

Study on Cost Management Method of Highway Construction under the "Internet + "Background

Xueli Zhu*

Shandong Management University Business School, Jinan, Shandong 250100, China

Abstract

To study the highway construction enterprises cost management method under the new "Internet +" background, the concept of "comprehensive project cost management" from the background of current cost research points out was pointed out firstly. Then, under the "Internet +" six advantages, the three aspects of project cost comprehensive management, namely, Project Whole Process Cost Management, Project Life Cycle Cost Management and Project All-round Cost Management, are studied respectively, and a new method for highway construction enterprises to carry out cost management under the "Internet +" background was provided. Finally, based on the new method, a successful cost management of a large highway construction project based on "Internet +" technology case is analyzed. The research results of this study can not only provide a theoretical basis for bridge construction enterprises to further reduce their own cost under "Internet +", but give reference for the promotion of "Internet +" in enterprises.

Keywords

"Internet +"; Road Engineering Cost; Cost Management; Comprehensive Management.

1. Introduction

As the basis of logistics and transportation industry, highway engineering is one of the important national economic development power sources. However, compared with other industries, highway engineering has four unique characteristics: large investment, long terms and wide areas, high quality requirements, complex outdoor working environment and many uncontrollable factors [1]. Among them, large investment is the focus of highway engineering investment enterprises [2].

Table 1. Completion Of Investment In Fixed Assets Of Highway And Waterway From Jan. To Nov. 2018

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov
Investment amount (ten thousand)	11741017	18221873	34134876	50250384	68080863	90658076	109930739	129610274	152901688	176378502	213351809
Increase (%)	162.0	113.8	111.7	108.7	104.9	101.0	100.0	99.0	99.5	99.9	100.4

As we all know, the development of highway construction is based on the country's high investment in infrastructure construction. Since the reform and opening up, China's economy has been developing at a high speed. Under this influence, as an important factor affecting the development, the highway has been fully valued and developed. As shown in Fig. 1, from 2013 to 2017, the annual investment growth basically exceeded 7%; although the overall growth rate of the national highway and waterway in 2018 slowed down, the total investment still exceeded 2.3 trillion yuan, with 86000 kilometers of newly opened roads, including 6000 kilometers of

expressways. This directly led to the further reduction of logistics cost. By the end of November 2018, the logistics cost was reduced by 88.4 billion yuan, exceeding the annual target [3].

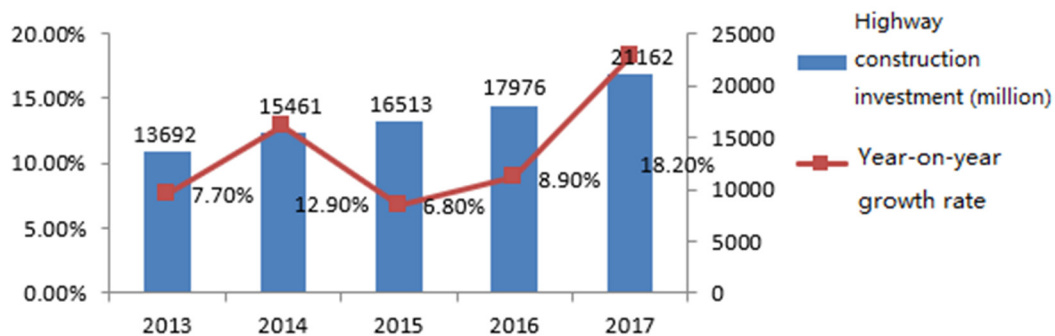


Fig 1. Total investment and growth rate of China's highway construction in 2013-2017

However, there are still many problems in the whole process of highway construction, especially in construction management. According to the Circular of The Transport Ministry General Office On the Supervision of The National Highway Construction Market in 2018, released by the central government network of the people's Republic of China in 2019, there are nine major problems in the road construction market in 2018, namely, construction procedures, bidding, contract performance, design change, subcontract management, quality and safety. On the one hand, the clearing of deposit and the payment of migrant workers' wages, the construction of credit system and the construction of rural roads. However, these nine aspects are directly related to the construction cost. Therefore, in the next step of highway construction, our government proposes to further intensify the information construction, innovate management mode and method, and give full play to the "Internet +" dynamic supervision and the advantage of big data supervision [4].

