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*Research Article*

# Research on Construction Cost Control Technology of Construction Project Based on Big Data Analysis Theory

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The current methods proposed in construction cost control of construction projects have problems such as applicability and low accuracy. Therefore, this paper proposes a method for evaluating engineering cost control based on the big data Analytic Hierarchy Process (AHP) method. Based on the big data technology, the construction cost control index of the construction project is selected, and the construction cost control index model of the construction project is constructed according to the selection results, and the evaluation set is constructed. The corresponding weights of the construction cost control indicators of each construction project are obtained through the analytic hierarchy process, and a weight set is constructed. The membership relationship between the index set and the evaluation set is determined, a fuzzy relationship matrix is constructed, and the construction cost control result of the construction project is obtained according to the calculated weight and the constructed fuzzy relationship matrix. The test results of examples show that the risk assessment accuracy of the proposed method is higher than that of ordinary methods, and the quantitative processing of audit risk assessment is realized.

## 1. Introduction

With the rapid development of the Internet and cloud computing, all kinds of data have exploded, and mankind has since entered the era of big data [1, 2]. At present, many companies have used big data for business analysis and processing, which is conducive to companies to more accurately specify future development strategies and improve their competitiveness. With the advent of big data, the development of information technology has also had a huge impact on the cost control of construction projects. With the establishment and continuous improvement of the socialist market economic system, construction enterprises have fully implemented the cost control of construction projects. However, how to use big data theory to effectively control construction costs in the construction process of construction projects is a problem that all enterprises and project managers must face.

Scholars at home and abroad have carried out a lot of research on the problem of construction cost control. As early as the beginning of the 14th century, foreign scholars have made preliminary explorations on construction cost control technology. The classical cost control theory has gone through three stages: cost measurement and control, standard cost control, and activity cost control. Early cost control was mainly realized by controlling a single object, ignoring the fact that cost control is actually a complete system [3]. At the end of the 19th century, the scientific management represented by Taylor came into being [4]. After abandoning the traditional experience management, he proposed a relatively complete scientific management method to improve the management quality [5]. Until the beginning of the last century, some scholars put forward the basic concept of standard cost for the first time and implemented it after further improvement [6, 7]. Driven by the trend of the times, in the 1980s, western scholars gradually integrated scientific concepts into cost control theory, thus forming activity-based cost control [8–10]. The above theories have promoted the development of cost control technology in various industries to a certain extent. In recent years, some scholars have also carried out relevant research on construction cost control in the field of construction engineering. Zhou pointed out that the cost control in the construction phase of the construction project is an effective means to reduce the investment consumption of the construction project and control the investment waste in the construction phase [11]. The cost management of construction enterprises is an important part of project cost control in the whole process of project construction. Feng et al. expounded the details and steps of the cost management of construction enterprises in the construction stage. This paper divided the project cost management into three stages: project preparation stage, implementation stage, and completion stage. Construction companies adopt the methods of precontrol, process control, and post-event control, respectively, for the cost management of each stage [12]. Li established a project cost control case database and used the weighted grey correlation method to realize case retrieval, so as to find the best solution for the new project cost management control problem [13]. Zhang et al. (2014) described the connotation and significance of cost control of engineering construction projects, systematically discussed the main procedures and work content of project cost management, and, combined with engineering practice, emphatically analyzed the cost management and cost control measures in the construction stage [14]. Oyegoke et al. identify and analyze the factors influencing the choice of effective cost control techniques for the UK construction industry and assess their importance [15]. Abbas et al. analyzed the unfavorable factors of cost control in Iraqi construction projects by carrying out a questionnaire. The results show that modern construction concepts, methods, and technologies are the main factors restricting the cost control of the project [16]. After analyzing the characteristics and costs of construction projects, Dai et al. constructed a cost early warning system suitable for construction projects based on the earned value management method [17]. Xie et al. put forward a method to control the cost of construction projects by combining artificial intelligence technology and wireless communication after analyzing market fluctuations and national policies in the construction industry [18]. Zhang et al. proposed a dynamic control method of construction cost for coastal engineering projects based on rough set theory, and the results show that the amount of data is the main factor to objectively judge cost control [19]. Korke et al., from the perspective of potential owners of construction assets, finally proposed a technology for construction cost control of construction projects by analyzing the financial feasibility of the investment and analyzing all aspects of cost control [20]. Ai put forward corresponding measures to control the cost of construction projects from the aspects of the preliminary planning of project cost, the control of labor costs in the process of project cost, the guarantee of bidding and procurement of bulk materials, the implementation of the quota system, and the management of turnover materials [21]. The above research has focused on the area of analysis of cost control techniques in engineering construction. However, the current data sources focus on individual construction projects, which results in the proposed cost control techniques not being prevalent in the construction projects concerned. It is also impossible to reasonably guide the project construction and the corresponding project cost control. In addition, most of the above studies are considered from the perspective of cost control in the whole process of the project. Although they can provide guidance for cost control in the whole process of the project, they cannot specifically guide the cost control in the construction stage due to the long project cycle.

