Data Research of the Whole Life Cycle Project Cost Information Sharing

Huashan Wang
School of Management, Tianjin University of Technology, Tianjin 300384, China

ABSTRACT: According to the characteristics of the engineering cost information flow in the whole life cycle, Design the project cost index system of the original data and analysis data, Collecting, sorting, analysis, calculates the project cost information, Estimate the whole life cycle engineering cost of the proposed project refer to the project cost to share information. Through the above analysis, Combined with the cost management and computer information technology, Build the project cost information data management model, Cost management participants share the information resources with the help of engineering cost information platform. Implements the beforehand, active and dynamic management of engineering cost in the total project life cycle.
KEYWORD: The project cost; Information data sharing; Full life cycle; Computer technology

1 INTRODUCTION

Along with social economy development, Construction projects become more large, more complicated, more systematic. The engineering cost management become more and more difficult, in the engineering project management. Under the existing project management mode, Construction project decision-making, project design, project implementation, project operation is independent of each other. All these factors result in each stage, various department's communication inefficient, and Information flow barriers. The result is bad for the whole life cycle to supervise and control the project cost. Therefore, many countries try to apply information technology to engineering cost management. Professionals hope to be able to enhance the level of project cost management. Leland Stanford Junior University established CIFE (Center for integrated Facility Engineering) in 1989, purpose is to carry out the study of engineering project management informatization. By the end of the 20th century, The United States has created a new project management mode based on the Web. UK research institutions also developed BCIS (Building Cost Information Service). This software is used in the project cost analysis, cost index analysis, price management and cost control. It can analysis the existing engineering cost index and price information to estimate the cost index and index of new construction. In our country, the ministry also formulated *The construction project cost information management method* (exposure draft) (Shibo Dong et al, 2005). National policy stressed that China should set up the project cost information database. By engineering cost information platform and website, collect construction projects information data of new technology, new craft, and new material. And to carry out data exchange and sharing of professional services about Engineering cost information index, index and price information (Bing Feng et al, 2005).

In the practical work, To put the project cost information into the computer system is not equal to realize the informatization of project cost management, breaking the information island is the key to realize the project cost management informationization (Dong Jin et al, 2009). On the one hand, we should take advantage of the information technology to strengthen the analysis, processing and exchange of information. Create a model to classify, summary and analysis data of engineering cost information. On the other hand, we should break the bondage of departments and stage. Actively explore the new mode of engineering cost management under the condition of informatization. In this paper, the whole life cycle engineering cost information data sharing is a starting point, To explore the change rule of the project cost information at each stage. To explore the the new ways of collection, statistics, analysis, about engineering cost information. Enhance the level of project cost information management, and provide the beneficial reference.

2 WHOLE LIFE CYCLE ENGINEERING COST INFORMATION

2.1 *Whole life cycle engineering cost information flow*

Whole life cycle engineering cost information system is a dynamic loop. In this article, Engineering cost was design for the feed-forward information flow, information flow among and information flow after the feed stream. Feedforward information refers to the same or similar completed project whole life cycle cost, we can use the information for similar engineering cost management for guidance. Information flow among is for the cost of the project information in real time to collect and process control, In view of the ongoing projects. It can be real-time monitoring of the current project cost. Information flow after the feed stream is a kind of overall feedback and correction to the whole life cycle cost management. It can Modify index and parameters about the project cost information database (Lu Yu et al, 2013).

Three kinds of information flow is restraining each other, interdependent, the former is the target basis of the latter, and the latter is the former elaboration and supplement. With the progress of the project, the project cost information from abstract to concrete.

2.2 *Engineering cost information management mode*

Whole life cycle engineering cost data management using the unified under centralized and decentralized management mode, it will gradually form run jointly by the state, industry, local mode. The local competent department of construction and engineering cost management institutions should collect raw data of Single items of projects, unit and division of the project in the professional field. They can provide summary data about the project cost; Industry department in charge of construction and engineering cost management institutions can collect, identify, statistics, analysis and measurement engineering information of same and similar projects. And the related project cost data report to the competent department of national construction. The project cost information data includes: the unit cost, the unit consumption and change trend of the main building materials and equipment. Specific content as shown in figure 1.

