Applied Science and Innovative Research
ISSN 2474-4972 (Print) ISSN 2474-4980 (Online)
Vol. 9, No. 3, 2025
www.scholink.org/ojs/index.php/asir

Original Paper

Research on Cost Management of Old Residential Area Renovation Projects under EPC Mode

Tingting Nie[1*], Ling Li[2] & Xiaoxia Lai[3]

[1,2,3*] College of Architecture, Chengdu College of Arts and Sciences, Chengdu, Sichuan 610000, China

Received: June 5, 2025 Accepted: July 3, 2025 Online Published: July 11, 2025

doi:10.22158/asir.v9n3p12 URL: http://doi.org/10.22158/asir.v9n3p12

Abstract

Under the strong impetus of the current urbanization renewal policies, the renovation projects of old residential areas across the country are showing a rapid development trend characterized by large-scale and high efficiency. To effectively control investment risks, construction units generally choose the EPC (Engineering, Procurement and Construction) general contracting model as the core contracting mechanism for old area renovation projects. Although this model helps significantly reduce the financial risks for the construction party, it also poses higher requirements for the general contractor to implement cost control in the complex and ever-changing old area renovation projects. Given the dual constraints of the government's strictly approved budget framework and the expected social and economic benefits, cost management has become the primary control link in the project management of EPC general contractors. This study, with the EPC model as the research background, selects the D old residential area renovation project as a specific case. Through a research approach combining literature review and questionnaire survey, it systematically identifies the multi-dimensional factors influencing the cost management of such projects. Based on the research findings, the research team has constructed a scientific and standardized evaluation system for the cost management factors of EPC model old residential area renovation projects, aiming to accurately identify and screen out key influencing factors, thereby providing theoretical basis and methodological support for the subsequent refined management implementation. This research achievement has significant practical significance for improving the cost control level of the EPC general contracting model in old residential area renovation projects. Finally, corresponding management strategies are proposed based on the identified key construction cost influencing factors.

Keywords

EPC, Renovation of old residential areas, Project cost management

1. Introduction

Under the strategic backdrop of the country's deepening reform and opening-up, the pace of urbanization has significantly accelerated, demonstrating tremendous development momentum. With the continuous increase in the permanent resident population in towns, a large number of people have flocked to the core areas of cities, greatly promoting the prosperity of China's real estate industry. However, in contrast to the high-quality development model pursued by emerging urban new districts, the central urban areas that were completed earlier have gradually accumulated into clusters of old residential areas. Especially the buildings completed before December 31, 2000, due to their low initial construction standards and long service life, have exposed a series of severe problems such as a sharp increase in maintenance costs, severe decline in building functions, outdated public service facilities, disorderly community environment, and inadequate safety protection mechanisms. The concentrated outbreak of these contradictions has made the original living conditions unable to meet the residents' continuous upgrading demands for living quality.

With the acceleration of urbanization, the renovation of old residential areas has become a key issue that all levels of government urgently need to address. It is regarded as an important measure to promote the sustainable development of cities and improve the quality of residents' lives. When implementing such projects, in addition to dealing with the common problems in traditional engineering such as large scale and long duration, special attention must be paid to fully listening to residents' opinions, strictly protecting public safety, and carefully maintaining existing buildings. Given the diversity of construction conditions and the significant characteristics of engineering risks for such projects, the EPC project general contracting model has gradually become the preferred alternative to the traditional decentralized contracting method, and has received widespread approval from construction units. When bidding for the renovation of old residential areas using the EPC model, construction units can combine the complex processes that were originally carried out separately in the design, procurement, construction, and subcontracting contract stages into a single engineering general contracting contract. Through this approach, the construction unit fully entrusts the project to a design-contracting-supervising general contracting unit with strong comprehensive capabilities, ensuring the full process control of the project from the design stage to the completion of construction. This not only effectively guarantees the realization of project functions and schedule, but also ensures that the building quality meets the established acceptance requirements, thus achieving the expected goals of the project. For construction enterprises to implement this bidding model, it has significant benefits, with clear contract terms, minimal management coordination burden, and significant reduction in investment uncertainty. However, for the project general contracting party, the EPC project contracting model means an increase in management workload, and for the renovation of old residential areas projects, the cost control difficulty increases exponentially, forming a difficult problem. It is worth noting that the funds for such renovation projects mainly rely on the sole source of government fiscal subsidies, and the effectiveness of the fund utilization directly affects the audit results, making cost auditing a core review link. In conclusion, cost control has

become an indispensable key node in the project management of the EPC project general contracting party.