In this paper, after collecting and sorting out the current data in the field of construction engineering through big data technology, based on the principles of comparability, independence, operability, and comprehensiveness, the impact indicators of cost control in the construction process of construction projects are selected. After the judgment matrix of the influencing factors of construction cost control, the relative weight of each influencing factor evaluation index is obtained by expert evaluation, and the method of construction cost control of construction engineering is proposed. On this basis, taking a construction project as an example, the feasibility and accuracy of the construction cost control method established based on the big data analysis theory were tested.

## 2. Principles and Basis of Construction Cost Control of Construction Projects

The construction phase of a construction project is long, and there are many uncertain factors affecting the cost control. For example, due to the strengthening of environmental protection policies, the prices of raw materials such as sand, gravel, and cement have risen sharply in some areas. In addition, when a construction project is undergoing underground construction, the underground situation is relatively complex, and the preliminary survey may not be comprehensive and accurate, resulting in a large number of design changes and engineering visas. If the construction unit does not pay enough attention to project changes and visa work, or the work procedures are not rigorous, it will also bring great uncertainty to the cost control of construction projects. For example, when a visa occurs, the construction unit may exaggerate the amount and scope of the project for the project visa. The supervisors have poor business ability, are not familiar with contracts and related regulations, and blindly sign their certification. Since the construction unit is a follow-up audit, it may not have a good understanding of the actual situation on-site. The above problems all bring hidden dangers to the cost control of construction projects and cause financial investment losses.

*2.1. Principles of Construction Cost Control of Construction Projects.* The cost control in the construction stage is a dynamic control process that is constantly cyclical. The so-called dynamic cost control of engineering projects is the collection of a large amount of data and information generated by the project manager at any time during the construction stage of the construction project, and the comparison between the actual cost and the target cost is carried out in real time. If cost deviations are found to be outside the permissible range, corrective measures are taken in a timely manner, while, at the same time, projections are made for future phases based on the actual costs of the project. In addition, comparisons are made with target costs, and deviations are constantly identified and corrected, so that actual costs are kept close to cost control targets. Figure 1 shows the schematic diagram of construction cost control of construction projects.

*2.2. Basis for Construction Cost Control of Construction Projects.* Basis for cost control in construction stage Basis for cost control in construction stage includes the following: (1) engineering contract: the cost control in the construction stage should be based on the project contract, around the goal of reducing the project cost, from both the budget revenue and the actual cost, and strive to tap the potential of increasing revenue and reducing expenditure, in order to obtain the greatest economic benefits. (2) Construction cost plan: the construction cost plan is a cost control plan in the construction stage formulated according to the specific conditions of the construction project. It includes not only the predetermined specific cost control goals, but also the measures and plans to achieve the control goals. It is the guiding document for the cost control in the construction stage. (3) Progress report: the progress report provides important information such as the actual completion of the project at each moment and the actual payment of the cost during the construction stage. The construction cost control work is to compare the actual situation with the cost plan of the construction stage, find out the difference between the two, analyze the reasons for the deviation, and take measures to improve the future work. In addition, the progress report also helps managers discover hidden dangers in project implementation in a timely manner and take effective measures to avoid losses as much as possible before the situation causes major losses. In addition to the above-mentioned main bases for cost control in the construction stage, project changes, related construction organization design, subcontract documents, etc. are also the basis for cost control in the construction stage.

In this paper, under the condition of strictly following the principles and basis of construction cost control proposed above, the hierarchical analysis method based on the big data environment is used to propose the construction cost control method for construction projects. The proposed method can provide reference and guidance for the construction of building projects in a more accurate and reasonable manner.

## 3. Establishment of Construction Cost Control Objectives and Index System under Big Data Environment

*3.1. Objectives of Cost Control.* The cost control objective must be clear and scientific, and only the effective control behavior can be guaranteed. If there is no goal, the control will lose its direction; if the goal setting is unscientific, the control behavior will deviate from the normal running track. The ultimate goal of cost control is to reduce costs. The resources (human, financial, and material) owned by any organization are limited, and any economic activity is inseparable from the role of economic laws. However, the role of the law of value prompts people to continuously pursue the least resource consumption, obtain better quality and more quantitative results, and try their best to achieve economic or social benefits that are higher than the average social consumption level. Therefore, it is necessary to strictly control the consumption of resources under the premise of satisfying a certain quality and function. The role of this value law and benefit mechanism is the economic basis for cost control. Use big data analysis theory to analyze various costs that occur in the production and operation process, find unnecessary economic expenditures and improve them, reduce any costs that do not increase the value of the enterprise, and thus reduce costs.

