Whole-process Cost Management of Green Building Projects

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Abstract. Carrying out full-process management of green building projects is of positive significance to effectively control project costs and help enterprises improve economic benefits. The article studies this. First, a scientific and accurate index evaluation system is established to evaluate cost management from the five stages of decision-making, design, bidding, construction, and completion. Secondly, the entropy weight method and fuzzy evaluation method are used to evaluate, and finally based on examples , obtain the evaluation results of the evaluation system and perform corresponding analysis to prove the accuracy of the proposed evaluation system and provide a reference for the national cost management of green building engineering projects.

Keywords: Green building; whole-process cost management; entropy weight method; fuzzy evaluation method

1 Introduction

As the State Council issued the "Opinions on Completely, Accurately and Comprehensively Implementing the New Development Concept and Doing a Good Job in Carbon Peaking and Carbon Neutralization", it was pointed out that the comprehensive green transformation of economic and social development should be the guide, and energy green and low-carbon development should be the key. Take a green, low-carbon, high-quality development path [1]. Investment in green buildings has been increased and significant results have been achieved [2]. However, to achieve sustainable development of green building projects, the project cost must be controlled throughout the entire process, which is of great significance for promoting the harmonious development of man and nature and improving social and economic benefits.

Domestic and foreign experts have conducted a lot of research on the whole-process cost management and control of green building project projects. Literature [3] explores the cost management process of the project in the decision-making stage, and lists the overall complexity of the project, the hardware conditions of the project site and other influencing factors. . Literature [4] proposed the TOPSIS model to complete the cost management in the green building management evaluation process. Literature [5] proposed the influencing factors of the whole process cost management of construction

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projects and gave suggestions. Literature [6] discusses the whole-process cost management in order to dynamically and effectively control the project cost. Literature [7] proposed that the investment decision-making stage is the source of cost management control of green building projects, and pointed out the factors affecting the accuracy of project investment estimates in the decision-making stage.

In summary, this article first establishes a scientific and accurate index evaluation system to evaluate cost management from the five stages of decision-making, design, bidding, construction, and completion. Secondly, the entropy weight method and fuzzy evaluation method are used to evaluate, and finally based on examples , obtain the evaluation results of the evaluation system and conduct .

2 An Overview of Green Building Projects and Whole-process Cost Management

2.1 Green Building Concepts and Characteristics

Green building refers to saving resources (energy saving, land saving, water saving, material saving), protecting the environment and reducing pollution to the greatest extent during the whole life cycle of the building, providing people with healthy, suitable and efficient space for use, in harmony with nature. A building of harmonious symbiosis. The "green" in the so-called "green building" does not mean green roofs or gardens in the general sense, but represents a symbol, which means that the building is harmless to the environment, can make full use of environmental natural resources, and does not destroy the basic ecological balance of the environment. A kind of building constructed can also be called sustainable development building, ecological building, energy-saving and environmentally friendly building, etc.

Green buildings mainly have the following characteristics: on the basis of safe construction, they make the lives of residents healthier and more comfortable and the living environment greener; they use land resources and other natural resources sparingly and pay attention to the harmonious coexistence of man and nature; the whole life cycle of the building management. Achieve harmonious symbiosis between humans and nature and promote sustainable development.

2.2 Current Status of Green Building Development

Since the release of the "dual carbon" policy, building green and low-carbon buildings and reducing carbon emissions throughout the building's life cycle have been an important step. According to data from the Ministry of Housing and Urban-Rural Development, the area of new green buildings in China has accounted for more than 90% of the area of new buildings. The area of new green buildings nationwide has increased from 4 million cubic meters to more than 2 billion cubic meters. By 2025, all new buildings in cities and towns will be Green buildings, building energy efficiency has been steadily improved, and a green, low-carbon, and circular construction and development model has been basically formed.

2.3 Whole Process Cost Management

Whole-process cost management is an emerging cost management model that integrates cost management ideas into the entire life cycle of construction projects. It divides construction projects into stages such as decision-making, design, bidding, construction, and acceptance, and combines each stage. The construction characteristics of the construction project subdivide the cost management resources, prices and other cost management lists, carry out targeted management work, and achieve systematic management from bottom to top.

Implementing full-process cost management for green building projects will help build a systematic cost management system, which not only improves green building projects. The cost management at each stage of the project is targeted, and multiple parts are organically integrated into a whole to maximize the cost management effect of green building projects.

