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Original Paper

Research on Cost Management Evaluation of Urban Renewal Projects under EPC Mode

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Abstract

Compared with developed countries, the research on modern urban renewal in China is relatively late. However, with the landing of more and more projects in recent years, since Guangzhou, Shenzhen and other places took the lead in urban renewal, urban renewal has gradually entered a period of market-oriented and diversified operation. In recent years, under the influence of urban renewal strategy, the construction of old residential renovation projects is in full swing. In order to reduce the risk of construction, the construction unit often selects EPC project general contracting mode as the contract form of old residential renovation projects. However, the EPC project general contracting mode not only reduces the investment risk of the construction unit, but also greatly improves the difficulty of the general contracting unit's cost management of the renovation project of the old residential area. In order to complete the renovation project of the old residential area within the range of the budget estimate approved by the government and obtain the expected social benefits, cost management has become the control point of the project management of the EPC project general contractor. Based on the perspective of the general contractor, this paper takes the renovation project of the old residential area under EPC mode as the research object, uses AHP and fuzzy comprehensive evaluation method to evaluate the project cost management, analyzes the deficiencies in the actual cost management and puts forward countermeasures and suggestions.

Keywords

EPC, Renovation of old residential areas, Cost management, AHP, Fuzzy comprehensive evaluation

1. Introduction

With the vigorous promotion of the national reform and opening up policy, the urbanization process has gradually entered a period of rapid development. The continuous rise of permanent urban residents promotes the continuous development of China's real estate industry. However, corresponding to the high-quality development of new urban areas, the central urban area built in the early stage of urban development gradually becomes a gathering place for old residential areas. Among them, the residential areas built before the end of 2000 due to the construction of low construction standards and long housing age lead to increased maintenance costs year by year, damage to building functions, backward public facilities, chaotic community environment, inadequate safety facilities and other problems have become increasingly prominent, and have been unable to meet the growing needs of residents. It is imperative to carry out urban renewal projects.

In recent years, the state attaches great importance to the work of ensuring people's livelihood, and since 2019, the renovation of old urban communities has been included in the low-income housing project, and governments at all levels have made great efforts to repair and renovate old communities. According to the document jointly issued by the Ministry of Housing, the National Development and Reform Commission and the Ministry of Finance, the old residential area is defined as the city and county town (Chengguan town) built before 2000, the backward public facilities affect the basic life of residents, and the residents' desire for transformation is strong. The shantytown (residential housing) that is included in the urban shantytown reconstruction plan, and the area and urban village where the residents' self-built housing is the main body, do not belong to the category of old residential communities. According to the spirit of the State Council Directive, by the end of the "14th Five-Year Plan", strive to basically complete the old residential areas that need to be remediated before the end of 2000. There are three kinds of contents of the renovation of old residential areas: First, the infrastructure category, mainly the transformation and upgrading of municipal supporting infrastructure, while taking into account the repair of the roof and external wall of the building inside the residential area, stairs and other public parts; Second, the transformation and construction of the environment and supporting facilities, energy saving transformation of residential buildings, with conditions to add elevators in the building could be carried out; Third, the service security, mainly including the road system, public space and landscaping inside the community, as well as the construction of property management information platform, intelligent upgrading and transformation of property services should be taken into account.

2. An Overview of AHP Methods

2.1 The Concept and Basic Principle of AHP

AHP, short for Analytic Hierarchy Process, is a statistical analysis method based on the subjective empowerment of experts, which is often used in the decision-making of complex systems. When the analytic hierarchy process is used, the problem to be decided is usually regarded as the target layer, and

the criterion layer and scheme layer are constructed from top to bottom according to the hierarchical logical relationship in the system, so as to simplify the problem in the form of peeling cocoons. Then, by constructing a judgment matrix, the function weight of each layer of indicators on the upper indicators is calculated, and finally the comprehensive weight of each level of indicators is calculated, and the index weight at this time represents the degree of its function in the system.