2. The Related Concept

2.1 The Concept of Old Residential Areas

Currently, the determination of urban old residential areas in China is mainly based on two core indicators: time and status. In the time dimension, the main focus is on the construction period and the duration of existence. Specifically, the construction period covers the three key periods of the 1980s, 1990s, and 2000s, which significantly reflect the characteristics and norms of urban construction in different historical stages. At the same time, the duration of existence focuses on four viewpoints: 20 years, 30 years, 40 years, and more than 50 years since construction. This directly shows the deteriorated state of the residential area due to the accumulation of time. In the status dimension, the comprehensive assessment of the area's location conditions, the preservation quality of buildings, the completeness of public facilities configuration, the effectiveness of property management, and the compliance with building standards are required (Li Yang, 2019). In July 2020, the State Council officially issued the "Guiding Opinions on Comprehensively Promoting the Renovation of Urban Old Residential Areas", clearly stating that residential areas that meet the following characteristics within provincial administrative regions can be defined as old residential areas, which are those built in an earlier period, lacking maintenance and repair for a long time, severely lacking public spaces, with lagging operation of public facilities, and with strong renovation demands from residents. Each region must conduct a comprehensive investigation of the old communities within its jurisdiction, and then precisely define the renovation goals and scope of work. According to the research suggestions of "Gao Mianan" (2022), residential areas that were put into use before December 31, 2000, should be placed in the first priority for renovation sequence. This study focuses on such residential areas with an early construction time, severe aging of structures and public facilities, urgent need for improvement of the living environment, and the absence of basic public services. The renovation strategies strictly exclude the option of complete demolition and reconstruction, and only implement partial repair and performance optimization.

2.2 The Concept of Project Cost Management under the EPC Model

The practice of engineering cost management under the EPC model refers to the systematic and scientific monitoring and regulation of the entire process of a project from its initiation to its conclusion, within the framework of engineering, procurement, and construction operations. The core objective of the EPC model is to significantly enhance the effectiveness of resource allocation through precise, efficient operation methods and intelligent technologies, achieve the optimization of costs, and enhance the overall market competitiveness of the project while ensuring benefits and quality. In the specific implementation, the EPC model's engineering cost management requires the formulation of detailed project cost planning and control schemes, the clarification of cost control indicators and implementation measures, and the establishment of organizational structures and work processes. Through precise calculation and in-depth

analysis of costs at each stage, it can scientifically set budget ranges and control standards, and establish feasible cost control measures to ensure the successful achievement of project goals. Through systematic analysis of various costs of EPC projects, it can comprehensively understand their composition structure and internal relationships, and precisely identify the key factors driving cost changes. Deep optimization should be implemented at the EPC project management mechanism, technological innovation, and process levels to maximize the efficiency of resource allocation, significantly reduce cost investment, and simultaneously enhance project effectiveness and quality assurance levels. In addition, a dynamic tracking mechanism for project costs should be established to promptly capture risks of cost overruns and quickly deploy special control measures and efficient avoidance strategies to ensure that costs remain within a reasonable range.

3. Research Methods and Index System

3.1 The Research Methods

(1) The case analysis method uses the D old residential area renovation project as a representative sample, focusing on the main influencing factors of its construction cost. Through this core research perspective, the project's internal logic and driving mechanism are systematically explored.

(2) By applying the literature research method, the researchers adopt a systematic process to collect and screen relevant literature, conduct in-depth analysis to form a scientific understanding of the research topic. This study adopts this method by systematically reviewing domestic and foreign literature on old residential area renovation and EPC model cost management, and initially constructed an index system for key construction cost influencing factors through cross-comparison analysis.

(3) The expert investigation method is used to deeply understand the engineers and experts involved in the old residential area renovation and EPC projects, systematically collecting and refining the multi-dimensional factors affecting the project construction cost analysis.

(4) The quantitative analysis method is adopted, based on the literature research, case analysis, and expert interviews, to build a solid data foundation, and accurately evaluate the subjective weight values of each influencing factor of the construction cost of the D old residential area renovation project under the EPC model by using the analytic hierarchy process.

3.2 The Index System

Through literature analysis and expert interviews, the construction cost influencing mechanism of D old residential area renovation projects in the EPC model is shown in Figure 1.

