficiency of the owner's investment and utilization. From the whole process planning analysis of the general contracting mode of the project, Peng Yuhui [5] believes that since the EPC project investment estimate is completed in the feasibility study stage without detailed design drawings, only the owner's "functional requirements" for the project at this time, there are no specific quantifiable engineering indicators.

Due to the incompleteness of the contract, the inaccurate description of the powers and responsibilities of the parties in the contract may lead to problems such as risk sharing, control ownership and contract flexibility. Therefore, this paper is based on the Guangzhou Metro 18/22 line project. Using contract analysis to identify the key elements of investment control and conduct detailed analysis, analyze the main points of investment control in the subway project using EPC mode, and provide effective suggestions for achieving investment control objectives.

2. Overview of the EPC Project of Guangzhou Metro Line 18/22

The Guangzhou Metro Line 18/22 is a pilot project for the construction of the EPC model in Guangzhou. The owner will invite the tender after the preliminary design. The EPC contractor for the construction of the subway project will be undertaken by the experienced general contractor. According to the special conditions and practical needs of the Guangzhou Metro Line 18/22 line (such as the construction risk point, high level, large scale of project and investment, high technical difficulty, complex engineering geology, etc.), reasonably Risk sharing, rational allocation of control rights, and the use of flexible contracts to control investment to ensure the construction of the 18/22 line. The owner starts from the year when the EPC contract is signed, and the price of the contracted part is measured and settled according to the initial budget of the corresponding scope of the government approval according to the bidding rate. The unit price is measured and settled according to the implementation quantity. The contractual relationship formed by it is shown in Figure 1.

