

The Technique and Management of Investment Control in Metro Engineering

Shunmao Mao^{1, a*}, Tingting Zhu^{2, b*}

¹Wuhan University of Technology, Wuhan city, Hubei province, China

²East China Jiaotong University, Nanchang city, Jiangxi Province, China

^amaoshunmao@163.com, ^bztthpu@163.com

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Abstract. Metro engineering is a systematic engineering with a wide range, great investment, long construction cycle, and complex circuit. If improper handled, most likely engendering the investment exceeds budget estimate, thus affecting the economic and social benefits of projects. Throughout the development of metro engineering in decades, we have well-developed experience of construction and project management, but the old traditional pattern by administrative means has been still followed, not form a system, so it brings great limitations to the entire management process. Therefore, combined with the management mode of construction projects in our country, the article focuses on clearing the basic principle of the investment in metro engineering, pay attention to related technical details of investment control in process of the investment, particularly in design phase. With the help of efficiently and scientifically management, putting the course of investment management in place, so as to achieve general goal of infrastructure engineering construction with economical investment, fast progress, and preferable benefit.

Introduction

In order to solve traffic congestion problems in big city and keep the city's rational distribution, from 1965 our country began to construct metro. At present, Beijing, Tianjin, Shanghai, Guangzhou and another 14 cities have been put metro system into operation, Wuhan, Nanchang, Nanning and another 28 cities have been approved of metro construction. Our national metros have 37 routes in 2009 and 10 routes in 2006, estimating the routes will be 86 in 2015. After 1998, the project management formed the tri-dimension structure, that is, project legal, contractors and supervision units, through mutual cooperation, mutual supervision and mutual restraint between units, promoting the development of project management and improving the level of construction. The first concept of project management is taken by the construction of Mingzhu Line in Shanghai Railway Traffic in 1999. The metros as the underground transportation artery, in order to ensure efficiency and benefit of the investment, effectively controlling the metro construction engineering will be the important subject in period of allover speed-rising.

The Importance of Investment Control

The Dominant Characteristics of the Metro Engineering. The metro construction's capital outlay is highly great. For example, cost of the metro under construction in Beijing is approximately 989 billion Yuan. Currently, the total estimated investment of under-construction Tianjin No.2

metro line's phase I is 150 billion Yuan. Obviously, metro is a typical fund-intensive capital construction project, it's necessary and exigent to strengthen investment control and reduce funds of engineering construction as possible.

Construction cycle is relatively long in general. Take Shanghai metro for example, similar to No.3 and No.5, completely elevated type's construction period is about 2-3 years. If the elevated section contains underground segment, the period is about 3-5 years. If route is underground, the cycle needs 4-5 years at least. No.12 line is affected by World Expo and schedule delay part of stations in city center, its cycle is up to 6 years. The metro construction cycle does not have a fixed quantitative index. With time prolonged, capital cost increases monotonically, it is essential to note the problem of investment control.

Metro project concerns with a wide range and more construction units. The investment structure of metro construction is divided into seven mains, such as construction preparation, construction, equipment, rail and fastener, reserve budget, construction loan interest, and so on. According to the analysis of the estimate budget in Guangzhou, Shenzhen and Nanjing, the proportion of each part accounts for 1~3 %, 25% ~35%, 30% ~40%, 2%, 10% ~15%, 5% ~7%, respectively.

Metro construction also has the characteristics of multi-line and stage construction. The work is more stable and more continual. The builders' experience and custom may have a repeatedly influence on metro construction decision.

In summary, Metro engineering is a systematic engineering with covering a wide range, great investment, long construction cycle, and complex circuit. Therefore, it is necessary to clear the basic principle of the investment in metro engineering, pay attention to related technical details of investment control in process of the investment, and implement in place in the course of investment management.

Basic Principles of Investment Control. One is adhering to the principle of competition. Metro engineering should make full use of the model of public bidding, break the profession monopoly, eliminate the entry barriers, improve industry technical standard and construction level, and ensure the healthy development of the industry. Due to break industry monopolies, the number of entry construction units will increase, that will further strengthen intra-industry market competition.

