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Study on the application of construction project cost control in China

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Abstract. Project cost control is a hot issue in construction enterprise management and a key factor to determine the return on project investment. With the continuous summary of modern project management experience, systematic, comprehensive and dynamic management methods and ideas gradually began to be adopted. As a controllable system, cost system is the key to determine the market competitiveness of construction enterprises. This paper combines qualitative research with quantitative research, normative research with empirical research, theoretical research with practical research, and makes comprehensive use of previous research results to provide guidance for the practical operation of cost control in construction enterprises. Firstly, it introduces the important factors affecting the cost and the background and purpose of the project cost control, and then analyzes the object and content of the project cost control and analysis. Finally, the phenomenon of "three super" and the deviation of the project cost are analyzedd and discussed. It is of great practical significance to study project cost control for promoting the reform of investment system and improving market competitiveness of construction enterprises.

Keywords: project cost control, construction cost, "three super" phenomenon.

1. Introduction

The management mode of enterprise information has quickly gained popularity and been put to use due to the rapid growth of information and network technologies. The rapid development of the construction industry has also greatly accelerated the process of urban growth, so it is very important to realize the informatization of engineering construction and project management. However, the needs for development have not been met by the conventional cost management paradigm. Additionally, the project cost budget serves as the fundamental control foundation for the complete construction project cost budget, and its accuracy can have a direct impact on the project's investment funds as well as the timeline for completion.

Nowadays, the construction project investment budget mode in China generally uses the static management mode of same quality and the same price engineering budget quota. This project mode is mainly supervised by the relevant departments of the government. The government determines the various prices of the construction project cost budget link, including the management fee, and may also limit the profit rate. It can not fundamentally and comprehensively take into account the technical strength and expertise of the investment enterprise, the labor level of the enterprise, the procurement of construction materials, the management strength of the enterprise investment and operation. Therefore,

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this backward cost management mode cannot really adapt to the investment enterprises according to the construction industry market conditions and their own advantages to determine the cost of construction projects.

This paper summarizes the deficiencies of the project cost management mode and points out the deficiencies of the current project cost management information system. Then it is clearly pointed out that using bill of quantities valuation is a more comprehensive and reasonable cost management mode which is more in line with the current construction investment market. In this paper, the research background and purpose of the project cost management information system are introduced. And the common methods of engineering cost control, the cases and deficiencies of engineering cost control are also list. Finally, the solution and future development direction are proposed.

2. Background and purpose of project cost control

2.1. Background of project control

With the active promotion of the reform wave and the effective implementation of reform measures, the situation in all walks of life is stable. The construction industry is also gradually gaining fresh blood in the reform, promoting transformation and upgrading. Although the construction industry has a large output value and a wide range of influence, its production and management efficiency is much lower than that of other industries. The phenomenon of high energy consumption and low efficiency in the construction industry prompts people in the industry to actively explore the production methods and management methods of construction projects for scientific and reasonable reform. The construction stage is the most direct and basic stage to form the engineering entity. The cost of the construction phase generally accounts for more than 90% of the cost of the construction project. In the construction phase, under the condition of meeting the requirements of the construction contract documents, the enterprise needs to ensure the quality and safety of the construction. Moreover, enterprises need to save construction costs as much as possible, create the greatest economic benefits, and obtain social benefits. Therefore, it is very necessary to carry out cost management and control in the construction phase of the construction project, and the study of cost control and management also has important practical significance [1].

At present, there are a series of problems in the cost control of construction enterprises, such as construction technology and management means are not advanced, weak cost management consciousness, serious quality and safety problems, and do not pay attention to control in advance and in the process. Therefore, the improvement and reform of cost control in the construction stage will be the most direct and effective place. Building information technology (BIM) has gained widespread industry acceptance in recent years as a result of the technological wave's progressive expansion and advancement. The project schedule plan and cost plan are successfully integrated on the basis of BIM 3 dimensional (3D) technology, which may create an integrated platform system based on BIM 5D technology construction stage cost management. During the construction process, the BIM 5D integration platform can also naturally link construction drawings, contract documents, quality and safety concerns, change requests, and other pertinent information in order to encourage a more systematic and detailed control of construction projects and enhance the management capacity of construction enterprises [2].

