

# Analysis of the Current Situation of Cost Management and Control of Highway Construction Projects

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**Abstract:** The highway engineering process is complex, coupled with a relatively long construction period, hence requires increased coordination between participating units to prevent economic disputes and efficiency losses. The main body of the construction project needs to strengthen the management and control of funds. In this regard, this paper analyzes the importance of cost management in highway projects by clarifying and analyzing the current cost management status quo problems and causes. The highway engineering cost control strategy and implementation methods are summarized to provide references for improving the quality of highway engineering.

**Keywords:** Highway engineering; Cost management; Management status; Cost control

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## 1. Introduction

Cost management is the key component of the construction management of engineering projects. The staff must consider the construction characteristics of engineering projects, the cost control issues for the overall deployment, and strengthen the problems of over-budget in advance to prevent and cope with the processing, all to ensure that the construction of engineering projects benefits from the loss of impact<sup>[1]</sup>. Highway engineering projects are large-scale and the risk of cost control faced is relatively large. To avoid the excessive loss of benefits, relevant personnel need to combine the construction characteristics of highway engineering projects, based on the whole life cycle perspective to strengthen the cost control of the various stages to effectively enhance the cost management of highway engineering projects.

## 2. Analysis of the importance of the implementation of highway project cost management

As construction management is the core of a construction project, the personnel involved must be based on the whole

life cycle perspective of the construction project, and take the initiative from the investment decision, bidding, design, construction, completion, and other important stages to control the use of funds within the fluctuation range, that is, within the approved investment limit, to avoid over-budgeting and other problems that may affect the efficiency of the project <sup>[2]</sup>. Once the problem of over-budgeting occurs, the deviation must be corrected promptly. Through in-depth analysis of the specific causes, scientific and reasonable measures can be implemented to prevent adjustments, ensure the smooth realization of the investment objectives of the construction project, and ensure that all types of resources can be optimally configured to achieve the expected return on investment <sup>[3]</sup>.

Based on the control principle, the project cost management needs to actively implement dynamic control of funds for the construction stages. During the control period, it is necessary to implement the control concept, focusing on the project feasibility study stage, preliminary design stage, project construction stage, and other important stages involved for detailed analysis and control. The project feasibility study report stage needs to be strengthened for the investment estimation of the problem of high attention, and the project construction stage needs to be strengthened for the project settlement problem, all to avoid the loss of benefits <sup>[4]</sup>.

Overall, the standardization of highway project cost management can achieve the goal of optimizing benefits, through the early prevention of over-budgeting and related benefit losses to ensure that highway project cost management is always stable. In this regard, the relevant staff should strengthen cost management through integrated planning and timely prevention of cost risks.

### **3. Analysis of the current situation and causes of cost management of highway projects**

The cost management concept is evolving backward with low management efficiency. However, it is still adopted by some, where it ignores the relevance of cost management in each construction stage, lacks awareness of the whole process of cost control, and does not adopt new methods and theories to transform and upgrade the traditional cost management system, which ultimately leads to the poor cost management efficiency and economic losses <sup>[5]</sup>.

Cost personnel do not realize the relevance of contract management and cost management and lack attention to the details of contract management, resulting in a lack of basic support for cost management work and is prone to over-budgeting problems. Furthermore, the implementation of the basic content of cost management is not standardized, such as the estimation index and budget quota are not combined with the actual situation, thus being unable to provide the basis for subsequent cost management. There is also insufficient pre-construction investment control that could easily lead to over-budgeting problems. Lastly, the ability and quality of cost personnel need to be improved. Some practitioners have limited professional ability and lack attention to cost management details, resulting in the cost management level not meeting expectations.