2.2 The Implementation Steps of AHP

(1)The hierarchical structure model is established according to the complex problems to be solved. The decision goal is taken as the target layer, the secondary index is taken as the criterion layer, and the tertiary index is taken as the scheme layer, as shown in Figure 2.1.

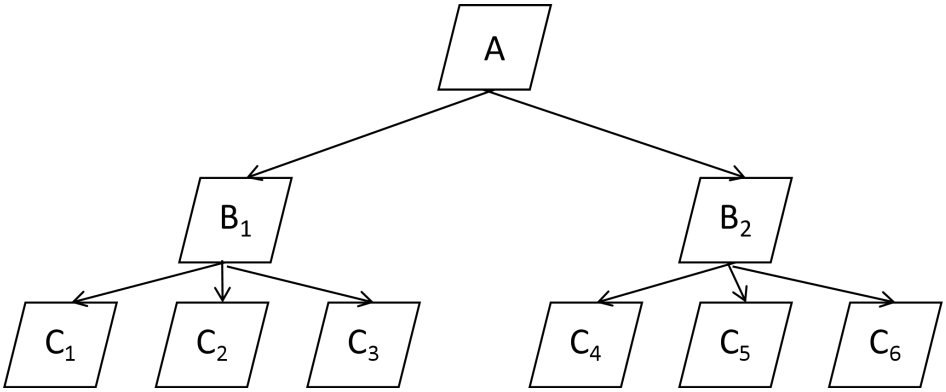

Figure 2.1 AHP Hierarchical Structure Model Diagram

(2) Construct a judgment matrix. According to the established hierarchical structure model, establish a judgment matrix of indicators at each level, and compare the importance degree of indicators in the judgment matrix, so as to determine the influence of indicators at the current level on the importance degree of indicators at the previous level. The 1-9 scale method proposed by Saaty was adopted for the grading scale of importance comparison, as shown in Table 2.1.

Table 2.1 Hierarchical Analysis 1-9 Scale Method Meaning

Marking Standards	Meaning
1	i is as important as factor j
3	i is slightly more important than factor j
5	i is more important than j
7	i is more important than factor j
9	i is absolutely more important than factor j
2、4、6、8	the importance of factor i is in the middle of the above degree

The judgment matrix of A_i at the target layer is denoated as $B_i = (b_{ij})\ n \times n$ as follows:

$$B_i=\begin{bmatrix} b_{11} & \cdots & b_{1n} \\ \cdots & \cdots & \cdots \\ b_{n1} & \cdots & b_{nn} \end{bmatrix}$$

Where,the score of the importance of factor i compared with factor j is denoted as b_{ij}; The importance score of factor j compared with factor i is denoted as b_{ji}; The value of b_{ji} can be $1/b_{ij}$, where i, j = 1, 2, 3,... , n; The b_{ii} value is 1. Therefore, when filling in the matrix, only the upper triangular matrix or the lower triangular matrix can be filled.

(3) Matrix consistency test. It needs to fill in the hierarchy matrix according to the pairwise importance of indicators judged by experts, and use yaahp software to test the consistency of each hierarchy matrix. Consistency test is the identification of whether the expert's judgment logic is consistent. The higher the consistency of the judgment logic is, the smaller the consistency test value is. After all matrices pass the consistency test, the weights of indicators at all levels can be calculated. Otherwise, experts should be asked to readjust the logically inconsistent parts of the judgment matrix until all are qualified.

(4) Calculate the weights of all levels of indicators and comprehensive weights.After the consistency test of all levels of matrix is passed, yaahp software can be used to calculate the respective weights of the scheme layer and the criterion layer as well as the comprehensive weights of the target layer.

3. Overview of Fuzzy Comprehensive Evaluation Method

3.1 The Principle of Fuzzy Comprehensive Evaluation

Fuzzy comprehensive evaluation method is a method based on membership degree theory of fuzzy mathematics. The method is characterized by clear and systematic results, and is more suitable for dealing with uncertain and difficult to measure problems.