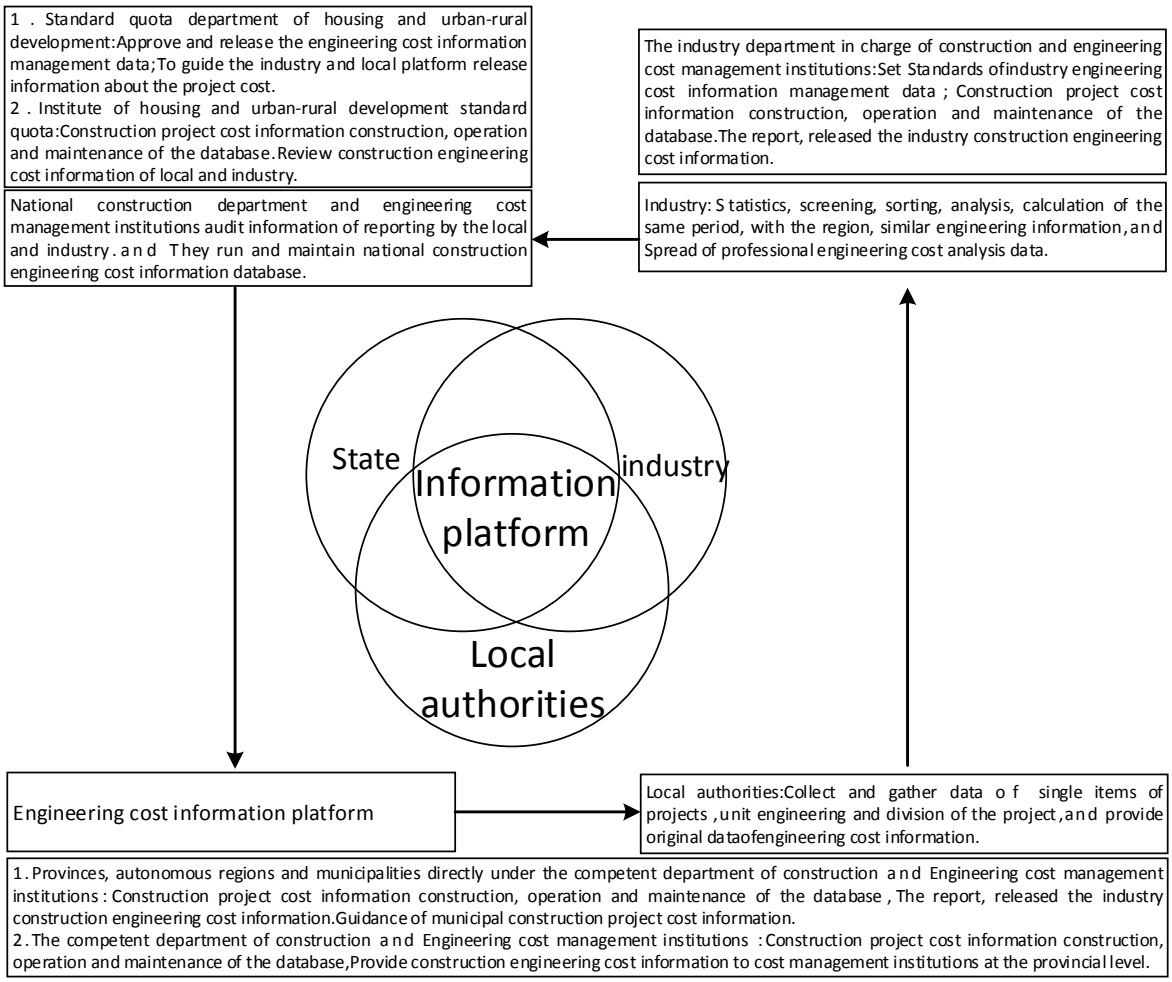

Figure 1 Engineering cost information management mode

Engineering cost consultation enterprises and personnel shall be in accordance with the relevant regulations, timely and accurately report the consultation results file. Construction of the parties shall fill in the project cost information based on the principle of timely, true and complete. Engineering cost management department shall report the outcome document as the basis of assessment. Share database resources base on the principle of reciprocity.

2.3 *The index system of project cost sharing information data*

The characteristics of the engineering cost information data is large amount of information, strong regional and timeliness. Therefore, timely and accurate information collecting engineering cost data is the core and the key of the construction of index system. Whole life cycle engineering cost information database is a combination of all kinds of data, accordance with the professional and the project. It includes the original data and analysis data. The project cost information data can be divided into general and special data according to use standard. It can also be divided into index information, price information, index, according to the reaction of content. This article main component raw data and analysis data of the project cost information database.