*3.2. Data Sources.* Based on the data collection method under the big data technology, the construction cost information of related enterprises in the construction industry is collected. The data set includes the construction cost information of the construction engineering field in different provinces in the past 10 years. By analyzing the collected information with the help of big data technology and following the index selection principles described in the following section, the evaluation indicators are organized.

*3.3. Principles of Indicator Selection.* The establishment of the evaluation index system should be determined according to the actual situation, and the establishment of the evaluation system is also different for different research purposes. Since the functions and costs in value engineering always change at the same time, an appropriate evaluation system should be selected to achieve the optimal matching between the two while quantitatively evaluating the indicators. Therefore, the establishment of the construction cost control index evaluation system for construction projects should follow the following principles: (1) typicality: the index should have a certain typical representation, that is, reflecting the specific industry as accurately as possible. (2) The comprehensiveness of the comprehensive index is aimed at the whole evaluation system. For example, the established index evaluation index should cover all aspects of the construction process related to the construction cost, and on the premise of ensuring that the evaluation index can truly affect the construction cost, the evaluation index should be refined and simplified as far as possible. (3) Systematism means that there must be a certain logical relationship between the indicators. Each subsystem consists of a set of indicators. The indicators are independent and related to each other. (4) Objectivity: the establishment of indicators should respect objective facts, truly and objectively reflect the impact on construction costs of construction projects, minimize the impact of subjective factors on the establishment of indicators, and establish indicators based on the principle of

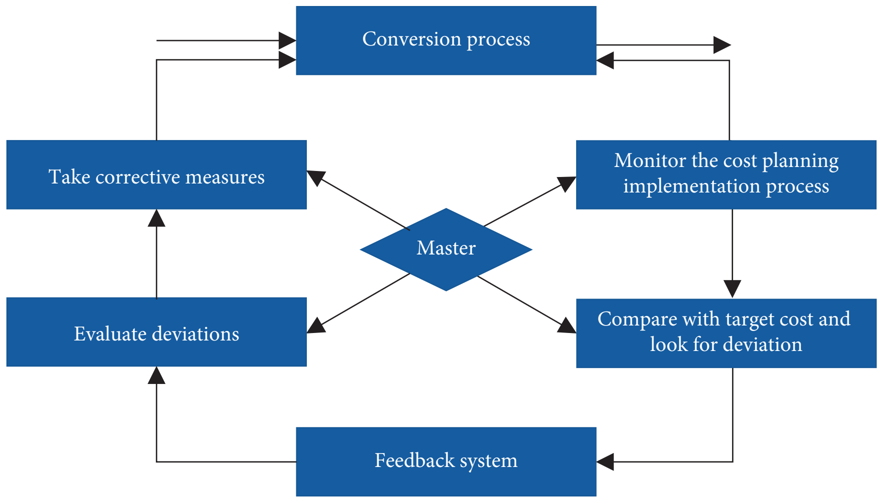



Figure 1: Schematic diagram of construction cost control of construction projects.

objectivity. (5) The establishment of operable and quantifiable indicators should have certain operability and be as simple as possible and easy to use in practice. At the same time, the principle of combining quantitative and qualitative is adopted to quantify each functional index, which is convenient for mathematical calculation and analysis.

*3.4. Determination of Evaluation Indicators.* The evaluation indicators of construction cost control of construction projects mainly include direct cost control and indirect cost control. The potential costs and importance involved in each factor are as follows: direct costs refer to the expenses that constitute or contribute to the formation of the engineering entity during the construction process and are expenses directly related to the production process. The results of the big data analysis show that direct cost control mainly includes production workers' wages, raw materials, fuel, electricity costs, and depreciation of machinery and equipment, while indirect cost control mainly includes managers' wages, office expenses, travel and transportation costs, labor insurance costs, inspection, and testing costs.

The construction cost control of construction projects is affected by many factors. The importance and influence of each factor are different. If all factors are used as evaluation indicators, unnecessary calculations will be added; if too few factors are used as evaluation indicators, it will be difficult to accurately reflect Reliability and accuracy of construction cost control. Therefore, based on the construction cost control index obtained from big data statistics, the key factors were identified, the main index parameters were extracted, and the evaluation index system as shown in Figure 2 was established. There are 2 first-level indicators, namely, direct cost $U_1$ and indirect cost $U_2$. There are 5 second-level indicators: $U_1$ includes $U_{11}\sim U_{13}$, including labor cost, material cost, and machinery cost. There are 13 three-level indicators in total. $U_{11}$ includes $U_{111}\sim U_{114}$, including time fee, bonus, allowance, and expenses paid under special circumstances, respectively. $U_{12}$ includes $U_{121}\sim U_{123}$, including raw material fee, material transportation fee, and material transportation loss fee, respectively. $U_{13}$ includes $U_{131}\sim U_{132}$ for mechanical usage fee and instrument usage fee; $U_{21}$ includes $U_{211}\sim U_{212}$ for fuel power fee and other loss fee; $U_{22}$ includes $U_{221}\sim U_{222}$ for data acquisition fee and testing and laboratory processing fee, respectively.

