

# Influence on Variation in Technology Management Quality Based on the Model of Engineering Cost Index

**Jing Wei\***

*College of Construction Management, Jiangsu Jianzhu University, Jiangsu, 221116, China*

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## Abstract

Development and changes in economic environment encourage the construction enterprises to make and improve their own core competency, as well as transform from the traditional extensive management mode to a meticulous, intensive and low-carbon one. The improvement of professional competence is a necessary requirement for a new development mode of construction enterprises. So as to improve this competence, we should make evaluation of the present management levels of all construction professional technologies at first and then find some weakness within, and further take some measures for improvement. This paper, from the perspective of cost index theory, built an enterprise engineering cost index model reflecting the variation of management levels in construction enterprises. Based on this model, we can calculate the link relative engineering cost index for enterprises every year, and according to the index, we are able to judge the trend and range of variation so as to improve their management quality.

*Keywords:* engineering cost; construction enterprises; technology management quality; generation model.

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## 1 Introduction

As the anchor of our national economy, construction industry plays an important role in promoting the national economic growth and the comprehensive social development. As an important component of construction industry economy, construction enterprises are the implementer and promoter [1]. In recent years, there are gradually more defects in the traditional construction enterprises mode featuring extensive management and cheap labor forces as the competitive edge. These defects severely inhibit the development trends of construction enterprises. In this case, enterprises should take several measures to build their core competency and secure the sustainable development, including remodeling the enterprise development genes, making some strategic focus and improving management ability. Therefore, there are a large number of experts working on the meticulous, intensive and information management modes with expectation of finding a new method to enable enterprises to improve the management and enhance their competency. In Liu Juhong's study [2], she discussed the connotation, features and factors of core competency and then she illustrated her points of view that it is necessary for enterprises with a hope of success to improve their core competency. In Zhang Fengfan's study [3], he based on the significance and objective requirements in enterprise meticulous management, put forward a brief analysis and some suggestions about the development path and specific measures to achieve this meticulous management, as well as provided some scientific evidence for the modern management of contemporary enterprises. In Sun Zhiwei's study [4], he made it clear the positive and negative influence on enterprise competency from the

informatization. Besides, it analyzed the existing problems in China enterprise informatization and raised some policies for response.

In order to enhance the enterprises competency, this paper started with improvement of their own professional competence, namely the construction technology management. At first, this paper gave some illustration of some core concepts and studied the methods applied to construction enterprise technology management and assessment on the basis of these illustrations. The study achievements are beneficial to improving the enterprise technology management, and then further improving the constructions quality in the whole industry.

## 2 Core Concepts

(1) Engineering construction enterprises: enterprises in building industry mentioned in the study background are from the Provision of Managing the Qualification of Enterprises in Building Industry (2006) from the Ministry of Housing and Urban-Rural Development in China which were released by the name of enterprises in building industry. In this provision, enterprises in building industry are defined as ones working on civil engineering, construction engineering, wiring, plumbing and equipment installation engineering, new construction, expansion or remodeling in decoration engineering. An enterprise in building industry is not a common name in engineering field, but engineering construction enterprises are applied more widely. At the same time, when understanding enterprises in building industry, it is easy for us to expand the range to engineering investigation design enterprises by intuition. This paper took the engineering construction enterprises as its objects of study in place of enterprises in

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\* *Corresponding author's* e-mail: wjweij@163.com

building industry.

(2) Technology management quality:

Technology management quality is a broad and ambiguous concept, but it works as the core capacity of construction enterprises. Construction enterprises have something in common with industries in other fields. Capacity of enterprises is usually embodied in several aspects, including production, technology, sales, management, and fund. It works as a whole, while the production, technology, management and sales are the parts. In terms of construction enterprises, their capacity is certainly embodied in exploiting market and contracting for engineering as well. However, their capability of exploiting market and production efficiency are determined by one of their core qualities, namely the capability of construction technology management. In this paper, the technology management level in construction enterprises was defined as the core professional quality which was internal in enterprises and the management level was determined by the project implementation.

(3) Engineering cost:

Engineering cost belongs to price category in nature. In market economy, different participants will have basically two kinds of understandings of engineering cost. Firstly, from the perspective of investors or owners, it means the anticipated or actual expenditure of all fixed investment and current asset investment in the construction of certain project [6]. Secondly, from the perspective of contractors, suppliers and designers, it means the trading price of projects, namely the price of projects. This paper, based on the second understanding, took the intersection between project owners and constructors as the starting point of studying the technology management of construction enterprises. Moreover, it rose that the engineering cost here means the actual cost in settlement of

projects in engineering construction.