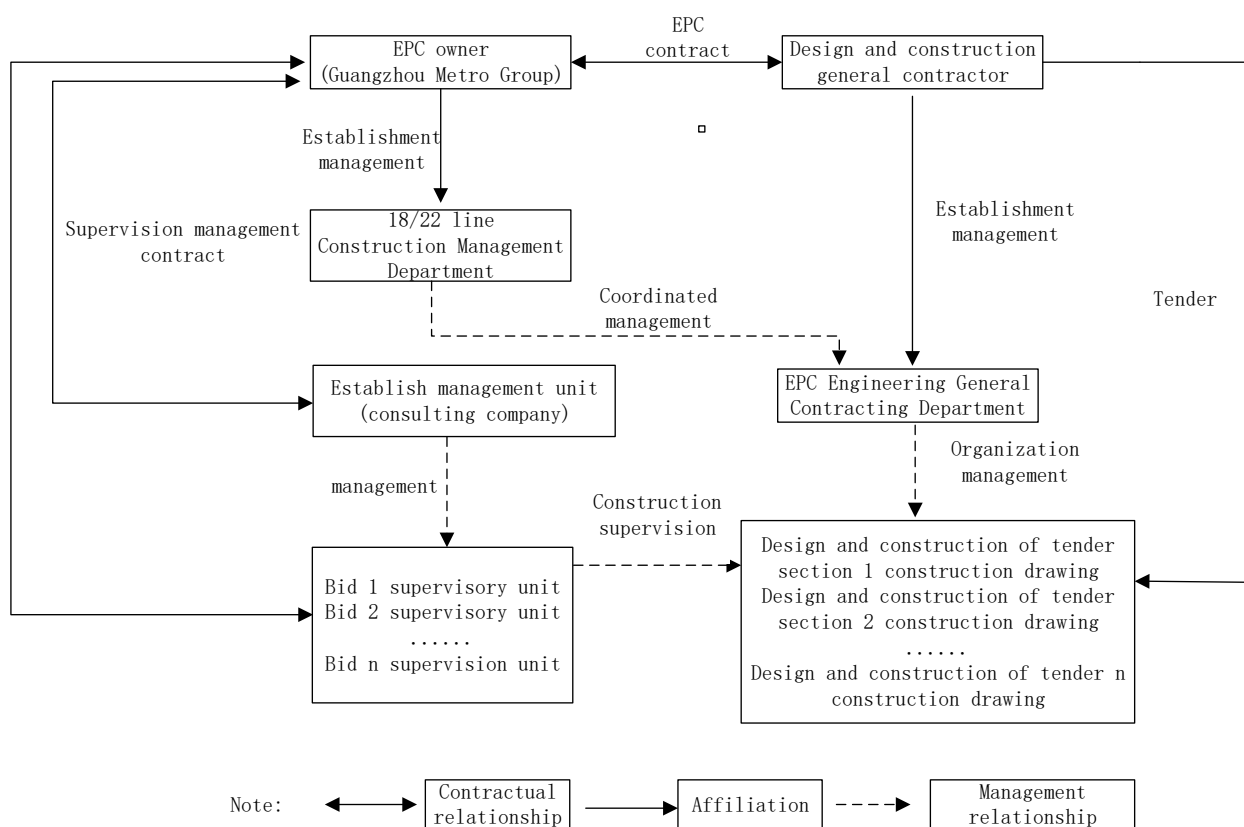


Figure 1. Contract relationship of EPC project construction implementation mode of Guangzhou Metro Line 18/22

3. Based on the Single Case Analysis, the Core Points of the EPC Mode Investment Control of the 18/22 Line

It is relatively difficult to identify the investment management and control core of the subway project under the EPC mode only by quantitative analysis. The qualitative research is to deeply analyze and study the research object and the research object, and then analyze the essence of the matter, and then get a more comprehensive understanding. Hey [6]. This paper analyzes the contract terms of Guangzhou Metro Line 18/22, analyzes the investment control points, and finally extracts the control rights of the owner and the general contractor through the collection and arrangement of the data. Risk sharing and contract setting are the core points of investment control in this paper.

3.1 Project Control Allocation is the Basis of the EPC Contract

After the owner signs the contract with the contractor, the owner's control over the project is transferred to the contractor. The contractor has the right to manage the project construction, and the owner has the power to make decisions, supervise and change. Since the EPC model adopted by Guangzhou Metro Line 18/22 is a weak general contracting mode, the owner manages the preliminary work of the project, the engineering design, and the construction, so the contractor's rights are weakened. Based on this model, the owner's control over the project increases, and it is easier to carry out investment control. Through preliminary design and formulation of the corresponding budgetary control objectives, the optimization of the total control of the general contracted project investment can be achieved.

Due to the fact that the EPC model has not yet been maturely applied, the construction technology is highly professional and the investment amount is huge, on the basis of identifying the project control points, the control right of the Guangzhou Metro 18/22 line project is decomposed and obtained. The division of control between the owner and the general contractor reflects the degree of authority of the owner to the general contractor and the rational allocation of control of the EPC project, as shown in Table 1.

From Table 1, the results of the control of the control of the Guangzhou Metro Line 18/22 line between the owner and the general contractor are obtained through analysis. Establish a control configuration model for the EPC project, as shown in Figure 2 below.

Table 1. List of control rights of general contracting mode of project of Guangzhou Metro 18/22 Line