## 4. Establishment of Construction Cost Control System under Big Data Environment

*4.1. Building the Hierarchy.* Analytic Hierarchy Process (AHP) expresses the problem to be solved by establishing a hierarchical structure, which generally includes the target layer, the criterion layer, and the substandard layer. According to the evaluation index system established in Figure 2, the goal is the construction cost control of construction projects, which includes two first-level indicators $U_1\sim U_2$, and three and two second-level indicators under the first-level index, respectively. Similar to the second-level index, the next time contains 4, 3, 2, 2, and 2 tertiary indicators.

*4.2. Constructing the Judgment Matrix.* Judgment matrix is used to judge the relative importance of elements in the same layer, which is an important step of AHP. A judgment matrix is constructed for the elements of each layer in Figure 2, and the relative importance of the elements of the same layer is judged by the pairwise comparison between the elements. Tables 1–3, respectively, give the judgment matrix of construction cost control and direct and indirect cost control. The evaluation index model corresponding to the construction cost control index of the construction project is shown in Table 4.

*4.3. Hierarchical Consistency Test.* Calculation of relative weight: based on the feature vector method, the feature vector of the judgment matrix can be obtained:

$$AW = \lambda_{\max} W, \tag{1}$$

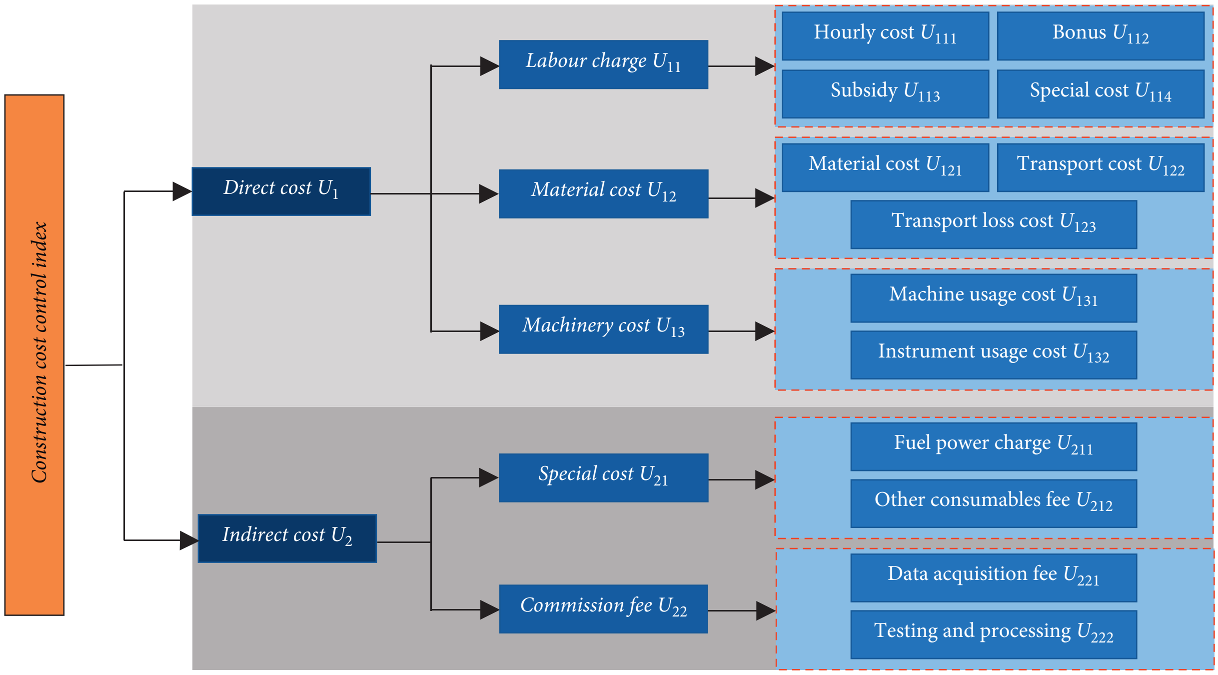



FIGURE 2: Index system of construction cost control based on big data theory.