Therefore, the cost management of highway construction is of great significance:

On the one hand, from the perspective of highway construction enterprises, although the current national investment in highway construction continues to grow, but the growth of its construction cost is also quite amazing. The cost of expressways in 2005 has been more than twice that of the end of 1990s. This phenomenon directly causes the profits of construction enterprises to shrink, resulting in the gross profit rate of highway construction less than 10%, and even less than 3%.

On the other hand, from the perspective of investors, the highway construction investors in China are the government, and investment comes from tax income. Therefore, the investment should be fully applied to the public interest, without any waste.

As is known to all, "Internet +" has its inherent advantages in solving large volume and long cycle problems because of its cross border integration, innovation driven, reshaping structure, respect for human nature and open ecology, which the highway engineering construction also have. Therefore, it is particularly necessary to explore new ways of cost management in highway construction based on "Internet +" [5].

Based on this, this paper starts with the concept of overall project cost management, and combines three contents, namely, project whole process cost management, project life cycle cost management and project omnibearing cost management respectively, and explores a new type of highway construction cost management mode.

2. Overall Project Cost Management

Highway engineering project cost management refers to a series of management activities such as cost estimation, project budget preparation and project budget control carried out to ensure that the actual cost of highway construction does not exceed the project budget [6-8]. These management activities are directly affected by the nature of Highway Engineering Management: on the one hand, highway engineering management belongs to process management. The process can be generally divided into feasibility study and project approval, planning and design, construction application and bidding, construction and control, completion and acceptance, and delivery and use. In these stages, cost, construction period and quality are three main objectives throughout the whole process, which affect and interact with each other, and the change or adjustment of one goal will inevitably affect the other two aspects [9].

On the other hand, highway engineering management belongs to comprehensive management. Take Jinan Ring Expressway (including the Yellow River Bridge) planned to be built in Shandong Province in 2019 as an example, with a total length of 66km and an estimated total investment of 13 billion yuan. The total length of the road section is 66km, with an estimated total investment of 13 billion yuan. In the road section, it is proposed to set up 2 super major bridges, 6 major bridges, 4 medium bridges, 21 small bridges, 8 interchange, 24 separated flyovers, 121 channels, 100 culverts and 1 service area [10]. It can be seen that highway engineering has obvious characteristics of large scale and investment, long construction period, complex environment and many uncertain factors. In addition, the development of engineering technology and social needs should be considered in the management process. Therefore, it is very important to build a comprehensive multi-dimensional project management, especially the cost management system model.

Although as early as the Tang Dynasty and the Northern Song Dynasty, China has accumulated a certain amount of construction cost control methods, and put forward a series of management methods including quota management, it is still in recent decades that the cost management of road engineering has attracted full attention. With the continuous development of economy and the progress of construction technology, the characteristics of large volume and high investment of road engineering have been highlighted. This makes managers have to think about more efficient and comprehensive management methods. In this context, a comprehensive modern project cost management theory has been put forward.

The overall project cost management theory was first put forward by R.K. Westney, the former chairman of international comprehensive cost management promotion conference in 1991 [11], which content mainly includes three aspects, namely: project whole process cost management, project whole life cost management and project all-round cost management.

2.1. The Whole Process Cost Management

As shown in Fig. 2, the whole process cost management, also known as dynamic control management, mainly includes the project resource demand plan preparation, the project cost estimation preparation, the project cost benchmark budget preparation and the control of the project cost related activities. Its specific definition is to investigate the basis of project cost estimation rationality and allocate the estimation, function and object system of the project during the feasibility analysis and project approval stage, so as to form the budget benchmark; then, according to the budget benchmark, control and adjust the project implementation, so as to ensure that the project can obtain the maximum economic benefit with the lowest cost.