Numbering	Control	Control matters	owner	General contractor	Control configuration result
C1	Project feasibility study review rights	Entrust the consulting and review unit or organization experts to review and approve the feasibility study, survey and design documents, various special evaluation (price) results and research test results. Have the right to inspect, supervise and review the work of this project.	✓		Full control of the owner
C2	Survey and design document review rights	Entrust the consulting and review unit or organization experts to review and approve the feasibility study, survey and design documents, various special evaluation (price) results and research test results. Have the right to inspect, supervise and review the work of the project	✓		Full control of the owner
C3	Project financing rights	According to the actual progress of the project, fund raising is responsible for the financing and supervision of the project construction funds, ensuring that the construction funds are timely disbursed, supervising the transfer of project funds, and being responsible for the audit of the project completion and final accounts.	✓		Full control of the owner
C4	Fund approval	按照项目进展情况及时筹措资金。 负责本项目工程建设资金的筹措和监督, 保证建设资金得到及时拨付, 监督工程资金的专款专用, 同时负责项目竣工决算的审核。	✓		Full control of the owner
C5	Construction organization design review right	监督工程总承包单位、施工分包、监理、设备材料供应、试验检测等单位依约履行合同义务。	✓		Full control of the owner
C6	Construction site supervision	Supervise project management contracting (PMC) units, construction, supervision, equipment and materials supply, test and other units to perform contractual obligations in accordance with the contract. In accordance with relevant regulations, earnestly perform their duties, strictly manage the construction, supervision and other units participating in the construction according to the contract, and may not subcontract or violate the regulations.	✓	✓	Joint control
C7	Advance payment approval authority	Control the cost of the construction period according to relevant standards and regulations.	✓		Full control of the owner
C8	Progress payment approval	Responsible for the cost control during the construction period and handle various engineering changes in accordance with relevant regulations.	✓		Full control of the owner
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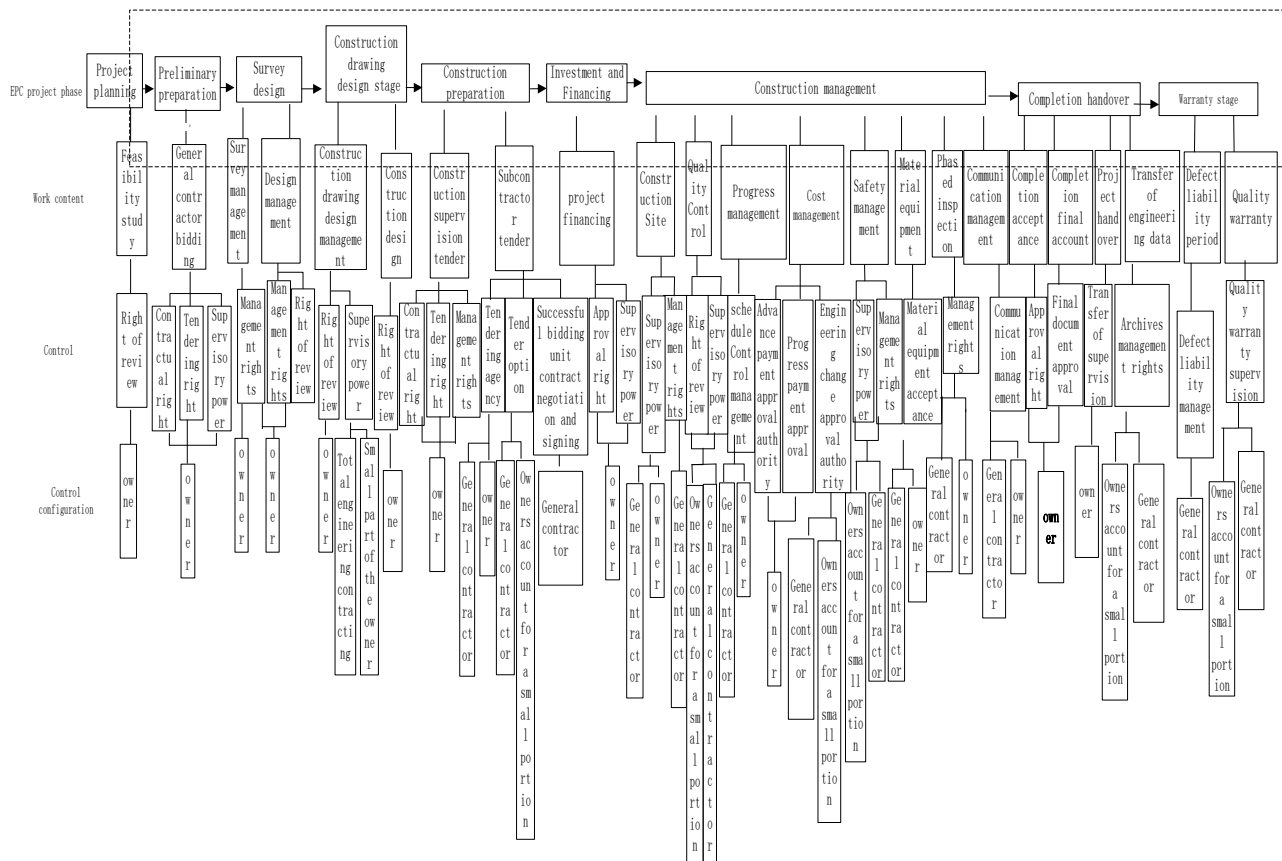