3.2 The Implementation Steps of Fuzzy Comprehensive Evaluation Method

(1) Determining evaluation factors

According to the evaluation index system, the second-level index evaluation factors (denoted as N_i) and the third-level index evaluation factors (denoted as n_{ij}) were determined.

(4) Determine the evaluation grade

As the evaluation vector of the fuzzy comprehensive evaluation method, the evaluation level ($V_{j)}$ directly affects the accuracy of the evaluation results. The number of levels is usually set between 4 and 9. If the number of evaluation grades is too large, it will easily lead to inaccurate evaluation criteria and difficult to determine membership degree. If the number of evaluation grades is too small, it is easy to lead to the index evaluation standard is too broad, and the accuracy of membership is low.

(5) Single factor fuzzy evaluation

The single factor fuzzy evaluation is to extract the expert's judgment score of the subordination level of the implementation of the index and sort out the subordination relationship of the influencing factor level.

Single factor membership = Number of experts belonging to V_j reviews/total number of experts (2.1)

The single factor fuzzy evaluation score is the product of fuzzy matrix and factor weight value.

$$S_i=R_i*Z_i \quad (2.2)$$

Where, S_i is the single factor fuzzy evaluation score; R_i is a fuzzy matrix; Z_i is the corresponding factor weight.

(6) Comprehensive evaluation

The comprehensive evaluation is to set up the membership matrix of each dimension according to the evaluation index system of the influencing factors of cost management. The fuzzy comprehensive evaluation result vector of each dimension factor can be obtained by multiplying the comprehensive weight of each dimension factor with the corresponding membership matrix.

$$E=Z_E*S_E \quad (2.3)$$

Where: E is the result vector of fuzzy comprehensive evaluation; Z_E is the comprehensive weight of the influencing factors; S_E is the membership matrix of the influencing factors.

(7) Determine the overall score of project cost management effect.

According to the evaluation result vector and evaluation grade assignment, the comprehensive score of the cost management effect of each project and the actual score of the implementation results of the influencing factors of cost management at all levels in the project are obtained.

G=E*V (2.4)

Where: G is the cost management effect score; E is the result vector of fuzzy comprehensive evaluation; V assigns a value to the evaluation level.

4. Cost Management Problem

This paper analyzes the problems of cost management through the above methods in the process of case project implementation, including the following aspects.

4.1 Designers Have Weak Awareness of Cost Control

D old residential renovation project is a non-profit project funded by the government, and the design cost is fixed. Designers do not integrate technology and economy closely when designing schemes and drawings, and designers consider more design standards, structural safety, and green environmental protection, rather than the economy of design schemes.

4.2 Excessive Reliance on Construction Materials and Equipment Procurement

The procurement plan of the procurement personnel relies excessively on the material supply order of the construction management personnel, does not consider the procurement node of the micro-fire station in the procurement plan in advance, and arranges the supplier's production scheduling in advance, resulting in the equipment delivery time being delayed by 15 days compared with the construction plan.

4.3 The Rationality of the Construction Scheme Is Poor

The renovation project of the old residential area involves multi-professional cross-construction, and the sequence of construction procedures should be fully considered when preparing the construction plan, otherwise it is easy to rework and result in demolition. In the construction process of X district, after the exterior wall is painted, the corridor windows are installed on the site. There is a certain deviation between the size of the exterior wall window and the window frame, resulting in lax closing and water leakage. It is necessary to re-deal with the size of the window opening and close it twice. The equipment support should be installed only after the roof. Besides, community A is waterproofed. The fixed support damages the waterproofness, resulting in a second waterproofness repair, and increases the potential water leakage.

4.4 Single Construction Management Means

Construction site safety management and finished product protection are mere formalities, the main management means of construction management personnel are requirements and penalties, the process management is imperfect, and the lack of site inspection during the construction and handover period leads to the loss of materials such as cables and permeable bricks, the damage of newly poured roads in the community increases material costs and maintenance costs.