TABLE 1: Construction cost control judgment matrix $A$.

| $A$ | $U_1$ | $U_2$ |
|---|---|---|
| $U_1$ | 1 | $a_1$ |
| $U_2$ | $a_2$ | 1 |

TABLE 2: Direct and indirect cost control judgment matrix $A_1$.

| Factor index | $A_1$ | $U_{11}$ | $U_{12}$ | $U_{13}$ |
|---|---|---|---|---|
| Direct cost $U_1$ | $U_{11}$ | 1 | $a_{12}$ | $a_{13}$ |
| | $U_{12}$ | $a_{21}$ | 1 | $a_{23}$ |
| | $U_{13}$ | $a_{31}$ | $a_{32}$ | 1 |

TABLE 3: Indirect cost control judgment matrix $A_2$.

| Factor index | $A_2$ | $U_{21}$ | $U_{22}$ |
|---|---|---|---|
| Indirect cost $U_2$ | $U_{21}$ | 1 | $a_{12}$ |
| | $U_{22}$ | $a_{21}$ | 1 |

where $\lambda_{\max}$ denotes the maximum eigenvalue of $A$. The eigenvector $W$ corresponding to $\lambda_{\max}$ is normalized to obtain the weight vector $\overline{W}$ between elements of the same layer.

When there are more elements to be judged (more than two), it is easy to construct a contradictory judgment matrix. Therefore, Saaty proposed to use the consistency ratio "*CR*" to test the consistency of the judgment matrix [22]. Consistency index "*CI*" is calculated in Formula (2), where $n$ represents the order of judgment matrix:

$$\mathrm{CI} = \frac{\lambda_{\max} - n}{n - 1}. \quad (2)$$

For problems with three or more layers in the hierarchical structure, the relative weights between the elements of each layer from low to high should be calculated first through the judgment matrix, and then the composite weight of the lowest-level elements to the total target should be calculated, and the overall consistency test should be carried out. The consistency test of the total ranking needs to consider the consistency index "*CI*" and the average consistency index *RI* based on the element weights of each layer, and the consistency ratio is

$$\mathrm{CR} = \frac{\sum_{i=1}^{n} w_i \mathrm{CI}_i}{\sum_{i=1}^{n} w_i RI_i}. \quad (3)$$

For the hierarchy established in Figure 3, $w_i$ is the relative weight value of each criterion, and $CI_i$ and $RI_i$ are the consistency index and average consistency index of corresponding judgment matrix $A_1 \sim A_2$.

*4.4. Evaluation of Construction Cost Control.* The constructed first-level indicator set is the expected audit risk indicator set:

$$U = \{U_1, U_2\}, \quad (4)$$

where $U$ represents the set of construction cost control indicators; $U_1$ represents the direct cost control indicator of construction; $U_2$ represents the indirect cost control indicator of construction. The constructed secondary index sets are the direct cost control index set and the indirect cost control index set, of which the direct cost control index set is as follows:

$$U_1 = \{U_{11}, U_{12}, U_{13}\}, \quad (5)$$

Table 4: Importance scale and its meaning in scale method.

| Serial number | Importance scale | Implication |
|---|---|---|
| 1 | 1 | $U_i$ is just as important as $U_j$. |
| 2 | 3 | $U_i$ is slightly more important than $U_j$. |
| 3 | 5 | $U_i$ is obviously more important than $U_j$. |
| 4 | 7 | $U_i$ is more important than $U_j$. |
| 5 | 9 | $U_i$ is absolutely more important than $U_j$. |
| 6 | 2, 4, 6, 8 | The median value between two adjacent judgments. |
| 7 | Count backward | If the importance value of $U_i$ and $U_j$ is $a_{ij}$, then the importance ratio of the two is $1/a_{ij}$ |

where $U_{11}$ to $U_{13}$ represent the secondary indicators corresponding to the direct cost control indicators, respectively. The specific set of indirect cost control indicators is as follows:

$$U_2 = \{U_{21}, U_{22}\}, \tag{6}$$

where $U_{21}$ to $U_{22}$ represent the secondary indicator corresponding to the indirect cost control indicator.

The evaluation set is a set of grades for evaluating each medical accounting audit risk evaluation index. The constructed evaluation set is as follows:

$$V = \{V_1, V_2, V_3, V_4, V_5\}, \tag{7}$$

where $V$ represents the constructed evaluation set; $V_1$ represents a high cost; $V_2$ represents a high level of cost; $V_3$ represents a medium level of cost; $V_4$ represents a low level of cost; $V_5$ represents a very low level of cost.

As the influencing factors of construction project cost control are mainly qualitative influencing factors, according to the principle of determining the membership function, this paper adopts the ridge distribution function. Considering that there is no numerical distinction between qualitative indicators, they cannot be quantified. It is necessary to first quantify these indicators and divide them into five grades: very poor, poor, medium, good, and excellent, with assigned grade values of 0.9, 0.7, 0.5, 0.3, and 0.1. Further, according to the principles of the determination of the affiliation function, the trapezoidal function is chosen here.