### **4. Analysis of cost control strategies and implementation methods for highway projects**

#### **4.1. Technology-enabled cost control management and realize the whole life cycle cost control**

By utilizing Building Information Modeling (BIM) technology, three-dimensional (3D) modeling and other modern information technology can be obtained on all types of engineering information to fully integrate it into modeling processing <sup>[6]</sup>. After a series of integrations, the BIM model can present the real highway project as a 3D model. Operators can use the simulation, synergy, virtualization, and other functional advantages of the

BIM model to create, simulate, and analyze the highway construction process, identify risk issues in advance, and strengthen the whole life cycle control of the project cost.

#### **4.1.1. Pre-investment decision-making**

Relying too much on experience to carry out investment estimation work is usually difficult to ensure the accuracy of the results, which is not conducive to promoting the smooth implementation of subsequent construction work. By relying on the BIM model database system, cost estimators can integrate the data information in the application system for in-depth comparison such as comparing and analyzing the market price of raw materials, machinery prices, and other data, to scientifically complete the research and analysis of estimation indicators. During this period, the cost personnel can also take advantage of the simulation function of the BIM model to accurately compare and analyze the different types of investment decision-making programs. The advantages and disadvantages of the different programs are then clarified in real time and the best investment decision-making program is selected for application <sup>[7]</sup>.

#### **4.1.2. Bidding stage**

Due to the relatively large volume of highway engineering projects, coupled with the complicated construction process, it is easy to lose a significant number of items during the preparation stage. The creation of a BIM model allows for a comprehensive analysis of bidding projects. This process involves integrating the BIM model with pricing standards to carry out accurate and high-quality quotation calculations. Simultaneously, the BIM model can intuitively analyze and calculate the highway's monolithic structure and the overall number of projects to prevent the problem of imprecise data calculation, which may trigger a series of negative impacts such as over-budget <sup>[8]</sup>.

#### **4.1.3. Design link stage**

Created using the BIM model, this approach helps cost personnel obtain basic data information for highway engineering in advance, enabling scientific optimization work following standard design limits. During the design optimization period, the cost of each project unit can be accurately checked and analyzed, combined with the analysis of the overall design program for overall optimization, to improve the feasibility of the design. Additionally, the optimization of the preparation of construction drawings can take advantage of the synergistic function of the BIM model to promote the cooperation of various professional work, make improvements on a unified platform, highly implement the budgeting content of the construction drawings, and reduce the possibility of subsequent design changes.

#### **4.1.4. Construction stage**

The visualization function of the BIM model can be used to simulate and analyze the process involved in each construction stage of the project in advance and identify the possible risks. During this period, the designers and constructors should combine the data resources acquired through the BIM model to complete the data and information sharing and collaborative communication and conduct appropriate discussions and modifications for the construction program to prevent design changes during formal construction.

During the formal construction stage, the cost staff can use the real-time statistical analysis function of the BIM model to comprehensively analyze the consumption of raw materials and the use of equipment, and reasonably allocate the use of resources to prevent wastage and other issues that may affect construction costs. It is worth noting that if the construction phase encounters design changes, in addition to the need for timely communication with the design team, it is also necessary to update the data in the BIM model, so as not to

affect the progress of subsequent construction <sup>[9]</sup>.

#### **4.1.5. Completion stage**

The completion stage using BIM modeling can be integrated to obtain data during the construction phase and other relevant information. By having comprehensive access to cost information and related data, the accuracy of the completion of the project can be guaranteed. Concurrently, the cost audit period can also be accessed from the BIM model database, and through automatic comparison and analysis, relevant personnel can effectively master cost control.

### **4.2. Strengthen the comprehensive control of the contract implementation process and improve the level of cost control**

Highway project capital investment is a large and relatively long construction process, where the construction phase needs to revolve around the contract terms and conditions of the agreed content to prevent delays or economic losses. Hence, the implementation of a contract management for ensuring highway engineering economic efficiency and quality enhancement is crucial. Most importantly, the cost control of the construction process is a key component. Therefore, after the completion of the contract, the contract management personnel need to facilitate the whole process of supervision and management for the implementation of the contract following the dynamic monitoring method. Once any party violates the contract, relevant personnel are responsible for correcting any wrongdoings to avoid affecting the realization of the target cost objectives <sup>[10]</sup>.