4.5 The Cooperation Degree of Residents in the Old Community Is not High

Different from new construction projects, the characteristics of construction and living projects make the daily construction work time of workers in old residential renovation projects seriously restricted. Therefore, whether residents cooperate directly affects the construction efficiency and project progress of workers.Construction noise and occupancy of residents' parking spaces affect residents' lives,there are more or less cases of residents occupying public space in each community. The renovation and demolition of illegal construction in old residential areas and the renovation of public areas have affected the unreasonable vested interests of some residents, resulting in the construction being blocked many times and affecting the renovation cost.

4.6 The Basic Conditions of the Old Residential Renovation Project Are Poor

The outdoor space of the project is small and the original road is narrow. In order to reserve a reasonable working space, the material blanking and the old storage under the EPC mode are restricted.

5. Suggestions for Optimizing Cost Management

1) The strength of site survey and the collection of opinions on the reconstruction of old residential areas are very important to the rationality of the scheme design, drawing design and construction plan preparation. Under the premise of EPC contracting mode, the design and construction personnel can jointly carry out site survey, carefully analyze the original conditions of the old district, and verify the details of the renovation content, specifications, dimensions, elevations and original design materials of the old district, laying a solid foundation for the drawing design and construction plan preparation.

2) Before the design of the old community, the project management personnel should arrange special personnel to collect and urge the community and street to complete the collection and sorting of the old community renovation opinions as soon as possible, and require the person in charge of the community and street to sign the consent of opinions on the renovation content determined by both sides, so as to reduce the engineering changes caused by the adjustment of the renovation opinions. Under EPC contracting mode, cost control in the design stage, in addition to the implementation of quota design system, technical and cost managers can actively participate in the optimization of design schemes, break the single situation of self-management of design units, and improve design economy. At the same time, the engineering change reward and punishment system can be implemented to give the design unit appropriate rewards and punishments according to the quantity and nature of the engineering change, so as to promote the designer to enhance the consciousness of cost control and reduce the design errors and omissions.

3) The price of materials and equipment accounts for 60% of the project cost, which is an important control part of cost management. In the process of project procurement, procurement personnel should determine the procurement list and prepare the procurement plan in advance according to the contract list and construction plan, and select qualified suppliers to ensure the supply of materials throughout the construction cycle. As for the procurement schedule, due to the dynamic nature and uncertainty of the project construction, the procurement department may require the construction manager to submit the procurement plan regularly, and combine the procurement plan prepared by the department and the actual construction material withdrawal list to supplement each other, check the gaps and make up for the deficiencies, and rationally arrange the procurement nodes to ensure the smooth progress of the project construction.

4) To formulate the construction plan scientifically, technicians should comprehensively consider the scale, basic conditions, reconstruction content of the old residential renovation project and the technical ability and personnel allocation of the enterprise itself, and scientifically and reasonably arrange the construction process, personnel and construction schedule to avoid idle work and other ineffective working time. Technicians should prepare effective safety management plan and emergency plan to increase the guarantee for project management; In addition, dust control and noise control in the construction stage should be fully considered to minimize the adverse impact on the life of residents in the community, so as to improve the satisfaction of residents and improve the cooperation of residents in the renovation of the old community.

5) Strengthening the construction site management can not only ensure the project progress, reduce the incidence of safety accidents, but also is an effective way to control the project cost. For schedule management, the construction management personnel should organize the construction team to submit daily work plan and completion amount, timely picket the reasons for the work that cannot be completed on time, adjust and improve. For safety management, the construction team can be required to set up a full-time administrator, daily inspection, while the construction management staff

supervision and management at any time to ensure that the safe construction is implemented to everyone. For the protection of finished products and material management, a sound regulatory system should be established to supervise while self-checking and self-correcting, reduce waste and loss, and ensure the best use of materials and equipment.

6) The propaganda personnel of the old residential renovation project should be trained to combine the reconstruction planning drawings, renderings, material samples and other materials that can directly reflect the contents and effects of the old residential renovation, and carry out the renovation promotion together with the community and street staff. While showing the professionalism of the contractor in an all-round way, it establishes confidence and hopes for a good living environment for the residents of the old community, and improves the enthusiasm and cooperation of residents for transformation.

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