Aiming at the factor set $U$ of construction cost control indicators, the risk assessment indicators at the same level are compared through the scaling method to obtain relative weights, so as to construct the judgment matrix. From Tables 1 and 2, it can be seen that the specific judgment is as follows:

$$A = [A_1, A_2], \tag{8}$$

where $A$ represents the judgment matrix, and $A_1, A_2$ represent the judgment matrix elements corresponding to the material misstatement risk index and the inspection risk index. Finally, the eigenvectors of the construction cost control evaluation indicators of each construction project are calculated to obtain their weights, and the consistency test is carried out.

The membership relationship between the index set and the evaluation set is determined, and a fuzzy relationship matrix is constructed. The constructed matrix is as follows:

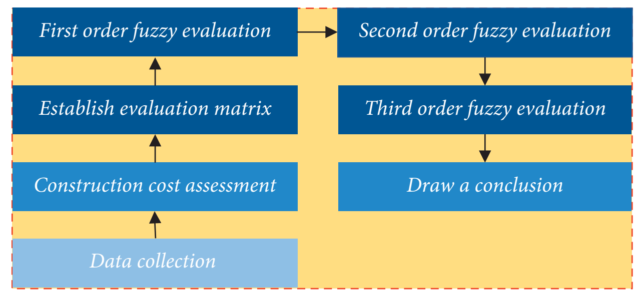



Figure 3: Basic flow of fuzzy hierarchical comprehensive evaluation.

$$R_i = \begin{bmatrix} r_{11} & \cdots & r_{13} \\ \vdots & \ddots & \vdots \\ r_{m1} & \cdots & r_{mn} \end{bmatrix}, \tag{9}$$

where $R_i$ represents the fuzzy relationship matrix; $r_{mn}$ represents the membership degree of the rating corresponding to the evaluation index.

According to the calculated weights and the constructed fuzzy relationship matrix, the medical accounting audit risk assessment results are obtained, as shown in the following formula:

$$B_i = W_i \times R_i, \tag{10}$$

where $B_i$ represents the medical accounting audit risk assessment result; $W_i$ represents the calculated index weight. The evaluation results are normalized, and finally, the results are analyzed and explained by fuzzy distribution method, weighted average method, and maximum membership degree method.

According to the data of construction engineering labor cost, mechanical cost, fuel power cost, and other data obtained based on big data theory, the construction cost of each part is analyzed, and then the fuzzy hierarchical comprehensive evaluation method is used to control and evaluate the construction cost of the entire construction project. The basic process is as follows: shown in Figure 3. Figure 3 shows the basic flow of fuzzy hierarchical comprehensive evaluation.

## 5. Risk Assessment Case Study

A company invests in the construction of apartment-style houses in a city to solve the living problems of residents in the city. The optimal design scheme is determined through the analytic hierarchy process based on the theory of big data, so as to control the cost. The specific construction plan is a 33-story frame shear wall structure with elevators inside. It is a unit apartment-style residence with three units per ladder. The area of the unit is 70–105 $m^2$. The exterior windows are made of aluminum alloy windows, and the exterior walls are made of beige paint. The interior is wall-mounted radiator, composite wood floor, etc. The surrounding greenery of the apartment is better, and there are cultural and entertainment facilities. Combined with the actual project, the optimal plan for the construction cost control of the project is obtained through big data analysis. At the same time, in order to highlight the superiority of big data theory in the analytic hierarchy process, the problem is further explained by comparing it with the traditional analytic hierarchy process. Test the accuracy data of construction cost control based on the big data analytic hierarchy process cost control evaluation method and the traditional analytic hierarchy process, and the obtained experimental results are shown in Figure 4. According to the experimental results of evaluation accuracy in Figure 4, the accuracy rate of construction cost control based on big data AHP is basically maintained at 90%, while the accuracy of construction cost control obtained without big data AHP is accurate. The rate remains at 80%. It can be seen that the construction cost control technology based on the big data theory is obviously better.

Figure 5 shows the weight distribution of the above construction cost control indicators in a pie chart. As can be seen from Figure 5, for the construction cost control of construction projects, the direct cost accounts for the largest weight, accounting for 74.3%, and the indirect cost accounts for the second weight, accounting for 25.7%. This shows that, for the construction of the project, both direct and indirect costs have a significant impact on the project construction cost, but direct cost control has a greater impact on project cost control. Therefore, in the actual construction process, more attention should be paid to the direct cost of the project control.