Figure 2. EPC mode control right configuration model

In general, the owner controls most of the power, mainly in reviewing and supervising the work of the general contractor, and the general contractor undertakes most of the work to assist the owner.

3.2 Reasonable Risk Sharing is an Important Mechanism

The uncertainty of the project is the main source of investment control risk under the EPC mode, and the risk sharing of the investment control of the EPC project is to clarify the responsibility of the owner and the general contractor, and bear the losses and benefits brought by the risk. Hey.

Through the responsibility of the general contractor of the Guangzhou Metro 18/22 line project and the control rights given by the owner, the identification results are summarized corresponding to the key control points, and the Guangzhou Metro 18/22 is obtained. The “control-responsibility” configuration table of the line project general contracting mode project is shown in Table 2.

Table 2. List of “Control Rights – Responsibilities” of the General Contracting Model Project of the Guangzhou Metro Line 18/22

Serial number	Critical control point	Destruction of responsibility	Responsibility
1	Project feasibility	Modify the feasibility study report responsibility	The owner is fully responsible
2	the study	Initial exploration and preliminary	The owner is fully responsible
3	Initial exploration and preliminary	Design document is incorrectly responsible	The general contractor is fully responsible
4	Designing Documents	Investigation and design documents are incorrectly responsible	The owner is fully responsible
5	Detailed survey and construction drawings	Project financing failure	The owner is fully responsible
6	Designing Documents	Funds are not available in time	The general contractor bears most of
7	Project funding source	The use of funds does not meet the requirements	The general contractor bears most of
8	Project funds in place and use	Bidding document error	The general contractor bears most of
9		Tender failed	The general contractor bears most of
10	Design, construction and tendering of materials and equipment	Incorrect contract terms	The general contractor bears most of
11		Construction drawing design plan error	The general contractor bears full responsibility
12		Construction drawing design plan modification	The owner bears most of the
13	Construction design	Land acquisition and demolition delay	The general contractor bears full responsibility
14		Construction site does not meet the requirements	The general contractor bears full responsibility
15	Project land demolition	Lack of unified management at the construction site	The general contractor bears most of
16	Construction site layout	Material equipment quality problem	The general contractor bears full responsibility
17		There is a problem with the construction organization	The general contractor bears most of
18	Material equipment procurement	Loss caused by delay in construction period	The general contractor bears most of
19	Construction design	Unsatisfactory engineering quality	The general contractor bears most of
20	Project schedule control	Insufficient quality inspection	The general contractor bears full responsibility
21	Engineering quality management	Legal liability for a safety incident	The general contractor bears most of

It can be clearly seen from Table 2 that the sharing of powers and responsibilities between the owners and the general contractor corresponding to the 21 key control points lays a solid foundation for investment control. EPC project investment control risk sharing is the result of the game between the owner and the general contractor. One of the misunderstandings is that the owner should transfer the risk in the project construction to the contractor as much as possible, but in fact, the owner and the contractor should reasonably allocate the risk. By reasonably assigning the risks between the owner and the contractor, it is clear that the investment control objectives of the main contractor are beneficial to the owner's effective control over the investment.