2.2. Purpose of project control

Project cost control is very important to project management, it runs through the whole process of the project. Therefore, in the project cost management, construction enterprises mainly carry out cost control in three stages, namely: pre-control, in-process control and post-control. Since there are many factors affecting cost changes at each stage, managers should control key links. They should reasonably formulate the target cost of the project in advance, supervise and adjust the dynamic cost in the process, and analyze and summarize the cost control of the project afterwards, so as to achieve the target period and achieve the target profit rate. The control ability of project cost can effectively reflect the

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management level of construction enterprises. Through the research of project cost, this paper can effectively reduce the waste of resources, reduce the project cost, so as to improve the enterprise's management ability and market competitiveness, and obtain more economic benefits.

3. Object and content of construction cost control and analysis

Generally speaking, the control of the construction cost of the project starts from many aspects, which is the process management of the overall control of the cost of the entire construction process of the project. Mainly in the construction process for the formation of cost, construction management and labor team of the human cost, division, project division, economic contract aspects of these four levels of process control. The specific objects and contents of control and analysis are described as follows.

3.1. The formation process of construction cost

The process control of the project cost generally entails maintaining overall process control throughout the project, starting with the project bidding, construction preparatory stage, construction process, and completion acceptance. In terms of project bidding, the cost of the entire project is computed based on the early project's general status, the bidding documents, and an investigation of the bidders' perspectives. Construction management staff should become acquainted with and go over the design drawings or other pertinent information during the preparation stage of the project. As for the uncertain problems, they shall be uniformly summarized and handed over to Party A, who shall uniformly organize the joint review of the drawings. Then, through the comparison and analysis of many schemes, the economical and reasonable scheme is selected for the construction organization design. According to the construction organization design scheme, the construction cost plan is developed, and the cost target is analyzed. Thus, the project cost control plays a forecasting role to achieve the optimization of cost control. In the construction stage, the effective process control of the construction process is mainly through the control of the construction budget, construction quota and actual cost.In the completion stage and quality assurance stage, the cost analysis of the completion acceptance stage and the later quality assurance stage of the construction period is carried out to effectively control the cost of this stage [3].

3.2. The cost required by the construction management and labor team

The cost control required by the construction management and labor team is mainly about the effective control of the various costs needed to be spent by this part of the population at ordinary times. These costs are generated in the process of construction. As a result, controlling the labour team and construction management is essential for keeping project costs under control. The total project cost will be broken down, a successful project cost accountability system will be put in place, and the total project cost will be divided into costs that will be borne by specific people or departments, and then establish a relatively perfect assessment mechanism, the cost responsibility system assessment.

3.3. The cost of the division project

The control of the total cost of the project is generally rough. In order to do the work of cost control in a more systematic and detailed way, it is necessary to control the total cost by sections and items. The specific method of division project cost control is to take the total cost of the project as the total amount, according to the division project quantity, and with the aid of the construction budget quota, the preparation of the construction budget, the decomposition of the cost plan, for the quantity and unit price of man-machine materials for division calculation. Only in this way can the cost of the subdivision project be highly effective and meticulous control.

3.4. Economic contracts

Economic contract is the basis and system for management and control of the whole project by both parties. Both parties agree on clear and detailed rights and obligations in the contract. When the construction unit carries out the project cost control, it is necessary to strictly control the quantity and

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amount related to the construction in all kinds of economic contracts signed by it in the cost budget, so as to ensure the effectiveness of the cost control in a wide range of construction project costs.

4. "Three super" phenomenon

4.1. Cause analysis of "three exceeding" phenomenon in the project implementation stage

"Settlement over budget, budget over estimate, budget over estimate" are three exceeding phenomenon. As known that construction projects are special products that cannot be repeated and can not be effectively compared among projects, and the management level of each construction unit is uneven, so different management of the same project will lead to completely different investment results. The timely treatment of engineering problems is very key to engineering cost control. Some problems and timely treatment may only take hundreds of thousands of dollars, otherwise, it may take millions or even millions of dollars. Of course, some items due to early management and other reasons, resulting in a congenital lack of investment control, no matter how hard we work in the later period, can not ensure that the investment does not exceed the budget estimate.