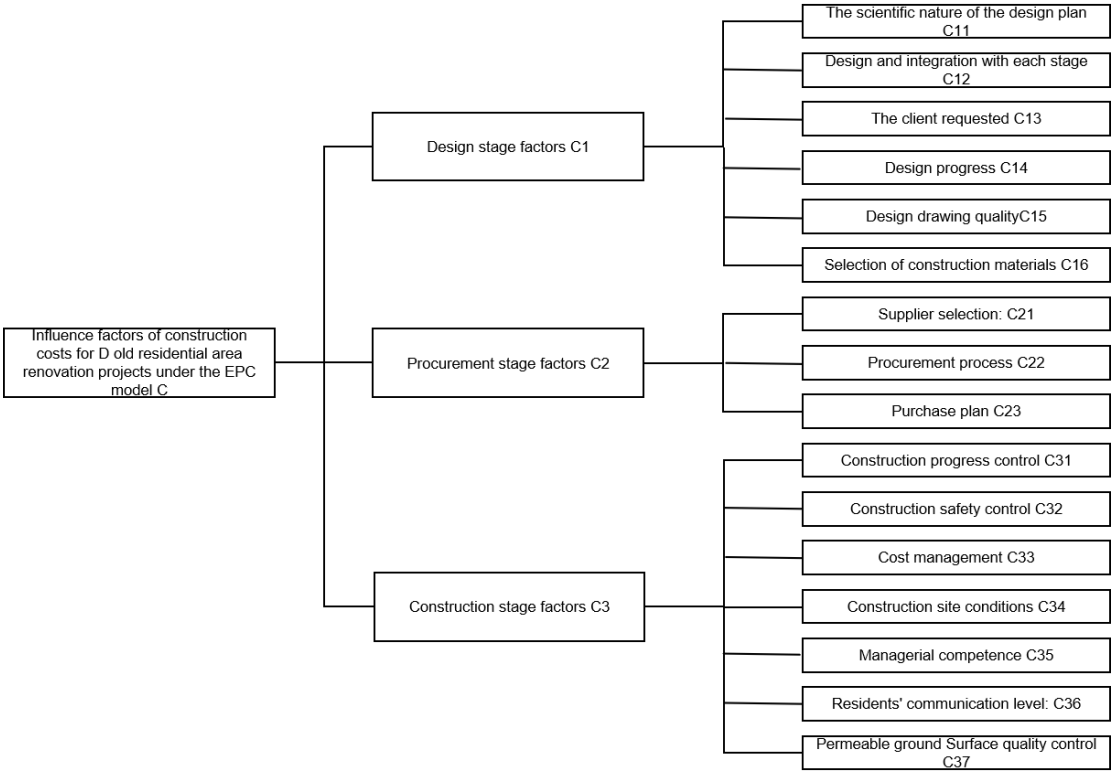

Figure 1. The Hierarchical Structure Model Diagram of the Influencing Factors of Construction Costs for D Old Residential Area Renovation Projects under the EPC Model

4. The Empirical Analysis

4.1 The Questionnaire Survey

Based on the cost composition elements system of the D old residential area renovation project under the EPC model, a questionnaire for evaluating the criticality of key factors affecting the special construction costs was developed. This questionnaire was conducted in a standardized question-and-answer framework, systematically examining the weights of cost factors in three different stages and their specific contributions to the overall cost. A total of twenty-four key indicators were covered. In addition, it specially invited authoritative industry experts to conduct grade evaluations for each indicator, and the evaluation system adopted a five-level quantitative scale. The specific scores were 5 representing extremely important, 4 representing important, 3 representing general, 2 representing weak important, and 1 representing less important. The evaluation experts only needed to mark in the designated circular options to complete the assessment process.

Considering the professional depth and domain span of the investigated content, in order to ensure the smooth implementation and efficient progress of the questionnaire survey, all participants in the survey needed to have a solid background in the construction industry. Most of them had experience in old residential area renovation or EPC project practice, or had engaged in related academic research. In the study, the cost impact factor system was evaluated through face-to-face interviews, aiming to improve data accuracy and enhance the credibility of the results, so as to more accurately determine the weights

of each indicator. Through approximately 30 days of in-depth research, a total of 67 industry experts were recruited, and 67 valid questionnaires were collected. The questionnaire recovery rate reached 100%, ensuring the completeness of the sample and the high quality of the research data.

