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Research on Optimization of Engineering Construction Decision Based on Logistics Integration Concept

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Abstract: With the development of engineering management theory and intensification of industry competition, investment decision-making in engineering projects has become increasingly important. In order to improve the economic and social benefits of engineering projects, decision makers need to optimize investment and design schemes during the feasibility study and design stages of the project. Logistics integrated management, as an important engineering project management method, can improve the overall management level of engineering projects and provide better support and guidance for decision makers. Based on logistics integrated management, combined with life cycle cost management, significant cost management, etc., this article discusses the optimization of engineering decision-making, proposes corresponding engineering cost estimation models, and conducts case application research to better serve engineering education reform and practice optimization.

Keywords: Life cycle cost; Logistics integrated management; Significance theory; Decision optimization

Introduction

1. Definition

Life Cycle Cost

Life cycle cost management (WLC) is a theory and method system of project cost management that is in line with international standards. In the 1970s and 1980s, scholars and practitioners in the engineering cost field in the United Kingdom and the United States pioneered the concept of life cycle cost management and conducted in-depth research. In foreign countries, organizations such as the Royal Institution of Chartered Surveyors and the American Institute of Architects have promoted the further development of life cycle cost management and formed a relatively complete theoretical system. This system uses interdisciplinary and multiple methods, focusing on investment cost, benefit analysis and evaluation, and plays an important role in seeking management theories that minimize the total cost in the future operation and maintenance stage. By the 1990s, the life cycle cost management system gradually became standardized and attracted attention to technology and application. This includes risk and uncertainty factors, practical application areas, life cycle cost calculation software, and integrated research on life cycle cost and environmental impact. Currently, life cycle cost estimation and management control technology has been widely applied in the field of engineering construction at home and abroad, such as residential, railway, tunnel, water conservancy, and medical industries.

2. Challenges

2.1 Current Issues

In the construction of landscaping projects for H units in northern China, the lack of reasonable cost evaluation and implementation plans has resulted in significant deviations between project budgets and actual implementation, as well as extensive management and resource losses during the actual implementation process. Therefore, it is necessary to refine the bill of quantities, clarify the construction content and unit costs, and optimize the overall construction plan in combination with later maintenance costs to reduce the total cost within the life cycle of the project. At the same time, an effective method model should be formed to guide specific engineering practices and subsequent project development.

2.2 Research objectives

(1) Establishing a significant cost item application model: By studying the bill of quantities, the importance of significant cost items in optimizing investment design schemes was determined, and corresponding application models were established to provide scientific guidance for optimizing engineering projects [26-27].

(2) Introduction of ILS technology: The integration of logistics technology into landscaping projects has been comprehensively verified through case studies, which has demonstrated the role of ILS technology in optimizing life-cycle costs.

(3) Considering the full life cycle content: Considering the design, construction, operation, and other aspects, determine the optimal investment and design strategies to improve the reliability and maintainability of the engineering project.

(4) Analyzing the improvement effect: Optimizing the investment design plan for significant cost items, quantifying the implementation content, and evaluating it.

3. Model Construction

Construction of similar engineering database

Due to the wide range of construction content in landscaping projects, for ease of analysis, this article takes subgrade construction in landscaping projects as an example to explore. Through network dataThrough mining and other methods, 55 effective cases were collected. Based on the analysis of the main body of the engineering content, the features were quantified, as shown in Table 3-1.

Table 3-1 Quantitative Evaluation Table

Project type	quantification of type characteristics			
	1	2	3	4
Subgrade wet and dry type	dry up	moderate humidity	moist	too wet
Special subgrade	Yes, it is.	No.		
Subgrade fill type	gravel	sand, sands	silt	clay
Construction method	mechanical construction	artificial		

4. Case Practice

4.1 Price analysis of different schemes

Based on the two scenarios constructed in the previous section, combined with the significant factors of the WLC, it is concluded thatSubgrade slope protectionThe cost content under different schemes is shown in Table 4-1.