The supervision organization is not perfect. Many supervision units only have a few relatively stable engineering and technical personnel, most of them are hired temporarily. The unstable supervision personnel is not conducive to the team's own construction. Secondly, the whole supervision system operates in a poor environment. The supervision organization is called a social intermediary organization, which is actually employed by the construction unit. In the current social environment, all the supervision activities are catering to their employers. This phenomenon is particularly prominent in the location of hidden works and temporary works. In addition, there is a lack of effective constraints on design changes and construction visas, especially for major design changes and on-site visas, which generally have the problems of incomplete procedures and "deliberation before submission". After the facts have been established, they are submitted to the approval authority for approval in the adjusted budget estimate. Poor management of the construction unit leads to rework, waste, and even project quality problems, leading to increased investment.

4.2. Ways to control "Three Super" in project implementation stage

The methods to control the "three super" during the project implementation phase include that the legal person responsibility system for construction projects should be earnestly implemented. The responsibilities, rights and interests of Managers should be specified and matched with rewards and punishments.

Strengthen the supervision strength and depth of the whole process of construction projects. The supervision engineer shall predict the project risks and the places where claims may occur, and formulate preventive measures to avoid or reduce the occurrence of claims. In the construction process, we should help and urge the contractor to develop advanced construction plans, reasonable arrangement of construction procedures, the establishment of a perfect quality assurance system, each process, each sub-item, division of the project, layer by layer check, to avoid unnecessary increase in costs caused by accidents. At the same time, for engineering changes, site visa and other issues related to the increase in cost, more should be done in the accounting before, after the change, to understand the specific reasons for the change, analysis of the impact of the change on the cost, construction period needs to be closely coordinated with the project supervision department and project units, tracking, examination and approval of the construction period of the cost, only in this way to plug the hole [4].

The construction unit should strengthen the management of the whole construction process, try to use advanced construction methods, new materials and new technology, reduce waste, improve construction efficiency, so that the project can be smoothly carried out after the start of work, there is no stoppage, rework, slow down phenomenon. Many engineering examples show that the construction process is well managed and the construction period is short, the project cost is less affected by the dynamic factors [5].

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5. Construction cost deviation

5.1. Overview of construction cost deviation

In addition to the accident of non-standard behavior ,in the cost control of building projects, the difference between the actual and anticipated value of the construction cost is referred to as the construction cost deviation. The difference between the completed project's actual cost and its projected cost is the deviation in project costs.

The actual engineering cost of the completed project in the formula is equal to the completed engineering quantity multiplied by the actual unit cost.The planned cost of the completed works is equal to the completed works multiplied by the planned unit cost.If the calculation result is positive, it means construction cost overruns; if the calculation result is negative, it means construction cost savings.

It must be also pointed out in particular that the construction project schedule deviation has an important impact on the results of the construction cost deviation analysis, if not taken into account, the actual situation of the construction cost deviation can not be reflected correctly. For example, the construction cost overruns in a certain construction section may be caused by the progress of the construction schedule, or may be caused by the price increase. Therefore, it is necessary to introduce schedule deviation into construction cost control for comprehensive analysis [6].

Schedule deviation (I) is equal to the actual completion time of the project minus the planned completion time.To relate to the cost deviation in engineering analysis, the schedule deviation can also be expressed as: Schedule deviation (II) is equal to the construction cost of the planned project minus the construction cost of the completed project.Among them, the construction cost of the planned project refers to the construction cost of the planned project completed in accordance with the schedule within the specified time. The planned engineering cost of the project to be completed is equal to the planned engineering quantity multiplied by the planned unit cost.If the progress deviation is positive, the construction period is delayed. Conversely, if the schedule deviation is negative, progress is ahead of schedule [7].

5.2. Methods of deviation analysis

Deviation analysis can be performed by different methods, including tabular method, cross graph method and curve method.