4.2 The Reliability Analysis

This research strictly adheres to scientific norms and conducts reliability tests on the data obtained from the questionnaire survey. The aim is to ensure the reliability of the data collection process and the accuracy and validity of the measurement results. Based on the necessity of reliability analysis, the research team selected the widely accepted Cronbach's α coefficient method in the field of psychology as the core evaluation criterion, and used the professional statistical analysis software SPSS to complete the specific operations. Following the existing research paradigm, the Cronbach's α coefficient is considered to have high reliability when it is above 0.8, moderate reliability when it is between 0.7 and 0.8, critical reliability when it is between 0.6 and 0.7, and significant reliability deficiency when it is below 0.6. Subsequently, the research team imported all 19 sets of strictly selected survey data (including 16 secondary indicators under 3 primary indicator systems) into the SPSS system to conduct a systematic reliability verification analysis. Through precise calculation, the final Cronbach's α reliability coefficient value was 0.958, which far exceeds the professional threshold of 0.8, fully confirming that this survey has a high degree of internal consistency. Therefore, from a statistical perspective, it can be conclusively determined that the data set collected in this research not only has excellent reliability qualities but also fully meets the basic requirements of subsequent empirical analysis, providing solid and reliable data support for the subsequent research stages.

4.3 The Index Weight

After rigorous verification, each judgment matrix passed the consistency test, and the final weight values are shown in Table 1.

Table 1. The Weight of the Project Construction Cost Influencing Indicators Obtained Based on AHP

Target layer	Criterion layer	Criterion layer weights	Indicator layer	Indicator layer weights
Influence factors of construction costs for D old residential area renovation projects under	Design stage factors C1	61.5%	The scientific nature of the design plan C11	17.12%
			Design and integration with each stage C12	36.68%
			The client request C13	5.14%
			Design progress C14	3.10%
			Design drawing qualityC15	9.63%

the EPC model C			Selection of construction materials C16	3.01%
	Procurement stage factors C2	11.61%	Supplier selection C21	4.57%
			Procurement process C22	2.74%
			Purchase plan C23	3.52%
	Construction stage factors C3	26.89%	Construction progress control C31	1.09%
			Construction safety control C32	3.11%
			Cost management C33	9.43%
			Construction site conditions C34	1.62%
			Managerial competence C35	6.37%
			Residents' communication level C36	5.56%
			Permeable ground surface quality control C37	3.06%

Given the multi-dimensional and complex nature of construction costs, this study adheres to the scientific research method of integrating theory with practice, and conducts in-depth research on the characteristics and actual demands of the D old community renovation project. Based on a comprehensive and systematic investigation, the research report has extracted four construction cost influencing factors with significant impact and a weight of more than 4%, forming an indicator hierarchy system. These factors specifically include: the design and integration with each stage (weight 36.68%), the scientific nature of the design plan (weight 17.12%), the client request (weight 5.14%), the design drawing quality (weight 9.63%), the supplier selection (weight 4.57%), the cost management (weight 4.74%), the managerial competence (weight 4.34%) and the residents' communication level (weight 5.56%). On this basis, the study has established a comprehensive governance framework for the core influencing factors, aiming to provide a set of efficient and feasible cost control system for the general contractor of future D old community renovation projects, thereby enhancing the practical guidance of industry practice.

5. The Management Strategies for Key Construction Cost Influencing Factors in Old Residential Area Renovation Projects

5.1 The Management Strategies for Key Influencing Factors of Construction Costs in the Project Stage

The renovation project of dilapidated old residential areas is characterized by its complex internal features, involving numerous intricate elements and closely interlinked processes, making it highly challenging. Therefore, during the design stage, precise management of the minor details is necessary. To ensure a smooth connection between the design plan and subsequent steps, several key management

measures have been specially formulated to enhance the synergy between the design phase and other stages, thereby fully supporting the general contractor in achieving the core goal of cost control.

(1)The design, procurement, and engineering personnel in the project team need to strengthen collaboration to ensure seamless integration of the project in the design, procurement, and implementation stages. Through regular cross-departmental coordination meetings, information sharing and knowledge exchange are promoted to ensure that team members have real-time access to the latest progress and accurately understand and implement all decisions.

(2)Designers should strive to reduce the need for modifications during implementation and strengthen collaboration and communication with the construction team to ensure that the design plan is both reasonable and feasible.

