Study on Construction Project Cost Control Based on Lean Construction Thought

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Abstract. Faced with the fierce competition in the construction market, construction enterprises only by setting up effective project cost management system can ensure their competitiveness and profit margins. Some construction enterprises have begun to use lean thinking to carry out cost control, and effectively improve the production efficiency and customer satisfaction, with lower costs and resources waste. Lean construction thought is of great significance for construction enterprises.

Connotation of Lean Construction

The concept of lean construction was first proposed by Finland professor Lauri Koskela in 1993. He pointed out that, the biggest characteristic of lean production is the high degree of adaptability. As everyone knows, the diversity and complexity of the construction market is an important factor affecting the production, so if people can improve the adaptability of construction production, the production efficiency will be easily improved and construction cost be controlled.

For each building product, it has its uniqueness, while for production of construction enterprises, there is repeatability and reproducibility. Lean construction is based on flow goods and fixed personnel, but construction is just the opposite and construction project is full of complexity and uncertainty, so lean construction is not simply to apply the concept of lean production to the construction system, but combined with the characteristics of the construction process, to improve the construction management process and form a specific lean construction system.

Overall, lean construction thought includes three aspects: lean design, lean supply and lean construction, as shown in Fig. 1:

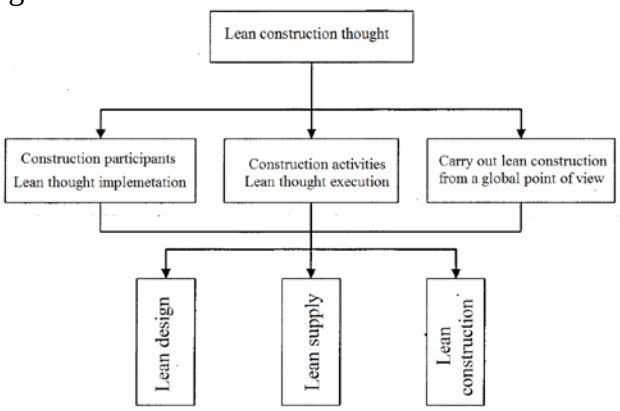

Fig. 1. Connation of lean construction thought

Cost Control System Based on Lean Construction

Support Layer. Construction project cost management based on lean construction is to solve the problem of information exchange and sharing. By establishing a cost information sharing platform, parties involved in the construction of the project are allowed to carry out cost management and communication in this platform, making cost control more effective. Therefore, support layer of cost control system based on lean construction is to build costs information platform.

Cost information platform relies on computer and network technology, and follows specific cost management system. Cost information platform will shift the cost information of the vertical direction to horizontal, to ensure effective communication of cost information. If there is a problem of cost management in the construction process, it will be quickly solved by full information sharing, without increasing the construction cost of the project. The overall framework of the information platform is shown as Fig. 2:

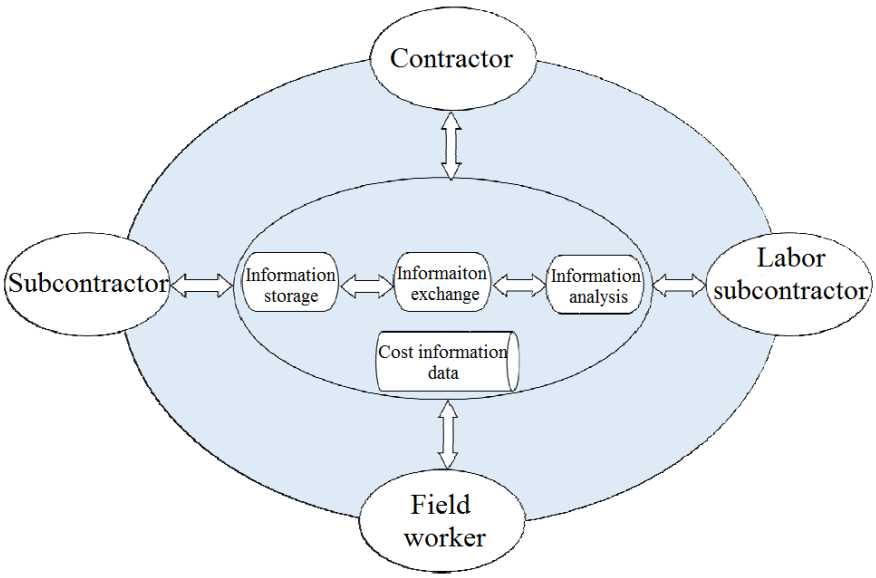

Fig. 2. Overall framework of cost information platform

Management Layer. For construction projects, the main body of cost management mainly includes three parts: the first part is contractor and subcontractor; the second part is labor subcontractor; the third part is field construction personnel.

Contractor and Subcontractor. In cost control system based on lean construction, contractor and subcontractor are decision makers in the whole construction project management process, and also advocate of lean construction thought. In the course of the project, contractor should put forward an effective system and measures to ensure that the cost management thought of lean construction can be implemented. Moreover, enterprises should take advantage of the cost information platform to establish communication with subcontractor and construction workers at the scene against project cost management problems, and then solve these problems in time.

Labor Subcontractor. Labor subcontractor is the guider of lean cost management concepts in in actual projects. Labor subcontracting enterprise is responsible for the training and promotion of lean cost management theory.

Field Construction Worker. Field construction workers are implementers of lean construction thought. In construction project cost management, construction workers should focus on lean thinking, and practice lean cost management measures.