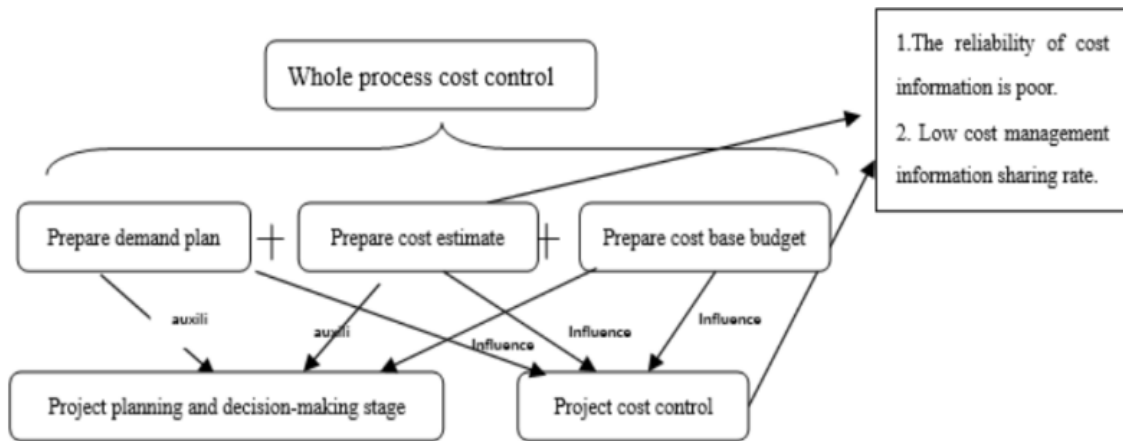


Fig 2. Contents and existing problems of cost management in the whole process of the project

However, with the continuous practice and exploration of cost management in the whole process of highway construction, more and more problems are presented [12-14], mainly reflected in the following two points:

Cost management information lags behind and reliability is poor. A lot of price information is needed in the preparation of cost estimation of highway project. However, in the current market, due to the backward mode of information acquisition system and the problems of regional difference, time difference and inability to effectively reflect the market price in real time, the guidance of cost estimation for the actual construction is not high.

Low cost management information sharing rate. Due to the great value of price related information, the information of cost management is not symmetrical to the construction unit and the owner unit in the project cost control, and there is a serious "Information Island" phenomenon. Companies would rather spend a lot of money to buy information from a third party organization than exchange information. Finally, a large number of engineering experience data are controlled by a few managers, which greatly restricts the effect of the whole process cost management.

2.2. Life Cycle Cost Management

The whole project life cycle refers to four stages, namely: decision-making stage, design stage, implementation stage and delivery use and maintenance stage. Generally speaking, the construction unit often takes the final accounts of construction and completion as the focus of investment control, and ignores the costs of design, use and maintenance and other stages, which often brings serious consequences [15-17]. For example, although the proportion of engineering design cost to the total project cost is generally 2% - 5%, its impact on the overall investment of the project will exceed 70%. It can be seen that the cost management of the whole life stage of the project is very important.

Project life-cycle cost management refers to the cost management of the whole project life cycle by the manager based on the principle of consumption in the whole process of project construction. In the current highway construction activities, although the life-cycle cost control and management has attracted the attention of investors, with the continuous in-depth application of the theory, the following problems continue to appear in front of managers to be solved:

(1) In the whole project life, some project managers are bound by the traditional management concept, which leads to the lack of awareness and attention to cost management. Therefore, the abnormal management situation of emphasizing progress but neglecting cost and emphasizing afterwards but neglecting beforehand will be formed.