Table 4-1 Subgrade Slope Protection Scheme

Subgrade slope protection scheme	Construction cost/yuan	Replacement cost/yuan	Planned preventive maintenance cost/yuan	Reliability maintenance cost/yuan	Operating cost/yuan	Total life cycle cost/yuan	Row. The order
Mortar rubble slope protection	3201	0	1012	1068	584	5865	2
Concrete protection	2679	0	795	1028	764	5266	1

Based on the above analysis, it can be similarly concluded thatSubgrade excavationThe costs of different options for subgrade filling and soft foundation treatment are shown in Tables 4-2.

Table 4-2 Subgrade Excavation Scheme

Selection plan for subgrade excavation	Construction cost/yuan	Replacement cost/yuan	Planned preventive maintenance cost/yuan	Reliability maintenance cost/yuan	Operating cost/yuan	Total life cycle cost/yuan	Sorting
Horizontal excavation method	2985	0	0	1564	1698	6247	3
vertical excavation method	3264	0	0	968	1023	5255	2
mixed excavation method	3068	0	0	1054	1078	5200	1

4.2 Research results

Comprehensive data analysis can obtain the initial WLC of each significant factor and the optimal alternative solution after applying ILS technology. The comparison between the initial solution and the alternative solution is shown in Table 4-3.

The total life cycle cost of the initial plan is: 6246+2253+5024+5865=19388 yuan/km.

The total life cycle cost of the alternative plan is: 5201+2079+4625+5267=17172 yuan/km.

Table 4-3 Price Analysis of Subgrade Scheme

WLC	Subgrade excavation	Subgrade filling	Soft foundation treatment	slope protection	Subtotal
Initial plan WLC	6247	2253	5023	5865	19388
Alternative Solution WLC	5200	2079	4624	5266	17172
Reduction rate of WLC (%)	16.8%	8.4%	8%	10.2%	11.39%

Through the study of this case, it can be found that selecting a small number of significant factors and conducting more detailed analysis on the alternative options for these factors can reduce the total life cycle cost (WLC) of the engineering project while meeting the performance requirements for construction and operation. At the same time, the degree of savings in the WLC is affected by factors such as the alternative options, the life cycle of the project, and the discount rate.

In this case, the decision optimization of logistics integration management for the design scheme of significant cost items includes the following paths:

(1) The mixed excavation method is adopted for subgrade excavation, which can effectively reduce the cost of excavation works. (2) The layered filling method is selected for subgrade filling, which can better control the quality and thickness of the filling layers, thereby reducing the cost of the filling project. (3) The replacement and improvement method is used for soft foundation treatment, which can improve the bearing capacity of the subgrade, reduce the demand for auxiliary structures, and save costs. (4) Concrete protection is used for slope protection, which can provide better stability and durability, reducing the cost of later maintenance and repair.

After optimization, the unit cost of the significant cost items in the project decreased by 2,231 yuan/km, with a decrease of 11.52%. At the same time, the unit cost of the whole life cycle also decreased from 23,760 yuan/km in the initial plan to 21,040 yuan/km, with a decrease of 2,720 yuan/km, with a decrease of 11.39%.

These results suggest that by selecting appropriate optimization schemes, the cost of engineering projects can be reduced without compromising construction and operational performance requirements. However, it is important to note that the selection of optimization schemes should consider factors such as alternative options, the life cycle of the project, and discount rates to ensure that the final selected scheme is feasible and maximizes economic benefits.

5. Conclusion

This article takes the bill of quantities of the landscaping project of H unit as the research object, verifies the application of the significance theory in engineering projects, and establishes a simplified significant cost project model to ensure the accuracy of the model. At the same time, the logistics integration technology is introduced, and its role in the optimization of life cycle cost is comprehensively verified through practical case analysis. The main results and conclusions include:

(1) Established a significant cost project application model and clarified the focus of investment design optimization.

(2) Detailed introduction of the process of determining optimal investment and design strategies using ILS technology, as well as the application path of FMEA and RCM technology.

(3) Optimizing the investment design scheme for significant cost items through ILS technology has improved the decision-making optimization level of the scheme.

However, due to limitations in historical engineering case references and bill of quantities, only one type of engineering was selected for research, and the significance theory was only validated from the perspective of the construction period. At the same time, only qualitative research methods were used, which had certain limitations and biases in analysis.

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