3 Basic Theory

3.1 Entropy Weight Method

The entropy weight method calculates the entropy value based on the degree of variation of each influencing factor index, calculates the weight based on the entropy value, and continuously corrects the weight. It is an objective evaluation method. The size of the entropy value is inversely proportional to the degree of indicator variation and the factors included. The steps of the entropy weight method are as follows:

(1) Establish an initial matrix, evaluation object Pi (i=1,2,…,m) and evaluation index Qj (j=1,2,…,n). The value of Pi under the indicator Qj is Gij, then the initial The matrix G is as follows:

$$G = \begin{bmatrix} g_{11} & g_{12} & \wedge & g_{1n} \\ g_{21} & g_{22} & \wedge & g_{2n} \\ G & G & O & G \\ g_{m1} & g_{m2} & \wedge & g_{mn} \end{bmatrix}_{m\times n} \tag{1}$$

(2) Standardize the above initial matrix using the critical value method to obtain the matrix Vij.

$$Vij = \frac{gij - \min(gj)}{\max(gj) - \min(gj)} \tag{2}$$

(3)Calculate the proportion Lij of the index value of the i-th evaluation object corresponding to the j-th impact indicator.

$$Lij = \frac{Vij}{\sum_{i=1}^{m} Vij} \tag{3}$$

(4) Calculate the entropy value ej of the jth indicator.

$$ej = -\frac{1}{\log m}\sum_{i=1}^{m} Lij \log Lij \tag{4}$$

(5) Introduce the difference coefficient dj, dj=1-ej. The larger the dj, the greater the difference and the greater the information contained, the greater the weight Wj should be given.

$$Wj = \frac{dj}{\sum_{j=1}^{n} dj} \tag{5}$$

3.2 Fuzzy Comprehensive Evaluation Method

This article uses the fuzzy comprehensive evaluation method. In the process of selecting appropriate evaluation criteria, 15 experts were invited to evaluate the scores according to their levels, as shown in Table 1.

Table 1. Evaluation criteria

grade	standard	illustrate
excellent	0.8~1	feasible
good	0.6~0.6	generally
middle	0.3~0.6	uncertain
Difference	0~0.3	Not feasible

Experts conduct a comprehensive evaluation of each indicator factor of the green building project whole-process cost management evaluation model to form a relationship matrix R.

$$R = \begin{bmatrix} r_{11} & r_{12} & r_{13} & r_{14} \\ r_{21} & r_{22} & r_{23} & r_{24} \\ r_{31} & r_{32} & r_{33} & r_{34} \\ r_{41} & r_{42} & r_{43} & r_{44} \end{bmatrix} \tag{6}$$

The final fuzzy evaluation matrix D is obtained using Formula 11, where "" represents the fuzzy operator. Comprehensive evaluation results of four levels in the distribution automation system indicators can be obtained.

$$D = w \cdot R \tag{7}$$

4 Green Building Project Whole-process Cost Management Evaluation System

The whole-process cost management evaluation system for green building engineering projects established in this article is as follows: The decision-making stage is divided into five specific factors, including: construction scale, construction area and construction location, technical plan, equipment plan, engineering plan and environmental protection measures. The design stage is divided into three specific factors, including: overall layout design, process design and construction standards. The bidding stage is divided into six specific factors, including: total investment environment, project conditions, industry environment and preparation level, construction market supply and demand, and owner requirements.The construction stage is divided into 5 specific factors, including: labor management, construction site management materials, use of mechanical equipment, project visas and design changes, quality and progress. The completion stage is divided into 4 specific factors, including: material price adjustment, project claims, project changes, and completion settlement review management,the details are shown in Fig 1.

5 Case Analysis

This article takes a certain engineering construction project in Lanzhou City as an example to conduct research, with a total of 5 26-story residential buildings.

First, the entropy weight method is used to determine the weight of the evaluation indicators, and a survey is conducted with project managers, technical and economic managers and other construction industry practitioners as objects, and the survey is conducted in the form of a questionnaire and summarized. The total hierarchical ranking calculated according to equations (1) to (5) is w0=[0.217,0.074,0.128,0.26,0.074,0.22,0.175]. Then calculate the weight index of each sub-item. w1=[0.2030.207,0.194,0.198,0.0198], w2=[0.344,0.328,0.328], w3=[0.165,0.162,0.169,0.173,0.165,0.165], w4=[0.205,0.21,0.192,0.19 2 ,0.201], w5=[0.25,0.244,0.25,0.256].