Managers should also apply the implementation of contracts for the whole process of supervision. For example, for the construction phase, meeting minutes and other important information must be collected and organized. It should be noted that the project site can be easily influenced by many factors and design changes. For design changes, managers need to reasonably adjust the project price according to the contract provisions. If the changes required exceed the original budget, a requote is needed, followed by a series of rigorous reviews, before full implementation.

Furthermore, the contract management should ensure that the project settlement method is scientific and feasible to confirm the accuracy, focusing on the construction phase by carefully reviewing problems and timely checking for defects and omissions. This is to ensure the authenticity and reliability of the settlement results. Throughout the process, a special pricing rectification group can be set up to correct and deal with unreasonable pricing terms or incomplete content and prevent the two responsible parties from economic disputes.

### **4.3. Attention to cost management foundation work to strengthen the quality of fine cost control**

The responsibility of project cost management is to strengthen the quality of cost control measures. In the management period, the staff must understand the basic content of project cost management to be implemented. On the one hand, the actual situation of the highway project should be considered when establishing the estimation index and budget quota. On the other hand, the cost personnel can use information technology to establish the material price and regularly release relevant cost information to facilitate cost control. It should be noted that the cost personnel need to fully integrate and objectively analyze the historical cost information to provide basic data for cost management.

### **4.4. Strengthen project pre-construction investment control and reduce over-budget problems**

Implementation of the pre-construction investment control work is crucial to reduce over-budget problems. In

practice, the staff needs to focus on the review of construction drawings and optimize them. Before the formal construction, the construction drawings can help deal with unreasonable problems for timely rectification to avoid subsequent design changes and other impacts that may affect cost. During the construction bidding stage, we must select a good credit bidding agency to complete a series of control management work such as the preparation of bidding documents.

Bidding documents can be regarded as an important basis for highway engineering project construction bids and also in guiding bidding unit decisions, bearing significant impact. Moreover, managers must analyze the construction organization design program throughout the entire process to determine its feasibility. It should be noted that during the whole process, the supervision unit is responsible for facilitating supervision and management functions, strengthening the quality of the project construction, and the progress of strict control, to ensure that all costs are controlled within the expected range.

#### **4.5. Improve the professional ability of practitioners, and steadily improve the level of cost control and management**

Many people are involved in the highway construction project. Coupled with the high degree of complexity of the construction technology process, it results in higher project cost management difficulty than conventional projects. To strengthen the centralized control of the overall cost of highway projects and reduce the problem of efficiency losses, cost practitioners must strive to improve their professionalism. Among them, cost personnel need to establish a standardized cost management system from the project feasibility study stage to the completion stage. Strengthening the communication and coordination with other departments involved in the cost management promptly can control the cost of construction within a reasonable range. Simultaneously, the staff must have the theoretical and practical ability to skillfully apply professional knowledge to complete all kinds of cost control work. During the control period, the cost personnel can combine the content of the construction contract terms, construction changes, and many more to accurately account for the amount of work, timely detection of errors, and strengthen the control, to avoid the problem of efficiency losses.

### **5. Conclusion**

The highway project cost management needs to adapt from the traditional sloppy management mode by adhering to the new concept and adopting new technology to establish high-quality cost management work. This is to ensure the cost management of highway project benefits is not impacted. Concurrently, the relevant personnel engaged in cost management must strengthen the individual cost control consciousness and strictly follow the contract content of cost control points to prevent over-budget and other economic risks. The staff must also establish the correct cost management behaviors, combined with experience and lessons learned to make up for any shortcomings. It is better to expand the staff's knowledge and enrich their theoretical and practical experience, all of which can better help smoothen the project cost management work to carry out high-quality construction work.

### **Disclosure statement**

The author declares no conflict of interest.

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