5.2.1. Tabular method. Tabular method is the most commonly used method for progress deviation analysis. The project code, name, and other details are assigned. Construction cost variations and labour cost characteristics are combined into a table and can be compared there. The table includes a list of each deviation metric to make it easier for the construction cost manager to comprehend and use the information. The advantages of tabular bias analysis are as follows [8].

(1) it is flexible and applicable, and can design the table according to actual needs and add or subtract items.

(2) The large amount of information can reflect the data needed for deviation analysis, which is conducive to the construction cost control. Personnel should take targeted measures in time to strengthen the control.

(3) With the help of computer, it can save a lot of manpower required for data processing and improve the efficiency of work. For example, table 1 is a deviation analysis table, and the project includes installing wooden, steel and aluminum doors and windows.

It can be seen directly from the table that the installation cost of wood doors and Windows is the same as the planned cost, but the cost of steel doors and windows and aluminum doors and Windows overruns. From the degree of schedule deviation, the installation progress of wood doors and aluminum doors and eindows is the same as the planned. Steel doors and eindows installation schedule advance, in the construction management can be considered that the cost overrun steel doors and Windows may be caused by the schedule advance, so the overall should strengthen the control of aluminum alloy doors and windows installation cost.

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Table 1. Deviation analysis table [2].

Item coding	1	021	022	023
Project name	2	Install wooden doors and Windows	Install steel doors and Windows	Install aluminum doors and Windows
Counter position	3	-	-	-
Planned unit cost	4	-	-	-
Complete the work quantity	5	-	-	-
Construction cost of the proposed project	6=4*5	30	30	40
The quantity of work has been completed	7	-	-	-
The cost of the completed works is charged	8=4*7	30	40	40
Actual unit cost	9	-	-	-
Other funds	10	-	-	-
Actual construction cost of completed project	11=7*9+10	30	50	50
Local deviation of construction cost	12=11-8	0	10	10
Local deviation degree of construction cost	13=11/8	1	1.25	1.25
Cumulative deviation of construction cost	14=∑12	-	-	-
Cumulative deviation degree of construction cost	15=∑11/∑8	-	-	-
Local deviation of burst degree	16=6-8	0	-10	0
Degree of local deviation of burst degree	17=6/8	1	0．75	1
Deviation of concentration of juice	18=∑16	-	-	-
Deviation of concentration of juice	19=∑16/∑8	-	-	-

5.2.2. Transverse chart method. Different cross pathways are used to mark the construction cost of the completed project plan, the anticipated construction cost of the project to be completed, and the actual construction cost of the completed project in order to analyse the deviation of construction cost using the cross chart method. Cross paths are proportionate to their length.Cross diagram image method is more intuitive, clear, at a glance to see the specific construction progress. It can accurately express the absolute deviation of the construction cost, and can feel the severity of the deviation at a glance. However, it also has some disadvantages, is to reflect less information, generally only in the project of the top management of the application. For example, table 2 is a cross chart image for the same project as Table 1.

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Table 2. Cross chart image [7].

Project coding	Project name	Amount of construction cost parameter [a]	Construction deviation	Progress deviation
021	Install steel doors and Windows	30	0	0
022	Install steel doors and Windows	40 30 50	10	-10
023	Install aluminum doors and Windows	40 50	10	0
Totel			20	-10

Notes: indicats the actual construction cost of the completed project, indicats the construction cost of the proposed project, and indicats the planned construction cost of completed project.

5.2.3. Curve method. Curve method is a method to analyze construction cost deviation by using construction cost accumulation curve [1]. Where a represents the actual value curve of construction cost, p represents the planned value curve of construction cost, and the vertical distance between the two curves represents the deviation of construction cost [9].

When using the curve method to analyze the deviation of construction cost, it is necessary to determine the planned value curve of construction cost first, because the planned value curve of construction cost is associated with the determined schedule. At the same time, the influence of actual progress should also be considered, that is, the actual construction cost curve a of the completed project, the planned construction cost curve b of the completed project and the planned construction cost curve p of the completed project should also be considered. As can be seen from figure 1 the vertical distance between curve *a* and curve *b* represents the construction cost deviation, while the horizontal distance between curve *b* and curve p represents the schedule deviation. Deviation analysis with curve method has the characteristics of image and intuition, but this method is difficult to carry out quantitative analysis, generally can only carry out qualitative analysis [10].