The other one is adhering to the principle of cost-effectiveness. The owner can organize engineering cost consultation companies and construction units to comply enterprise quota. According to engineering experience and other expense standard, organizing personnel to calculate expenditure item of all kinds of subentry engineering, convenient for investment rationality of macroscopic control engineering. Simultaneously, the firm should plan well metro transfer in the condition of complex routines, organically combining urban underground space development and metro construction, which both play a considerable economic benefit and have huge social benefit and combat readiness.

The Control of Investment in Metro Engineering

The process of metro construction must go through the design, bidding and implementation phases, considered several factors, such as city layout, resource allocation, economy, traffic, land development and utilization, etc. Finally, choose and carry out the metro construction scheme in accordance with the city developing scale.

The Control of Investment in Design Phase. The key to investment control lies in proper control of designs. Therefore, particular attention must be paid to the following three tasks.

Orchestrating and establishing the criteria of engineering design. The engineering quality depends on designing quality. The premise of designing quality of metro engineering is the choice of

designing criteria. The choice must be combined with investment control, which makes them coordination and mutual restriction and prevents from the tendency of unilateral pursuit of improving criteria, but relaxing the investment control, and reducing the criterion because of the high requirement of investment control. To ensure the investment control under the premise of guarantee of quality in design phase, the following tasks must be valued. The project owner and design unit should determine the technical criteria as soon as possible, pay attention to the overall optimization of the criteria, ensure the coordination and standard matching of technique in the whole system; The design of system in whole routes and signal item with commonality should carry out the national relevant stipulations and the owner's requirement of investment control; Choosing corresponding standard system on equipment and the stereotypes of electro-mechanical device.

The managers should firmly establish the sense of value engineering. In general, the proposal of subway construction has two or more. Compared with two proposals, A and B, if the safety coefficient of A is slightly higher than B, but cost is much more, there should be B plan. Meanwhile, the owner shall ask for the participants setting up and carrying out the concept of engineering construction of achieving the engineering quality and safety through improving the level of management and creating value by managing.

Strengthening the management of design alteration. Due to subway engineering generally bids in line with bidding graphs, construction graphs are presented gradually after construction units entering, so there is possibly appearing the situation of design alteration. The owner should prevent construction units from taking actions to increase the design alteration of engineering investment for sake of seeking greater interests and reducing management cost. According to the statistic, the general portion of this kind of alterations in metro engineering is 1~5% of the total investment.

The Control of Investment in Bidding Phase. The bidding of construction project is the process of competition and benefits between participants. It is also one of important means of controlling in engineering cost. As the owner, should pay attention to the following two aspects in bidding phase.

Do well the bidding plan of metro engineering according to the construction schedule. Due to the metro engineering is highly complex with many bidding projects and multiple disciplines, in the previous period of project construction, the owner needs to compile the plan of bidding. The plan of bidding based on the market research and analysis of characteristics of projects can fully introduce competition. Combining with the rigorous and precise bidding documents, it can well guarantee the rationality and legitimacy of the contract cost of construction projects, reduce the disputes of two sides in performing the contract, safeguard the benefit of two sides and effectively control engineering investment cost.

Reasonably arrange the bidding sequence. Electro-mechanical equipment of metro engineering has a large proportion in the total investment of engineering, but its price is often influenced by the technical improvement, RMB exchange rate and other factors. In addition, bidding too early may cause losses because of altering the contracts of the equipment supply, so the proper time for bidding can effectively save engineering investment.

The Control of Investment in Bidding Phase. The owner should strengthen the process control, choose reasonable construction scheme and promote the construction schedule. Aiming at the benefit-making characteristic of construction units, the owner should make corresponding decisions from the consideration of the input cost of construction units. Therefore, saving the cost of construction units is indirectly controlling the engineering investment, recognizing and compensating its additional loss is also needed to set up a good construction environment, the benefit is much higher than the loss of compensation.