**3 Rationality Evaluation of Enterprise Technology Management Based on Cost**

**A. FEATURES IN MANUFACTURE AND MANAGEMENT OF CONSTRUCTION ENTERPRISES**

Construction enterprises are a for-profit economic organization working on manufacture and management activities of material products. Building product with a distinction in their technology and economy, as their main products, determine that construction enterprises possess some features obvious in its manufacture and management manners. These features lie in the following two aspects. On the one hand, there are fixed building products and flexible construction. Building products are large in size, fixed in site and product, and frequency of pedestrian flow, which make construction enterprises fail to equip themselves with stable and fixed production environment. On the other hand, the diverse building products and comprehensive constructions lead to labor shortages for enterprises and lead to a construction with a wide range and too many variable factors.

Content of management in construction enterprises include production and operation management. Production management means to carry out management of production activities within enterprises. Operation management centers on operation and mainly consists of activities like market inquiry and forecast, operation policy and contracted projects which aim at leaving more benefits on enterprises and society. The basic procedure of construction enterprises in operation and production segments is shown in the figure 1.

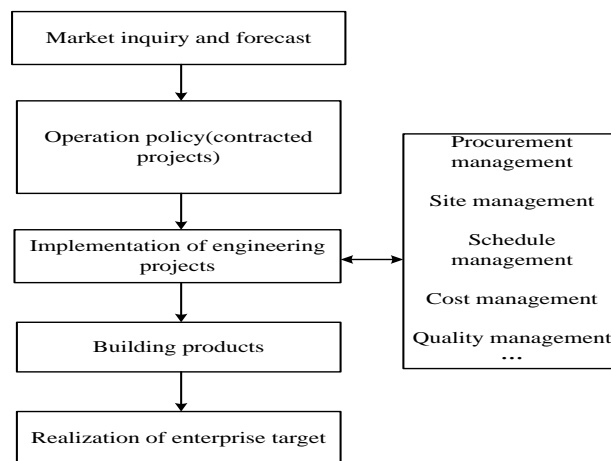


FIGURE 1 procedure of construction enterprises in operation and production segments

**B. ANALYSIS OF PERFORMANCE IN CONSTRUCTION PROJECTS**

The construction technology management in engineering construction enterprises requires to be proved by the performance in construction projects. The construction process in project will leave great profits and achievement

on enterprises. When making an assessment of construction technology management, it should start with the performance during the process of construction projects. Achievement and efficiency are collectively called the performance in Chinese, which covers the efficiency and structure in the activity of the assessing objects and emphasizes the relationship between the input

and output. A higher ratio between input and output achieves a high efficiency. While in market economy environment. All operation management activities focus on methods to reduce input and increase output, while maximizing the ratio between the input and output, namely the maximized performance. As for methods to achieve the maximized assessment of performance during the project construction, it can be analyzed with the help of Value Engineering Theory.

Value Engineering (VE in short), also called the Value Analysis (VA in short), aims to analyze the methods of applying the minimum cost of life cycle for a reliable realization of necessary functions of objects, like products, operation or service. Meanwhile, it is an organized idea or method of technology economy and a management technology devoting itself to the functional analysis [7]. In terms of construction enterprises, although the production process is simply one phase in the life cycle of building products, which does not go through the whole process of construction project products, from design to operation application and then further to the building out of service. However, it is still available for assessment and management of the production process and values, for there is always a cost and production value in every phase of the product formation, and there always remains a room for improving the efficiency.

### C. RELATIONSHIP BETWEEN THE PROJECTS COST AND ENTERPRISE CONSTRUCTION TECHNOLOGY MANAGEMENT

From the unique production from construction enterprises and the VE theory, it can safely conclude that the construction quality of engineering construction enterprises depends on the production value within projects, while the production value depends on the ratio between the function and consumed cost of products. Because of the low impact from construction on construction engineering products, cost level in construction projects turns into the core quota showing the enterprise production and management quality (construction quality).

Cost level of engineering projects is shown in the methods and strategies applied in cost management control for one thing, including formulating some rational cost plan and then strictly carrying it out in all segments of projects implementation for keeping the engineering cost within the limits. However, effects of implementation need to be taken for inspecting whether the cost management methods are advanced or not. For another, what can better reflect the cost management quality of engineering projects is the cost control effects in settlement after projects completion, whether the final cost is controlled within the target range and the target cost is of higher competency in this field.