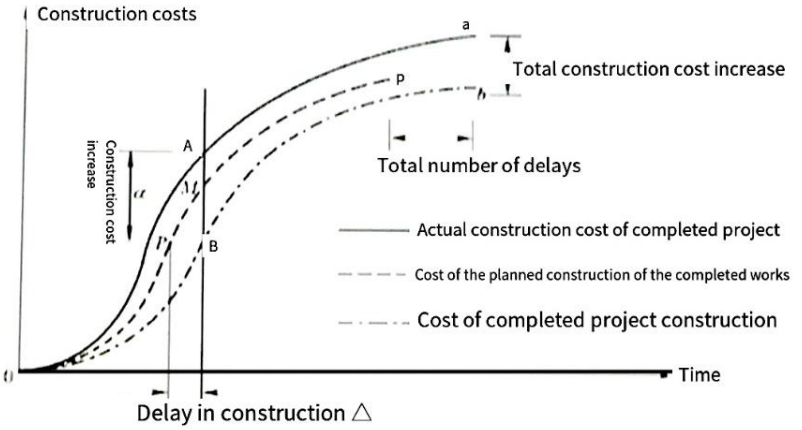

Figure 1. Curve analysis [11].

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6. Conclusion

A large number of studies and practical engineering cases show that high project cost is a common problem in the construction industry. To solve this problem, the first step is to determine the cost factor. Construction firms can prevent cost overruns, improve overall project profits, and effectively manage these key aspects by creating preventative methods. In order to provide the main cost influencing factors for construction enterprises, this paper analyzes and discusses the influencing factors of cost, the background and purpose of engineering cost control, the object and content of engineering cost control and analysis, the phenomenon of "three super" and the deviation of engineering cost.

In practice, the construction company must communicate effectively with the client at the beginning of the project to fully understand the client's needs. In order to prevent price conflicts, it is necessary to fully understand the parameters of the contract and ask the customer to make the necessary explanation of the drawings and specifications before signing the agreement. In the process of project implementation, the contractor must also use the correct method of cost control. In order to reduce uncertainty and potential cost overruns, construction firms can also take advantage of the remaining factors by conducting detailed investigations on a project and client basis prior to the commencement of the project.

References

[1] BIM Appliction Standard 2007 Based on IFC Standard published by the US National Institute of Building Sciences.

[2] Li J 2009 Research on Key Technologies of Concrete Structure 100 Year Durabiliity of the National Stadium for Beijing 2008 Olympic Games *Proc.of Shanghai Int. Conf. on Technology of Architecture and Stucture* p 68.

[3] Ma Z,Li H and Yang J 2014 Using XML to support information exchange in construction projects *Autom. Constr.* 12 pp 491-506.

[4] Linderoth H 2010 Understanding Adoption and Use of BIM As the Creation of Actor Net works *Autom. Constr.* pp 66-72.

[5] Eastman C, Teicholz P and Sacks R et al. *2000 BIM handbook* New Jersey ohnWiley &Sons.

[6] Zhang J and Hu Z 2011 BIM-and-4D-based integrated solution of analysis and management for conflicts and structural safety problems during construction:principles and methodologies *Autom. Constr.* pp 155-166.

[7] Li Y, Lang H and Wu T 2013 Project Quality Management Based on Building Information Modeling Construction technology *Technology* 10(1) p 20-23.

[8] YA and K 2011 Technology adoption in the BIM implementation for lean architectural practice *Autom. Constr.* pp 189-195.

[9] Smith D and Tardiff M 2009 Building Information Modelling: a Strategic Implementation Guide for Architects, Engineers *Constructors and Real Estate Asset Managers* 25(1) p 99.

[10] Ding L and Ying Z 2014 Burcu Akinci.Building Information Modeling application framework The process of expanding from 3D to computable *Autom. Constr.* 24(2) pp 82-93.

[11] Ma Z,Wei Z and Wu S 2011 Application and extension of the IFC standard in construction cost estimating for tendering in China *Autom. Constr.* 24(3) pp 96-204.