(2) In the whole project life, although the manager considers the whole consumption, the procurement plan is not thorough, rigorous and does not fully analyze the market situation. Causes such as purchase overspending, improper material management, loss, deterioration and even loss of chaos.

(3) In the implementation stage of the highway project, to catch up with the construction period, most of the managers and constructors cannot carry out comprehensive road maintenance under the best maintenance time and conditions. In the use and maintenance stage, there is often no comprehensive summary of maintenance laws, strict implementation of highway maintenance specifications, road quality assessment. As a result, the average design life and service life of China's highways are far lower than those of developed countries such as the United States, which leads to waste of resources and costs.

2.3. Omnibearing Cost Management

The duration, cost and quality of highway project constitute its three major objective systems, which are independent and mutually restricted. Therefore, to achieve all the objectives of the project and the smooth completion of the project, investors must comprehensively and systematically coordinate all the relationships among the objectives (such as: coordination among the objectives of scope, duration, quality, risk, resources, capital, human resources, communication, etc.), and then observe and control the interaction between these objectives from a systematic perspective make it balanced to achieve the project system goals. This is the Omnibearing cost management.

This theory optimizes the cost management system of highway construction in our country at this stage, but there are still many problems in the practical application, and these problems can not be solved by the comprehensive cost management theory alone[18-19]. Therefore, it is very important to explore a new project cost management.

3. Highway Construction Cost Management based on the "Internet +"

From the introduction of the project comprehensive management theory and the analysis of the problems existing in the current highway cost management, it can be seen that when the traditional project comprehensive management theory is applied, most of the problems appear in the processing and transmission of information. Therefore, to further optimize the cost management of highway construction, it is necessary to do a good job in the information management of highway construction. Because Internet technology has inherent advantages in the process of transmitting and processing information, the combination of highway construction cost management and "Internet +" is particularly important.

3.1. Comprehensive Management Method of Highway Project based on "Internet +"

Based on this view, combined with the "Internet +" cross boundary integration, innovation driven, reshaping structure, respect for human nature, open ecology and linking everything, the construction cost information management strategy should include the following contents:

(1) Establish cost management database and demand system

No project is independent. To solve the problem of poor reliability and low sharing rate in the whole process management, a real-time and accurate cost management database based on "Internet +" must be built.

According to the system management theory, the key to establish cost management database is to establish a set of real-time and reliable content index, single index and material information index. Therefore, the database should contain the comprehensive data of the three core aspects of each highway project in different years, different construction stages, content, single side and

price. Through data mining technology, all kinds of data should be analyzed and refined to reflect the cost in real time, so as to truly realize the dynamic collection of cost and provide scientific basis for the management and regulation of construction enterprises.

On the other hand, to control the project cost and solve the problems of management system loopholes and confusion in the process of project life-cycle management, after the completion of the cost database, it is necessary to combine the logical relationship of the cost management business data based on the cost management database. Establish the business work standard system and the function classification system of cost management personnel, allocate the process of highway construction audit according to the management function and carry out the construction work.

(2) Establish the target system of highway construction cost information management

According to the theory of life cycle cost management, the cost management of highway engineering is divided into stages and levels. Therefore, cost management information must also be based on stages and levels, emphasizing the role of planning.

Specifically, when preparing the demand plan, the goal of cost information management should be made clear, that is, on the basis of meeting the construction period, quality and safety, the actual cost expenditure should be lower than the cost plan.

In the preparation of cost estimation and benchmark budget, from the perspective of cost management, combined with cost management database and demand system, the corresponding construction cost index, management personnel function system and information management system function configuration system should be established in each link of the construction process, so that the personnel, objectives and system can be decomposed and effectively completed layer by layer.