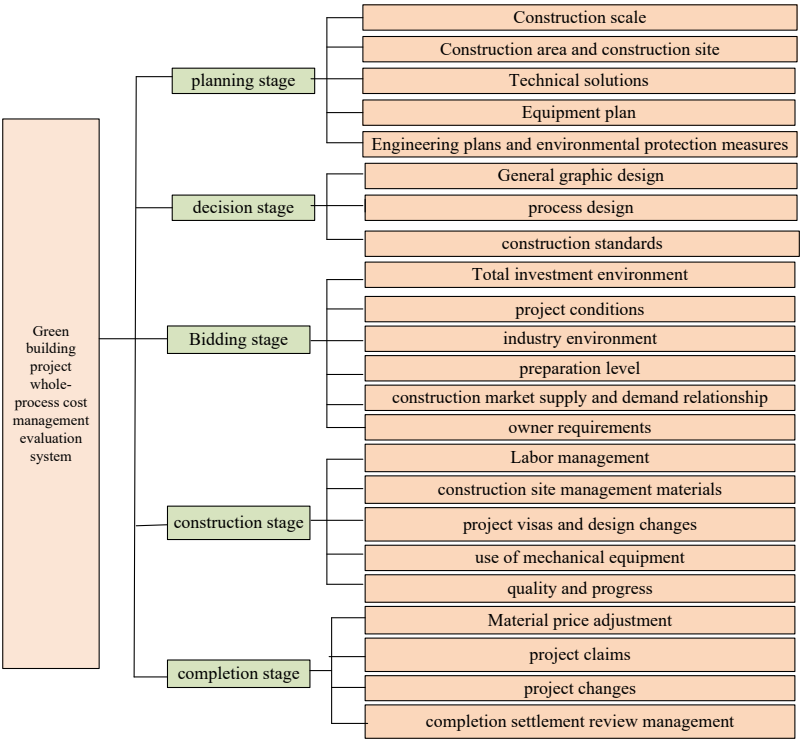

Fig. 1. Green building project whole-process cost management evaluation system

Secondly, scores are scored based on the experts' fuzzy evaluation of the importance of factors affecting the whole-process cost management of the project, and then a fuzzy evaluation matrix is formed, as shown below:

$$R = \begin{bmatrix} 0.416 & 0.230 & 0.123 & 0.123 & 0.108 \\ 0.333 & 0.231 & 0.155 & 0.179 & 0.102 \\ 0.424 & 0.231 & 0.153 & 0.09 & 0.13 \\ 0.370 & 0.200 & 0.183 & 0.155 & 0.093 \\ 0.385 & 0.192 & 0.173 & 0.134 & 0.116 \end{bmatrix} \tag{8}$$

$$D=w0\times R=[0.392,0.217,0.157,0.131,0.104] \tag{9}$$

The results of the above equation show that 0.392 means that the decision-making stage has the highest impact on project cost management; 0.217 means that the design stage has a high impact on project cost management; 0.157 means that the bidding stage has a medium impact on project management; 0.131 It means that the impact of the construction stage on the project management is at an average level; 0.104 means that the completion stage has the lowest impact on the project.

Therefore, it is necessary to increase the importance of the design stage and use green materials such as new materials as much as possible. The lack of green concepts among designers will bring instability factors to the construction and cause deviations in project cost management. Therefore, it is necessary to choose a company with the best comprehensive quality and the most qualified qualifications. Excellent design unit to ensure the controllability and safety of the whole process cost management of green building project projects.

6 Conclusion

This article studies the whole-process cost management of green building engineering projects. First, it establishes a scientific and accurate index evaluation system from five dimensions. Then it uses the entropy weight method and fuzzy evaluation method to evaluate the proposed evaluation system. Finally, it combines a certain residential building in Wuhan Taking the project as an example, the results show that the design stage has the greatest impact on cost management. New materials should be used as much as possible to effectively save energy and reduce emissions. At the same time, the overall quality of designers should be improved, which is conducive to improving the control of cost management throughout the process. Provide reference significance for other construction cost management.

This article considers the main influencing factors at each stage of the whole-process cost management system. In the next step, we will continue to increase the system indicators at each stage of the whole-process management to improve the applicability of the evaluation system.

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