Table 1. Project cost sharing information data index system design

<table>
<tr><td rowspan="3">Single items of projects as a basic information</td><td rowspan="3">Stage division</td><td rowspan="3">The main body</td><td>The original data</td><td>The analysis of the data</td><td>The original data</td><td>The analysis of the data</td><td>The original data</td><td>The analysis of the data</td></tr>
<tr><td colspan="2">Summary data</td><td colspan="2">Comprehensive unit price data</td><td colspan="2">Labor, materials, equipment data</td></tr>
<tr><td>Summary data</td><td>The analysis of the data</td><td>Listing quantity of construction projects</td><td>Comprehensive unit price</td><td>The price</td><td>consumption</td></tr>
<tr><td rowspan="7">1. Professional engineering
2. The project name
3. The construction unit
4. The construction site
5. Construction scale
6. Contractual deadline
7. Engineering characteristics
8. Building standards
9. Engineering category
10. Quality grade</td><td>Investment decisions</td><td>The developer</td><td>Investment estimation (The total investment/ Unit investment)</td><td rowspan="6">1. The unit cost
2. Social average cost
3. The social average profit
4. Partial construction cost proportion
5. Measures to project cost proportion
6. Other project cost proportion</td><td></td><td rowspan="7">(Material cost+The cost of the mechanical+Artificial cost+profits+The management fee+Cost of risk)/ List of quantities</td><td rowspan="7">The price of labor, materials, machinery</td><td rowspan="7">1. Total amount of Labour/Unit volume of employment
2. The total amount of the main materials (Steel, wood, cement, concrete products, glass, etc)/ Main material unit consumption
3. The total amount of the main mechanical affecting/Affecting the unit consumption of main mechanical
4. The cost of labor, materials, machinery in 100 m2 building area
5. Labor, materials, machinery cost in proportion in unit project</td></tr>
<tr><td>The preliminary design</td><td>The contractor</td><td>The design budgetary (General estimate/ Unit budget price)</td><td></td></tr>
<tr><td>Construction drawing design</td><td>The contractor</td><td></td><td>Consumption of labor, materials and equipment</td></tr>
<tr><td>The bidding stage</td><td>The contractor</td><td>The bidding price control, The contract price(The total price control/ The unit price control)</td><td></td></tr>
<tr><td>Completion inspection and acceptance</td><td>The contractor</td><td>Completion and settlement(Summed up to calculate/ Unit and settlement)</td><td>Consumption of labor, materials and equipment</td></tr>
<tr><td>Use and maintenance phase</td><td>The contractor</td><td>Use cost and maintenance cost</td><td></td><td></td></tr>
<tr><td colspan="8">note: (The use of labor, materials, equipment, quantity and cost)</td></tr>
</table>

The project cost information data index system of the single items of projects as a design object. First of all, the classification and coding of the construction engineering based on single items of projects as a basic information. Basic information is the main characters of the construction project cost factors, it includes basic overview and technical economic conditions of single project. The basic information of the single projects includes: Professional division, name of the project, the construction unit, construction site, construction scale, contractual deadline, engineering characteristics, category, building standards, quality grade, etc. The professional engineering is divided into building, decoration engineering, installation, municipal engineering, landscape engineering and mining engineering and so on six secondary indicators. Engineering characteristics mainly describe the type and structure type. Building standards including building factory, building overall width, total height and architectural decoration standards (Qin Lin, 2005).

To have to recruit bid construction project, the employer and the contractor shall sign the construction project construction contract first. The developer to submit the project cost in the contract information to local engineering cost management institutions. And it will be dealt with the basis of a construction permit. The contractor recognize settlement documents submitted to the local engineering cost management institutions, and it will be dealt with the basis of the completion acceptance. The index system of project cost sharing information data design as shown in table 1.

Industry department in charge of construction and engineering cost management institutions to the original, the summary of the project cost data for statistics, sorting, analysis and calculation. On the same project longitudinal monitoring and early warning. Longitudinal monitoring analysis indicators as shown in table 2. Lateral comparison and analysis at the same time, with areas and similar engineering projects, as shown in table 3. According to the requirements of the investment estimation accuracy in different stages. And refer to the project investment estimation stage division and the precision requirement (Jie Ni et al, 2013). Specific see table 4. If the design budgetary estimate of the amount is 20% above investment estimation, or the contract price is beyond design budgetary estimate of 10%, it needs to be reported for examination and approval department budget and the original examination and approval department, get their approval. If the completion settlement price exceeds 5% of the contract price, it needs to analyze the cause of cost overruns, and formulate corrective plan, and report to the project examination and approval department.