(3) Application and assessment of construction cost management information platform

Because in the process of overall management of project construction, cost information needs not only timely collection but also dynamic control, building up the application and assessment mode of construction cost management information platform based on the "Internet +" technology is of great significance for improving the construction cost management system. Combined with the project cost comprehensive management theory and the "Internet +" technology, the application and assessment of this platform should include:

Firstly, when using the construction cost management information platform to carry out cost management, it is necessary to reasonably configure the operation and maintenance personnel of the information platform, system operation training personnel, construction cost management business training personnel and other professional and technical personnel, and carry out data input, data output, report query, data analysis, data review and other management work.

Secondly, to ensure the effectiveness of cost management and information system application, enterprises need to develop a management and information system application assessment system that links project construction cost management profit and loss with employee performance, and gradually implement the application of cost management and information system through assessment.

Thirdly, establish supervision and assessment system and conduct supervision and assessment on a monthly or quarterly basis to grasp the management of project construction cost in real time. Strictly implement the regulations of management measures, realize the performance of employees, reward the excellent and punish the inferior.

Finally, analyze the profit and loss of the project on a monthly basis, find out the reasons for the loss and propose corrective measures. Put an end to bad management in time, accumulate profit experience and promote excellent management experience.

3.2. Case Analysis

A road and Bridge Group is a famous large state-owned enterprise. Founded in the late 1990s, it is mainly engaged in the construction of high-grade roads, bridges, municipal engineering, ports, airports and other large-scale infrastructure projects at home and abroad, and has special qualification for general contracting of highway engineering construction.

However, with the increasingly fierce competition in the construction industry, more and more of them are exposed within the group, mainly reflected in the following aspects:

(1) The company can't grasp the first-hand information of real-time business timely, quickly and accurately; all kinds of cost information are mixed, and can't effectively select high value information.

(2) It is difficult for leaders at all levels of the company to grasp the specific situation of the project in each phase and make correct decisions.

(3) The internal communication among all levels of the company is inefficient, and the information among all departments can not be shared, resulting in the overall efficiency of the enterprise is not high.

By analyzing these three main contradictions, It can be found that the problems are focused on information processing, transmission and management. To solve these problems, "three steps" must be completed:

(1) Based on the traditional total cost management theory, combining the inherent advantages of "Internet +" technology in the process of transmitting and processing information, A new network management mode and a classification cost management database should be established to solve the problem of information mixing and poor reliability.

(2) To solve the problem of decision-making difficulties, the "Internet +" must be taken as the basis, and elaborate the detailed stages of the project, and formulate the target system for supporting the highway construction cost information management. Plan oriented, cost control as the core, accurate cost planning, control, accounting, analysis and assessment.

(3) To solve the problem of communication difficulties in company, an effective cost management information platform must also be established. Through the platform, the headquarters, functional departments, division companies, customers and even company employees are connected together to realize the overall sharing of enterprise information and resources, so that the enterprise can achieve twice the result with half the effort in the cost management of highway construction.

4. Conclusion

To study the new method of highway construction cost management under the background of "Internet +", based on the basic theory and method of project cost comprehensive management, this paper expounds three aspects, namely, the whole process cost management, the whole life cost management and the omnibearing cost management, and analyzes the main problem of the current cost management is the cost information management. Finally, the paper puts forward corresponding countermeasures according to the "Internet +", and analyzes the specific cases, and conclusions are drawn as follows:

(1) In the whole life cycle of highway construction, managers should build a real-time and accurate cost management database based on the "Internet +", help complete the effective collection of project cost management data, and establish the cost management information demand system based on the logical relationship of cost management business data.

(2) In the decision-making stage of the project, the manager shall divide the project into different levels and stages, and make the general plan of information management of highway construction cost and the general objective of cost management, so as to ensure that the general

objective of cost can be correctly and effectively decomposed under the general plan of information management.

(3) In the whole process of highway construction, managers should build effective information platform for construction cost management based on the "Internet +" , improve staff assessment, and analyze and analyze the project profit and loss in real time, so as to adjust and summarize experience and lessons in time.

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