## 4 Assessment Model for Enterprise Technology Management Based on Engineering Cost Index

Engineering cost is one of evidences assessing the rationality and benefits of investment. However, in term of enterprise management, engineering cost is also a criterion to weigh the construction enterprise technology

management and its operation achievements. On the one hand, the engineering cost index is in line with the dynamic changes of time, while the construction technology management quality in enterprise is also unfixed. On the other hand, it is simply a relative number and can only be found to be high or low by mutual comparison, so can the construction technology management quality in enterprise. Based on the above reasons, this paper introduced the engineering cost index theory in this industry and made some improvement as well so as to secure an enterprise engineering cost index model which is available for enterprise to make an annual assessment of the variation direction and degree of its construction technology management quality.

### A. BRIEF INTRODUCTION TO ENGINEERING COST INDEX

Index is simply a statistical data. From the perspective of economics, in a broad sense, all relative numbers formed by comparison between any two figures can be called the index. In a narrow sense, index is a particular relative number used to measure the general variation of multiple projects in different occasions. The difference between the index and average relative number lies in the following aspects. Average relative number is a ratio between the two related figures, while index can present the development of complex social economic phenomenon. Besides, index can analyze the impact of different components within this phenomenon. Engineering cost index is usually considered as a quota reflecting the impact from price changes on engineering cost in certain period. It also acts as the basis to adjust the spread in engineering cost.

### B. ENTERPRISE ENGINEERING COST INDEX

In terms of enterprises in construction industry, for the enterprise management and development always focus on raw materials, and construction market which applies the dynamic price change by manual or mechanic force, the final construction cost in every contracted project is not only determined by the internal enterprise management quality, and project implementation ability, but also determined by the outside market changes. Market changes on the one hand cover the investment in enterprise engineering construction, such as the price fluctuation of labor force, materials and machine-shift, and cover the supply and demand in the industry and the changes in competition environment on the other hand. In general, the outside world is hard to find basis in the vague engineering cost from any project which includes several variation factors. Therefore, we can refer to methods of compiling the engineering cost index in this industry (district). Based on the overall engineering cost index in this industry, we can separate the market change factors from the enterprise engineering cost so as to acquire the quota reflecting the dynamic variation tendency and degree of enterprise construction and production ability. From the above relations, by analyzing the components in engineering cost we can conclude that it covers cost, profits and taxes of engineering enterprises. The components of engineering cost are shown in the figure 2 in detail.

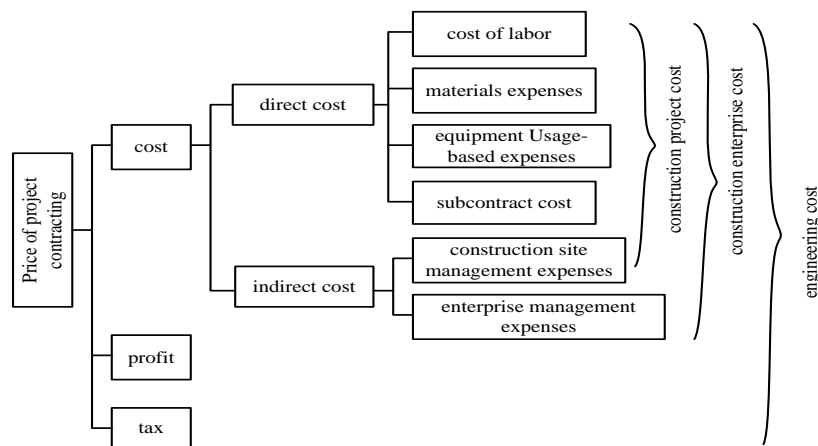


FIGURE 2 Components of engineering cost in construction enterprises

C. GENERATIVE MODEL OF ENTERPRISE ENGINEERING COST INDEX

The basic principle of enterprise engineering cost index is the same as the common index compilation, namely taking the ratio between the two prices in reporting period and base period as the variation degree. If we want to acquire the cost index reflecting the enterprise construction technology management quality, we are supposed to revise the influence from the abnormal constraint factors on engineering cost within the projects and put forward the fluctuation from the external economic and environmental factors. The final remaining parts are the enterprise engineering cost index reflecting the dynamic management quality for enterprises. The detailed steps are shown as follows:

(1) Ascertain the price index of expense of labor force, materials and machine-shifts in regional engineering construction

The price index of machine-shifts can refer to the experiences from Hongkong and overseas. This will not be considered for the present and assumed to be fixed. While for the expenses of labor force and materials, we should take an overall account of the main posts and the market price fluctuations of main materials in all professional engineering during the construction, set a rational weight and ascertain the labor force and material price index.

(2) Collect the assessment of cost data and basic data about the completed projects within the reporting period for the target enterprises

According to the need of compiling cost index and the principle of sustainable development, we can classify the engineering data from a horizontal and vertical or subjective and objective aspect when making a sound data analysis of a completed engineering for the convenience of latter collection, analysis and processing. In line with the above principles, a complete engineering data should cover the overview about engineering, construction standard (quality standard within schedule included), main materials quota, partitioned project cost quota, unit project cost quota and project total cost quota.