Figure 6 is a weight distribution diagram of direct and indirect cost control in the construction of construction projects. As can be seen from Figure 6(a), for direct cost control, the impact of labor costs has the largest weight, accounting for 63.9%, the mechanical cost has the lowest weight, accounting for 11.4%, and the material cost is in the second place. Between. In general, the weights of the direct cost control indicators of construction projects are ranked as follows: labor wages > material costs > machinery costs. This shows that in terms of direct cost control of construction projects, special attention should be paid to manual deployment during construction, and the work efficiency of personnel in various positions should be improved as much as possible to reduce unnecessary labor costs. As can be seen from Figure 6(b), special expenditures account for the largest proportion of indirect costs, and special attention should be paid to this impact when controlling construction costs. Special expenditures are more important than entrusted expenditures, which shows that when choosing construction cost control, the impact of special expenditures should be fully considered.

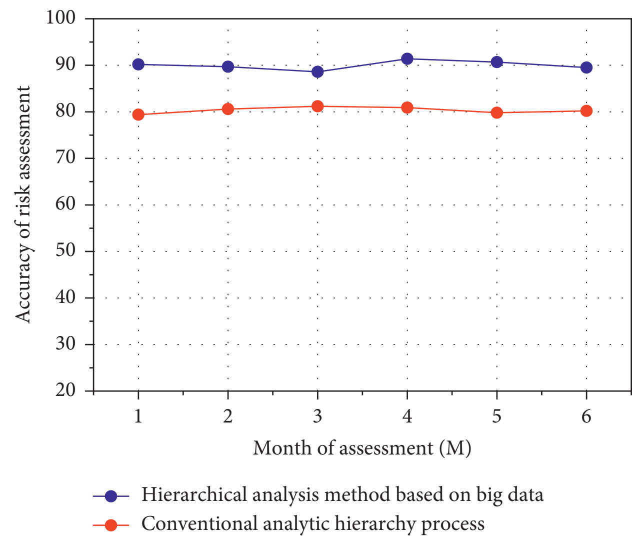



FIGURE 4: Accuracy test results of construction cost control in construction projects.

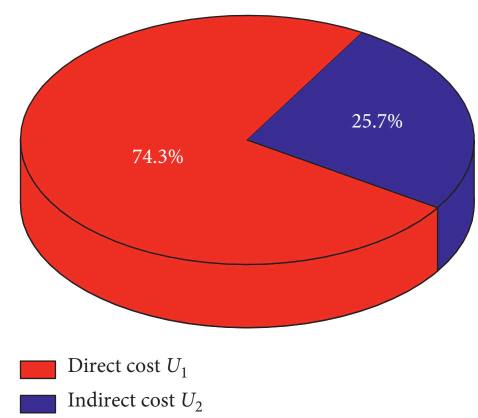
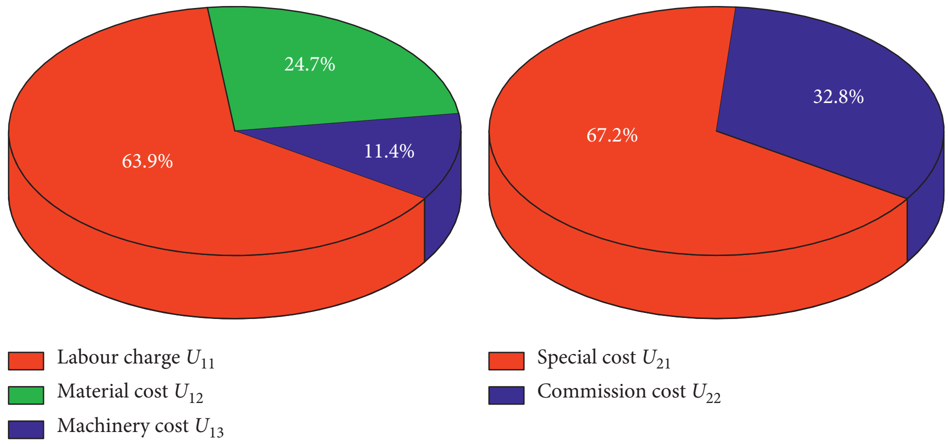



FIGURE 5: Weight distribution of primary indicators.

Table 5 shows the weight ranking of the three-level indicators of construction cost control on the target layer. It can be seen from the table that the consistency check meets the basic requirements. Among all the three-level indicators, the manual time fee occupies the largest weight, while the test and laboratory processing fee in the commission fee occupies the smallest weight. Therefore, for this project, among all possible construction costs in the comprehensive construction project, the construction cost control can mainly be controlled from labor costs, fuel power costs, etc. The above conclusion will also effectively guide the construction unit to control the construction cost of the project.

Based on the above analysis, direct cost is the main factor restricting the cost control of construction projects. After comprehensively analyzing the relationship between the actual situation of construction projects and construction costs, this paper puts forward the following suggestions for direct cost control of construction projects, in order to better guide project construction cost control.