3.3 Flexible Contract is an Important Means of Investment Control

Most subway projects select contract models based on contract system and type. Taking Guangzhou Metro Line 18/22 as an example, first of all, according to the needs of the owners of the Guangzhou Metro Line 18/22 project, the characteristics of the project and their own capabilities, the experts should be selected to select the appropriate contract type (for example DB contract, DBB contract, EPC contract). The owner then selects the contract system based on the needs. . This article takes the project of Guangzhou Metro Line 18/22, relying on the background, the owner's goal and contract flexibility as a whole, to understand the owner's goal of contract coordination and control, and to make different contract terms through the flexible state descriptive index of the contract. The degree of flexibility in the design.

(1) For the Guangzhou Metro Line 18/22 line project, the project is singular and non-repeatable, and the owner clearly understands that the Guangzhou Metro Line 18/22 line project should be analyzed in detail. After that, design the contract terms that best meet the characteristics of the project, and the owner should understand that the Guangzhou Metro contract terms should be the result of the design and not just a simple choice. If you choose the existing contract model text, you should also combine the unique characteristics of the Guangzhou Metro Line 18/22 line project and the owner's goal to design a contract clause with reasonable flexibility.

(2) The contract flexibly designs the contract terms at the contracting stage, but because of the flexibility of the contract, there is a certain time interval, which is generally manifested in the process of coping with uncertain events during the contracting phase of the project. Therefore, when designing the contract terms of the Guangzhou Metro 18/22 line project, the contract flexible clause should be set from the perspective of the whole process and should not be regarded as a simplified contract.

(3) Guangzhou Metro Line 18/22 should focus on the interaction between the rigid clause and the flexible clause when setting the contract terms. It is necessary to consider the function of restraining the parties to the contract and the protection of the contractual relationship. If the constraint function is the main function, the contract package should design a rigid company with low flexibility in the contract, and set more constraints and restrictions on the party's behavior. In this case, there may be no early warning mechanism and relatively few flexible elements. If adaptation and coordination are the main ones, the contract terms should be set in the relationship dimension of contracting and issuing, and flexible contracts with higher flexibility in contract design. The contract terms should pay attention to the dynamic incentives of the clauses and renegotiate the design and try to be in the contract. During the process of making, you can anticipate possible problems and develop effective solutions in advance.

4. Analysis of the Core Points of Investment Control in Guangzhou Metro Line 18/22

This paper identifies the core elements of investment control of EPC project of Guangzhou Metro Line 18/22 as project control right allocation, risk sharing and flexible contract, and analyzes the three cores of investment control of the project, in order to apply EPC in rail transit. The model has certain guiding significance. Optimizing the allocation of project control rights is the basis for effective risk sharing. In the contract establishment stage, as far as possible, the problems in the implementation are expected to be formulated in advance. In the future new EPC project, the control rights, risks and contracts should be systematically studied as a whole according to the principle of equal rights and responsibilities, thus helping the owners to take the lead in investment control and promote the smooth implementation of EPC projects.

References

- [1]. China Construction Association, Construction Project Investment Control [M]. Beijing: Intellectual Property Publishing House, 2003.

- [2]. Ang B W. The LMDI approach to decomposition analysis: a practical guide[J]. *Energy Policy*, 2005, 33(7):867-871.
- [3]. Wei Hongjuan. The theory and application of owner investment control system under EPC mode[D]. Changsha: Hunan University, 2013.
- [4]. Chen Wei. Investment Control of Highway Construction Project under Design Supervision of BOT+EPC Mode [D]. Chongqing: Chongqing Jiaotong University, 2015.
- [5]. Peng Yuhui. Research on Total Investment Estimation of EPC Construction Project [D]. Nanning: Guangxi University, 2017.
- [6]. Yu Y, Chen D, Zhu B, et al. Eco-efficiency trends in China, 1978–2010: Decoupling environmental pressure from economic growth[J]. *Ecological Indicators*, 2013, 24(1):177-18.