(3) Revise the engineering cost data based on the

completed projects quality standard and the ratio between profit and tax.

According to the construction quality standard from collected completed projects within the reporting period, we can apply the empirical coefficient between the quality standard and cost, in which the former is ascertained by the target influential factors within the sample projects. Moreover, we can apply the profits margin by dividing the external economic factors so as to revise the engineering cost data.

(4) Calculate the unit engineering cost index

We can calculate the cost index of unit quantities in partitioned project from the revised cost data. Besides, we can acquire a weighted unit project cost index according to the proportion of partitioned project in unit projects (acquired from the empirical data in unit project cost based on historical project).

(5) Revise external economic environment factors

We can carry out revision in external economic environment factors for the weighted unit engineering cost index. The methods taken are, based on the estimation of expenses of labor force, materials and the ratio between the profit and tax within, to make some reductions in their influence on the variation of unit project cost index.

Calculate based on the above steps; apply the link relative index which takes year as time unit. The formula of link relative about the enterprise unit project cost is shown as follows:

$$I(dw)_{i,k} = I'(dw)_{i,k} - (I_i^r - 100)\mu^r - (I_i^c - 100)\mu^c, \quad (1)$$

where  $I'(dw)_{i,k}$  means the link relative original for the cost index of unit k project in year NO.i. This index fails to get rid of the influence from variation factors in expenses of material and labor in the external economic environment.  $I_i^r, I_i^c$  means the price index of labor force and materials at year NO i respectively.  $\mu^r, \mu^c$  means the proportion of expenses of labor force and materials in unit project cost.

Calculation formula about  $I'(dw)_{i,k}$  is shown as follows:

$$I'(dw)_{i,k} = \sum_{j=1}^n I(fb)_{i,j} \mu_j, \quad (2)$$

where  $I(fb)_{i,j}$  means the partitioned project  $j(j=1,2,\dots,n)$  cost index for enterprises in year NO.  $i$  (index includes the price variation factors, like labor force and materials).  $\mu_j$  means the weights of partitioned project  $j(j=1,2,\dots,n)$  in unit project  $k$ .

Calculation formula about  $I(fb)_{i,j}$  is shown as follows;

$$I(fb)_{i,j} = \frac{p(fb)_{i,j}(1-\alpha_{i,z}-\beta_i-\theta)}{p(fb)_{i-1,j}(1-\alpha_{i-1,z}-\beta_{i-1}-\theta)} \times 100 \quad (3)$$

Where  $I(fb)_{i,j}, I(fb)_{i-1,j}$  means the cost of unit quantities of partitioned project in the year NO.  $i$  and NO.  $i-1$  for enterprises respectively.  $\alpha_{i,z}, \alpha_{i-1,z}$  means the empirical coefficient of influence from sample engineering on quality standards for enterprises in the year NO.  $i$  and NO.  $i-1$  respectively.  $\beta_i, \beta_{i-1}$  means the profits ratio for enterprises in the year NO.  $i$  and NO.  $i-1$  respectively.  $\theta$  means the ratio between profit and tax in engineering cost (when taxpayers are from local urban, town or rural areas, the comprehensive coefficient is 3.41%, 3.35% and 3.22% respectively).

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## 5 Conclusion

In term of engineering construction market, there still lies a huge room for improvement in the present market operation mechanism. In terms of the industry market management departments, the application of a rational method and system for assessing the technology management quality is beneficial to perfecting the government mechanism of market access in engineering construction industry. Besides, it also helps inhibit the law and regulations violations in bidding management, so as to maintain a sound competition tendency in construction market [9-11]. For those constructions enterprises who are devoted to improving their core competence and taking a leading role in the industry competition for a long-term, a rational assessment method and mechanism is able to encourage themselves to be more positive and active in enhancing their technology and management, and drive the whole industry to take part in the sound competition. Besides, it can also improve the quality of projects, save investment and optimize the resources allocation. This paper started with the present status and problems in engineering construction industry. Based on the conclusion of the study achievement we already have had, it discussed the methods for a rational assessment of engineering enterprises technology management quality. This method not only promotes the study on assessment in engineering field, but provides great assistance for the present industry management. In a word, it is of great practical significance.

## Authors



**Jing Wei, born 1973, Jiangsu Province of China**

**Current position, grades: lecturer**

**University studies: Master's degree was earned in major of constructional engineering, Hebei University of Engineering in 1995.**

**Scientific interest: engineering supervision**