(3)The selection of design and procurement must be made as early as possible to ensure that the construction team has sufficient preparation time. Therefore, it is necessary to start immediately during the design and procurement period and require these decisions to be highly mature and comprehensive before the start of construction.

(4)The change management process during the design and procurement stages must be strictly regulated, requiring each adjustment to be subject to comprehensive assessment and approval, while precisely examining its potential impact on the project progress and costs.

(5)It should build a data sharing system, such as using cloud storage and collaborative document tools, to support the efficient circulation of information throughout the design cycle. Additionally, a complete information classification and access control system must be improved to ensure data confidentiality and security protection levels.

Compared with conventional engineering projects, the assessment criteria for the renovation of dilapidated old residential areas show significant differences. Resident satisfaction becomes the core element for the formulation of the plan. Given that residents are the main beneficiaries of the renovation, the fundamental purpose of the project is to comprehensively improve their living conditions and quality of life. If the actual demands of the public are ignored during the decision-making stage, the renovation results are likely to deviate from the expectations of the residents and even cause negative impacts on their daily lives. Therefore, the renovation of dilapidated old residential areas must strengthen the deep involvement and strong support of residents. Any disregard for the needs of residents may lead to resistance, seriously restricting the progress of the project. At the same time, based on long-term observation and accumulation of the internal environment, surrounding ecology, and existing living conditions of the residents, it can provide insightful suggestions and feedback for the renovation project, laying a key foundation for the scientific construction and efficient implementation of the plan. Therefore, when comprehensively planning the renovation plan, it is necessary to fully consider the diverse demands of residents, which can effectively enhance the renovation effect and living experience, and promote the public's comprehensive acceptance and active collaboration, laying a solid foundation for the smooth progress of the project.

5.2 The Management Strategies for Key Influencing Factors of Construction Costs during the Procurement Stage

In the construction project of the D old residential area renovation, the traditional construction plan mainly focuses on ground laying and wall repair. Among them, sand, gravel, cement, commercial concrete and dry-mixed mortar are the key building materials, which have a decisive impact on the construction cost. Relevant data indicates that the cost of purchasing sand and gravel is approximately 16 million yuan, the cost of cement is about 6 million yuan, the cost of commercial concrete is as high as 30 million yuan, and the cost of dry-mixed mortar is also close to 9 million yuan. These significant economic amounts fully reveal the core position of material expenses in the total project investment. For the project construction unit, to achieve effective management of the total cost, the first task is to strictly monitor the cost of bulk materials. This measure often yields twice the results with half the effort. However, in the material selection process, it is necessary to avoid the simple deviation of the strategy based solely on price, and instead comprehensively evaluate the material performance indicators, the later technical support system and the supply cycle to ensure the scientificity of the material procurement decision. In the field of old residential area renovation, due to the complexity and uniqueness of the project, choosing the appropriate supplier is crucial for ensuring the smooth progress and efficient completion of the project, and also constitutes a key element for the general contractor in cost control and profit improvement. To achieve the quality selection of suppliers, it takes the large material procurement of the D old residential area renovation project as an example, and when the procurement volume of a certain material reaches a certain scale, the procurement department should give priority to adopting the strategy of centralized procurement. This model can utilize the scale effect and usually can obtain more favorable procurement prices, thereby providing significant advantages and bargaining capital for the procurement team in the bargaining process, which helps to exert effective pressure on the supplier and ultimately obtain more competitive quotations. In contrast, if the decentralized procurement method is adopted, the purchasing party will face a greater disadvantage in the price negotiation and will have difficulty obtaining significant procurement discounts or price advantages. When implementing the centralized procurement procedure, the procurement unit must strictly screen reputable and resource-rich supply cooperation units to ensure high-quality material quality and accurate delivery time. For standardized materials, the procurement unit has the right to adopt diverse procurement strategies. The first step is to deeply explore the supply network, systematically evaluate the candidate partners, and issue formal inquiry invitations; subsequently, alternative approaches can be sought, through a rigorous supplier evaluation mechanism for screening, and ultimately determine the price-optimal cooperation institution. During the procurement process, it is necessary to ensure that each link complies with the established norms and process requirements to ensure the efficient operation of the entire supply chain.