3 USING THE SHARED PROJECT COST INFORMATION TO ESTIMATE THE COST OF THE PROPOSED CONSTRUCTION PROJECT

Life-cycle engineering cost sharing information is the basis of macro management, project decision-making. It is also a rapid estimation of construction project cost data. The quantitative analysis method of engineering cost information data with fuzzy mathematics method, artificial neural network, statistical regression, support vector method, etc. Fuzzy mathematics method classification including fuzzy clustering method and fuzzy inference system on the application. The fuzzy clustering analysis method is a multivariate analysis method of mathematical statistics.

Quantitative mathematical method is used to determine the sample of the close and distant relationship. Divided objectively thereby engineering cost information data types. Generally include cost, consumption quantity, and three types of information data.

Using the method of construction project investment estimation in the stage of investment, first, we should classify of engineering cost information data. Then choose three similar projects are completed as samples. According to the construction time, construction site, adjust the influence factors of the project. The proposed project and similar projects need to establish the corresponding membership function about similarity degree. Describe and establish the similarity matrix according to membership function between the proposed project and similar projects. Proposed the Euclidean distance between the project X and similar projects Y is:

$$\mathrm{d(x,y)} = \sum_{k=1}^{n} |u(x_k) - u(y_k)| \tag{1}$$

In the formula, u——Membership function.

Close to the calculating formula for:

$$(\mathrm{x,y}) = \frac{1}{n} \times d(x,y) \tag{2}$$

According to the largest degree principle, Selection of the three biggest degree to assess the value of the three most similar of the proposed construction project engineering samples A B C. Regional level of productivity development in our country is different, economic development is not balanced, so the price of labor, materials and mechanical difference is larger. Adjustment coefficient calculation formula about the place is:

$$\alpha = \frac{\sum_{i=1}^{n} D_{ri} \times P_{ri}}{\sum_{i=1}^{m} D_{qi} \times P_{qi}} \tag{3}$$

In the formula, D_{ni}——Similar project unit price in the region;

P_{ri}——Similar projects were weighted in the local;

D_{qi}——Similar project unit price in other areas;

P_{qi}——Similar projects were weighted in other areas;

The price adjustment coefficient calculation formula are described below(4):

$$\beta = \frac{\sum_{i=1}^{n} D_{ri} \times P_{ri}}{\sum_{i=1}^{m} D_{qi} \times P_{qi}} \quad (4)$$

In the formula, D_{ni}——Similar project unit price at this stage;

P_{ri} ——Similar projects were weighted at this stage;

D_{qi}——Similar project unit price in the base period;

P_{qi}——Similar projects were weighted in the base period;

When other factors existing in the engineering construction, is calculated using the above method can also be adjusted factor. Investment estimation of the proposed construction project unit valuation is:

$$\mathrm{D} = [\alpha_1\beta_1 D_1 + \alpha_2\beta_2 T_2 D_2(1-T_1) + \alpha_3\beta_3 T_3 D_3(1-T_1)(1-T_2)] + \left(\frac{(1-T_1)(1-T_2)(1-T_3)(\alpha_1\beta_1 D_1 + \alpha_2\beta_2 D_2 + \alpha_3\beta_3 D_3)}{3}\right) \quad (5)$$

We can estimate and predict the construction project operation and maintenance costs through the analysis of the whole life cycle engineering cost information.

The proposed project whole life cycle engineering cost is:

$$\mathrm{LCC} = S' \times D + S'(PWA \sum_{i=1}^{nar} A_i + \sum_{k=1}^{nar} C_k PWN_k + PWS \times S) \quad (6)$$

In the formula, S'——The architectural area of the proposed project;

D——The investment estimation of the unit price of the proposed construction project;

PWA——The discount factor of the annual cycle cost;

nar——The annual cycle of cost;

C——The cost of the annual cycle occurs;

nnr——The annual cycle of cost;

PWN——The annual cost discount factor;

PWS——The salvage value of the discount factor;

S——The salvage value;