First of all, according to the construction progress, at the beginning of the month, the labor quantity is reasonably




(a) . (b)

Figure 6: Weight distribution of direct and indirect cost control in construction projects. (a) $U_1$ weight distribution. (b) $U_2$ weight distribution.

Table 5: The weight ranking of the three-level indicators of construction cost control on the target layer.

| Second indexes | Third indexes | Weight | Sort order | Consistency ratio |
|---|---|---|---|---|
| Labour charge $U_{11}$ | $U_{111}$ | 0.207 | 1 | 0.0851 < 0.1 |
| | $U_{112}$ | 0.135 | 2 | |
| | $U_{113}$ | 0.091 | 5 | |
| | $U_{114}$ | 0.041 | 10 | |
| Material cost $U_{12}$ | $U_{121}$ | 0.102 | 4 | |
| | $U_{122}$ | 0.055 | 8 | |
| | $U_{123}$ | 0.027 | 12 | |
| Machinery cost $U_{13}$ | $U_{131}$ | 0.056 | 7 | |
| | $U_{132}$ | 0.029 | 11 | |
| Special cost $U_{21}$ | $U_{211}$ | 0.123 | 3 | |
| | $U_{212}$ | 0.050 | 9 | |
| Commission fee $U_{22}$ | $U_{221}$ | 0.061 | 6 | |
| | $U_{222}$ | 0.023 | 13 | |

calculated according to the process and the market labor unit price to calculate the control index for this month. Second, during the construction process, the daily labor quantity is continuously recorded according to the project subitem, and the same project is completed after a subitem is completed. The labor quantity in the quantity list quotation is compared to find out the existing problems, and the corresponding procedures are carried out to correct the control indicators. After completing several project subitems every month, the labor quantity in the engineering quantity list quotation of the respective divisions is compared to assess the completion of the control indicators. Saving labor through this control means reducing labor costs, that is, increasing corresponding benefits.

Secondly, the procurement department will issue the amount of materials required for the construction of this month to the procurement department. On the premise of ensuring the quality of materials, the check and storage link should be strictly control. Secondly, strictly implement the quality procedures and documents to ensure the reasonable stacking of materials and reduce secondary handling in the construction process. The specific operation is based on the progress of the project, and the quota is used. After completing a subitem, the control effect shall be assessed. At the end of the month, the control amount and price shall be compared with the actual quantity to assess the actual effect, whether there is a problem that the same developer calculates the price difference of materials, etc. The focus of materials cost management under the bill of quantities quotation is to keep abreast of market price changes throughout the construction period and to stock up on quality and inexpensive materials in a timely manner. In addition, the availability of materials during the construction process is enhanced by establishing its own material supply base to reduce the rate of material loss during the transportation of materials. The utilization rate extends the service life of the self-owned revolving materials, and the leased revolving materials are accurately calculated according to the construction period and the days of use are accurately returned to the rental unit when they are not needed to reduce the number of occupied days.

Finally, the expenditure of machinery fee is about its control index of the cost of construction products. The number of mechanical console shifts to be used is calculated according to the bill of quantities. Detailed records of the shifts are made every day during the construction process. If there is a power failure on-site that exceeds the time specified in the contract, the on-site visa record should be prepared with the contractor on the same day. The actual shifts will be used at the end of the month. Compare and analyze the reasons for the difference in quantity with the absolute number of control classes. Generally, a lease agreement is adopted for the price of machinery costs. The contract generally does not change during the settlement period. Controlling the actual consumption is the key. According to the on-site situation, the equipment should be arranged reasonably, and the time of entering and leaving the site should be reasonably arranged to make full use of the large equipment to reduce the cost.

## 6. Conclusion

Based on the existing fuzzy comprehensive evaluation method, aiming at the problem of construction cost control of construction projects, this paper uses the big data theory and introduces the analytic hierarchy process to comprehensively evaluate the construction cost control. The main conclusions are as follows:

(1) Based on the characteristics and principles of construction cost control, through the big data analysis theory, two main influencing factors are proposed when considering construction cost control, that is, direct cost and indirect cost, and various factors for construction cost control are further determined. On this basis, an evaluation index system for construction cost control of construction projects is established.

(2) Compared with the traditional analytic hierarchy process, the accuracy of construction cost control indicators obtained based on big data theory is higher.

(3) For the construction cost of construction projects, the proportion of direct costs is relatively large, and labor costs account for the largest proportion. On the contrary, indirect costs account for a relatively small proportion, and among them, the proportion of testing and laboratory processing fees is the smallest.

## Data Availability

The experimental data used to support the findings of this study are available from the corresponding author upon request.

## Conflicts of Interest

The authors declare that they have no conflicts of interest to report regarding the present study.

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