Methods Layer. We adopt target costing method to break down the overall objectives of the project and implement it, to provide a reference object for the operating cost management. Activity-based costing method can combine cost management and cost accounting, so that eliminate the non-value adding activities and improve work efficiency. It is useful for the management of the value of the project. Finally, we use earned value analysis to assess the cost variance, and forecast the development trend of cost in the construction process, providing effective support for decision makers.

Target costing method – cost forecast. To realize the maximization of profit, it requires reducing the waster of the whole process of construction. As a kind of strategic technology, target costing support the implementation of lean construction in construction project management. Its advantages are mainly embodied in the following aspects:

a) Life cycle cost management of the project: target cost management is not only applied in the construction phase of the project, but also preparation phase, completion phase, etc. The formation of the life cycle cost management would help to achieve the overall project cost targets.

b) Full participation: target cost management allocates separate cost targets, so from project manager to basic level construction personnel, everyone can clearly understand their goals.

c) Continuous improvement: in the process of target management, continuous improvement is required, for the purpose of cost saving.

d) Clear cost objectives: target cost management method is a comprehensive, systematic and scientific method of cost management, which can help to realize the combination of technology and economy in project cost management.

Activity-based costing method - cost accounting. Activity-based costing (ABC) has become an advanced method of cost management. Different from the traditional cost management methods, activity-based costing method can prevent the distortion of the cost, so it is widely used in traditional manufacturing and service industries. But application of activity-based costing in construction industry is relatively late. Activity-based costing is one of the auxiliary methods of lean construction, and is of great significance for construction project cost accounting.

a) Improve the traditional cost system: activity-based costing method improve the traditional cost accounting system from two aspects of time and space, so as to achieve the accuracy of cost control. In terms of time, cost data acquisition frequency will affect the accuracy of cost calculation; in terms of space, the accuracy of the cost depends on the degree of the cost management.

b) Provide cost quantization means: activity-based costing method can make a qualitative analysis of the operation. And in the process of cost management, find out the inefficient and valueless operations and then improve operation process by cost quantization means.

c) Improve the management level of construction project: operation is the bridge to connect cost calculation and control, constituting the construction activities of the entire construction project. Therefore, activity-based costing method can calculate the construction project cost operation layer, and promote the controllability of cost, so as to improve the management level of construction project.

d) Improve the profitability of construction project: activity-based costing method is to draw support from operation cost accounting for cos control. It can eliminate the inefficient and valueless operations to reduce overall project costs, so as to improve the profitability of construction project.

Earned value analysis – cost variance. Cost analysis of lean construction is a dynamic process, which should be combined with the construction schedule. Earned value analysis is a method to assess the cost variance, by integrating the project schedule and cost.

The basic idea of earned value method is to conduct earned value of target through analyzing project cost and schedule. Its key is to check the cost and schedule regularly, and according to the actual progress to determine whether the cost is over, whether the progress is delayed, and then adjust the follow-up project plan and implement feedback.

a) Main parameters

There are three basic parameters in earned value method: actual cost (AC), which refers to the actual cost of the operations have been completed when the project enters a particular point; planned cost (PV), which refers to the standard cost of budget; earned value (EV) refers to the value of the contractor in the project.

In addition, there are evaluation parameters and forecast parameters, as shown in Table 1:

Table 1. Earned value index system

Earned Value Index System	Basic parameters	Actual cost (AC)	
		Planned cost (PV)	
		Earned value (EV)	
	Evaluation parameters	Variance index	Cost variance (CV)
			Schedule variance (SV)
		Performance index	Cost performance index (CPI)
			Schedule performance index (SPI)
	Forecast parameters	Estimate at completion (EAC)	
		Estimate at time (EAT)	

b) Evaluation index

After obtaining the three basic parameters, the evaluation index can be calculated as Table 2:

Table 2. Earned value evaluation index

No.	Index name	Formula	Index range	Result
1	Cost variance (CV)	CV=EV-AV	CV>0	Actual cost is less than planned cost, within the expected range
			CV<0	Beyond expected cost, should find out the cause and take measures
2	Schedule variance (SV)	SV=EV-PV	SV>0	Actual progress of the project is ahead of schedule
			SV<0	Actual progress of the schedule is delayed
3	Cost performance index (CPI)	CPI=EV/AC	CPI>1	Project costs are not beyond the planned cost
			CPI=1	Project actual cost exactly meet the planned cost
			CPI<1	Project actual cost exceeds the planned cost
4	Schedule performance index (SPI)	SPI=EV/PV	SPI>1	Completed work over program requirements
			SPI=1	Completed work just meet program requirements
			SPI<1	Completed work just is behind program requirements

c) Improvement measures

Based on parameters analysis, because the variances are different, the improved measures are also different, as shown in Table 3:

Table 3. Earned value measures

No.	Parametric relationship	Variance	Measure
1	AC>PV>EV; SV<0; CV<0	Low efficiency, slow progress and overrun cost	Replace the low-efficiency staff; add materials
2	AC>EV>PV; SV>0; CV>0	Low efficiency, fast progress and overrun cost	Reduce staff
3	PV>EV>AC; SV<0; CV>0	Low efficiency, slow progress and cost decrease	Add high-efficiency staff and accelerate the progress
4	EV>PV>AC; SV>0; CV>0	High efficiency, fast progress and cost increase	Can maintain the status quo
5	EV>AC>PV; SV>0; CV>0	Fast progress and cost increase	Reduce staff; slow the progress; reduce cost
6	PV>EV>AC; SV<0; CV>0	High efficiency, slow progress and overrun cost	Add staff and accelerate the progress

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