5.3 The Management Strategies for Key Construction Cost Influencing Factors during the Construction Phase

During the complex process of implementing a construction project, due to the high work pressure and the lengthy project duration, the real-time monitoring of cost dynamics is often overlooked, resulting in a passive management model where cost accounting can only be conducted after the project is completed. To ensure the achievement of cost targets, a dynamic cost management mechanism must be introduced during the construction stage. By applying earned value analysis techniques, the deviation from cost and the delay in progress can be precisely quantified, and a comprehensive project cost monitoring system can be established. In the actual operation, it is recommended to conduct dual evaluations of cost and progress on a monthly basis, establish a benchmark based on the data of the previous stage, and implement necessary management corrections accordingly. The core lies in the hierarchical decomposition of the target cost, where the cost indicators are detailed down to specific trades and operation units, and further implemented to individual positions. This aims to achieve equal binding of rights and responsibilities at all levels and ensure the simultaneous improvement of cost control accuracy and execution efficiency. In the subsequent steps, the budget cost of the target monthly task volume (BCWS) should be calculated, and the relevant data of the actual completed engineering quantity should be accurately recorded. Based on this, the budget cost of the completed work (BCWP) can be evaluated. Finally, the actual cost (ACWP) of each individual project in this month can be obtained through precise accounting by the financial department.

After a thorough examination of the dynamic correlation between project costs and progress, it can provide a reliable basis for the cost control process. In terms of specific indicator calculation, the cost variance (CV) is determined by the difference between BCWP and ACWP, with negative values indicating that the expenditure exceeds the budget, and positive values indicating significant cost savings. The schedule variance (SV) is obtained by subtracting BCWS from BCWP, with negative values indicating schedule delays and positive values indicating that the project is completed ahead of schedule. This quantitative analysis method helps project managers identify deviations promptly and take corrective measures.

6. The Conclusion

At present, our country is vigorously carrying out the comprehensive upgrading of old residential areas. The application of the EPC model has significantly enhanced the efficiency of the renovation. Under this model, the general contractor needs to bear higher risks. Therefore, contractors must pay special attention to cost control in old residential area renovation projects under the EPC system. By integrating existing cost management research results with the essential characteristics of the EPC model, this study systematically analyzed the deep-seated reasons for cost changes in key stages such as design, procurement, and construction, and formulated multiple precise cost improvement plans with the support

of modern information technology. These strategies help optimize the cost structure of the EPC model in old residential area renovation projects and enhance the overall efficiency of project implementation.

Acknowledgement

Thanks for the project of Research on Cost Management of Old Residential Area Renovation Projects under the EPC Model (Project Number: WLYB202511).

References

Chen Cheng. (2023). *Research on Construction Cost Management of C-type Old Residential Area Renovation Projects under the EPC Model*. Harbin Institute of Technology.

Gao Miaonan. (2022). *Research on Problems and Countermeasures of Old Residential Area Renovation in Shijiazhuang City*. Shijiazhuang: Hebei Normal University.

He Qinqin, Li Xisheng, & Wan Yinzi. (2021). Priority Analysis of Renovation Contents in Old Residential Areas Based on SEM - Taking Shangyi Xin Village in Nanjing as an Example. *Construction Economy*, *2021*(3), 70-74.

Li Mianyue, Huang Li, & Dang Anrong. (2022). Comprehensive Risk Assessment and Update Optimization Strategy Based on Multi-source Data - Taking Fuzhou City Cunshan District as an Example. *Shanghai Urban Planning*, *2022*(03), 38-45.

Li Yang. (2019). *Research on Resident Participation Incentive Mechanism in Urban Old Residential Area Management*. Xi'an: Xi'an University of Architecture and Technology.

Meng Yuan. (2024). *Research on Cost Management Evaluation of Old Residential Area Renovation Projects under the EPC Model*. Hebei Geology University.

Sun Yao, & Zheng Dongyu. (2022). Application of Unmanned Aerial Vehicle Oblique Photogrammetry in BIM Design of Reservoirs. *China Rural Water and Electricity*, *2022*(8), 174-177+181.

Wei Liping. (2023). *Research on Risk Management of Old Residential Area Renovation Projects under the EPC Model*. Hebei Institute of Architectural Engineering.

Zeng Canzhang, & Zhang Xiaojun. (2023). Research on Influencing Factors of Cost Control in Old Residential Area Renovation Projects under the EPC Model. *Construction Economy*, *44*(S1), 245-247.

Zhong Yunfeng. (2021). Research on Difficulties and Measures of Cost Management in Old Residential Area Renovation Projects. *Construction Economy*, *2021*(3), 60-63.