If you need to consider partial project unit price, That predict engineering estimate and budget for the sum of partial project unit cost. Calculation formula is shown below:

$$\mathrm{LCC} = S' \sum_{i=1}^{n} [\alpha_{1i}\beta_{1i}T_{1i}D_{1i} + \alpha_{2i}\beta_{2i}T_{2i}D_{2i}(1-T_{1i}) + \alpha_{3i}\beta_{3i}T_{3i}D_{3i}(1-T_{1i})(1-T_{2i})] + s' \sum_{i=1}^{n} \left(\frac{(1-T_{1i})(1-T_{2i})(1-T_{3i})(\alpha_{1i}\beta_{1i}T_{1i} + \alpha_{2i}\beta_{2i}T_{2i} + \alpha_{3i}\beta_{3i}T_{3i})}{3}\right) + s' PWA \sum_{j=1}^{n} A_j + \sum_{k=1}^{nnr} C_k PW\,CN_k - PWS \times S \quad (7)$$

In the formula, S'——The architectural area of the proposed project;

α_{ni}——Location adjustment coefficient;

β_{ni}——The adjusted factor based on time;

T_{ni}——The degree of similar engineering;

D_{1i}, D_{2i}, D_{3i}——Division component project unit price of the three most similar engineering compared with the case of a partial project i;

PWA——The annual cycle cost of the discount factor;

nar——The cost of several year cycle;

A——The annual cycle of cost;

C——The cost of the annual cycle occurs;

nnr——The annual cycle of cost;

PWN——The annual cost discount factor;

PWS——The salvage value of the discount factor;

S——The salvage value;

We can prepare the plan of investment in fixed assets according to the whole life cycle engineering cost sharing information. We also can analyze the construction cost and the unit production capacity by reference to it. It can also be used as the basis for preparation of investment estimation, preparation of preliminary design, review the construction drawing budget (Qiaoting Dong, 2013). He can also be used as a basic data to determine the tender price control, and to prepare the quota. We also adjust the coefficient can be determined using them, prepare the cost index, study the changing rule of the construction cost.

4 CONCLUSION

We study the whole life cycle engineering cost information data through applying the computer information technology and mathematics model, and to development and utilization of the project cost information resource. To build the whole life cycle engineering cost information data index system, to create information sharing platform, we can estimate the whole life cycle of projects to the project cost by using mathematical model. Quantitative analysis of the history of the engineering cost information, and consider the factor of construction time and construction site, we can predict the project construction cost, operation cost and maintenance cost. We also can dynamically control and optimization of whole life cycle engineering cost management.

Table 2. Longitudinal monitoring analysis indicators design in the same project

Construction engineering	The difference	ratio	instructions
Investment estimation	Investment estimation -Roughly estimated at the design stage	(Investment estimation -Roughly estimated at the design stage)/ Investment estimation	Conclusion: Positive said saving, Negative value to save; Said saving of absolute value, The size of relative value to save
Roughly estimated at the design stage	Roughly estimated at the design stage -The bidding price control	(Roughly estimated at the design stage -The bidding price control)/ Roughly estimated at the design stage	
The bidding price control	The bidding price control -The contract price	(The bidding price control -The contract price)/ The bidding price control	
The contract price	The contract price-Completion and settlement	(The contract price-Completion and settlement)/ The contract price	
Completion and settlement			

Table 3 Lateral comparison analysis indicators design similar project

Construction engineering	The difference	ratio	instructions
The unit cost	The social average unit cost-The unit cost	The social average unit cost-The unit cost/ The social average unit cost	Conclusion: Save is value, Negative value overruns; The absolute value said saving and cost overruns, The size of relative said spare and cost overruns
Unit volume of employment	Average unit man-days consumption society-Unit volume of employment	Average unit man-days consumption society- Unit volume of employment/ Average unit man-days consumption society	
The unit consumption of the main materials	Social average main material consumption-The unit consumption of the main materials	Social average main material consumption- The unit consumption of the main materials/ Social average main material consumption	
The unit consumption of the major mechanical machine-team	The main mechanical affecting social average consumption- The unit consumption of the major mechanical machine-team	The main mechanical affecting social average consumption- The unit consumption of the major mechanical machine-team/ The main mechanical affecting social average consumption	

Table 4 The stage division and the precision requirement of the project investment estimation

phase	content	Investment estimation accuracy requirements of error is allowed
The first stage	Project investment ideas	>±30%
The second stage	Project investment opportunity study period	-30%~30%
The third stage	Preliminary project feasibility study period	-20%~20%
The fourth stage	Project feasibility study period in detail	-10%~10%
The fifth stage	Project engineering design stage	-5%~5%

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