In order to control investment, it is essential to avoid the construction units' losses caused by shutdowns as much as possible, in the conditions of levy land and remove without finished and not possess of the commenced prerequisite, forbidding the construction units entry into construction sites; as well, carrying out the written reply as soon as possible can save the cost of construction units, increasing corresponding rewarding measures can also promote construction units to complete the contract tasks.

The owner should reasonably compile the plan of the use of fund. The finished daily output of metro engineering in construction phase is likely to be ten million Yuan, the interest expense is huge. The way on saving interest lies in three aspects.

Compiling the reasonable plan of the use of fund. Through compiling the plan of the use of fund, reasonably determining the target values of engineering cost on entirety and each stage, makes the engineering cost as a reference and lays a basis for funds raising and coordinating, so that makes control measures pertinence and eliminates unnecessary fund waste and schedule out of control.

Perfecting related work, according to the plan of funds utilization. In the process of construction projects, strictly executing the plan of fund utilization, furthest saving investment and improving the benefits of investment.

Doing well the comparative analysis of the plan of fund expenditure. The owner must regularly analyze the actual expense and the planned expense of primary budget, take some corresponding measures to control the actual expense within limits of budgeted expense and use the investment difference analysis method to analyze, predict and control.

The Measures on Investment Control of the Metro Engineering

At the current engineering construction system, the profit of construction units increases with settlement amount increased so increasing engineering investment will be all participants' common interests and then the participants have no inner initiative to actively control the engineering investment. Some measures must be taken to arouse enthusiasm for work of the participants reducing engineering investment, mainly manifested in the following four aspects.

Strengthening the management and evaluation of quota design of design units. Strengthening the management and evaluation of quota design, rewarding design units using mature and reliable technique and experience and adopting the determined scheme that can reduce engineering investment by scientific research are to fully arouse enthusiasm of design units and designers for working, such as Nanjing metro project can be used for reference. Practice shows, setting up the relationship between the control of investment and design cost greatly inspires initiative of design units specializing in techniques.

Building a good construction environment and guiding the construction unit to build up the idea of technique and management to create benefits. Facing up to the extra engineering cost of construction units and agreeing to compensate in time is benefit to build a good construction environment and guide the construction to build up the idea of technique and management to create benefits. Practice shows, In the case of preparative work inadequacy, it is prone to corruptions. To save construction investment, the owner sometimes must execute transposition thinking from the construction units and sometimes reducing the cost of construction units is equal to reduce the engineering investment.

Strengthening the appraisal of responsibility of supervision unit and consulting unit. Doing well investment control is the premise of the supervision unit and consulting unit to get rewards. To this end, the owner must improve the contract charging principles, increase the contract terms of the rationalization, reduce engineering cost and rewards, such as taking the responsibility for a task

until it is completed and the performance encouragement. Meanwhile, building the system of 'assessment of investment control target', everybody is responsible for investment control. The responsible persons must save the engineering investment on the precise of safety and ensuring the schedule as their work target.

Strengthening the engineering incorruptness. Currently, the reduced rate of many projects of government auditing is more than 30%. Through strengthening the construction of probity system, promoting the perfect preservative mechanism in all participants, improving the system of owner management to balance the cost of corruption and profits and clarifying the requirement for operation and takeover to put an end to the fluke mind of acting inferior as superior. Meanwhile, due to the scope of construction engineering is the putrescent prone location, so all participants should strengthen the study of putrescent cases.

Conclusion

The owner should pay attention to the data and the audit work of the beforehand, intermediate and afterwards at any time. The owner should not only strengthen the audit of settlement data of prophase engineering, but cannot release the reporting data that not meet the normative standard, cannot approve the engineering cost that not meet the contract engagement. In addition, the owner should earnestly work out the settlement examination of metro engineering, compress the falsity parts as possible in settlement and guarantee the authenticity, scientific nature and rationality of the investment of metro engineering.

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