Research Article

Construction Cost Budget Control Based on the Dynamic Distributed Clustering Algorithm

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In order to improve the effect of construction cost budget control, this paper applies the dynamic distributed clustering algorithm to the analysis of project cost budget data and proposes a two-stage strategy iterative algorithm to obtain the iterative control law and iterative performance index function. Moreover, this paper constructs an executive evaluation neural network to approximate the iterative control law and iterative performance index function, respectively. This neural network structure can implement the proposed algorithm online without the need for system dynamics. Through numerical simulation research and evaluation test research, it can be seen that the dynamic distributed clustering algorithm proposed in this paper has a good effect on the construction cost budget control system, which can effectively improve the reliability of construction project cost budget control.

1. Introduction

In the past ten years, many professionals have compiled different types of the budget estimation software, which have been applied to a certain extent in actual budget estimation work. This software gives full play to the characteristics of fast computing speed and a large amount of stored information, which greatly improves work efficiency and reduces the labor intensity of staff. However, compared with the best software in the world, there is still a big gap in the ability of logical analysis and the scope of adaptability between the currently used budget software.

At present, there are still many unsatisfactory aspects of the construction engineering budgeting software, and many softwares are limited to the internal use of the development unit, or the use of similar units. There are still many units that still use the traditional manual method to prepare budget estimates because they do not have the budget estimation software. But at the same time, it is undeniable that the development of the engineering budget software has also achieved great results [1]. Engineering budget software has played an irreplaceable role in the fields of rapid bidding quotation, completion settlement, and other fields of today’s projects. According to the calculated project quantity, the project budget software has been able to transform it into the project cost, and timely print out the beautiful and standard project quotation, quantity of materials, and other materials as required [2]. It can be said that in this step, the engineering budget software can completely replace people, free the staff from tedious calculation, and copy work. Analyzing this step, it can be found that the project budget software mainly completes the input query and calculation tasks of the database, including the quota database, the quantity machine database, etc., in this process, and then attaches the print output [3]. From a technical point of view, this step is actually a database operation problem. In today’s computer technology, the language used for database programming has developed rapidly, such as the famous Visual FoxPro, Access, and Delphi, are quite mature. It provides perfect database operation commands and has a perfect editing user-friendly interface function, which is a very good platform for developing the engineering budget software [4].
The key technical problem that restricts the development of the engineering budget software into a truly complete budget software is how to make the computer recognize the drawing like a human and calculate the engineering quantity according to the requirements [5].

In the bidding stage, the tenderer can use the project cost index to determine a reasonable winning bid, and avoid the phenomenon of winning the bid below the cost price or exceeding the block price. In the construction stage, the project cost index provides an important reference for compiling the budget cost, and it has an important role in determining the budget cost. Accuracy allows for quick judgment. It can be said that the project cost index plays an extremely important role in the dynamic management of the project cost [6].

The role of the construction project cost index runs through the whole process of construction, and plays different roles in the construction project initiation stage, feasibility study stage, design stage, bidding, and construction stage [7]. The project cost index can be directly used for investment estimation in the project approval stage of the construction project; in the feasibility study stage of the construction project, it provides an important economic reference index for the owner to determine the investment quota; in the design stage, it provides convenience for limit design; in the bidding stage, it is reasonable to determine the bottom bid and block price to provide reference, so as to select the winning bidder; the construction stage can be used for the review of the construction budget and final accounts [8]. Therefore, the research on the index of the project cost can play a very good role in the control of the project cost in the whole process of the construction project. For government-invested construction projects, in order to avoid blind investment and capital waste, the government’s fund manager needs to know the cost of the proposed project, which requires an economy that can be directly used for investment control. The reference index [9]. The construction cost index is such an economic reference index, which can easily determine the investment estimate of the proposed construction project. Therefore, the compilation and release of the project cost index can provide a reference for government construction projects on project cost management, thereby guiding government departments to rationally use funds and select construction-related units [10].

The influencing factors of the project cost are the direct reasons for the determination of the project cost, and there are many factors that affect the project cost, and different scholars have different views. Reference [11] analyzes the reasons for the out-of-control cost of construction projects in the construction stage, in view of the current situation of separation of technology and economy in the field of engineering construction. The contract terms are not strictly signed, the construction organization design is not optimized, the design change and on-site visa management are chaotic, and the construction progress is blindly pursued. Literature [12] believes that the factors affecting the project cost are as follows: changes in engineering designs, changes in equipment and material prices, changes in fixed cost standards, changes in underground and underwater conditions during construction, changes in labor wages, and force majeure factors. And the whole process of the construction itself. Reference [13] analyzes and research the influencing factors of the project cost in the construction stage from the perspective of the construction party from the key links of the project cost control link, implementation of the construction organization design or the scheme review link, the material management link, and the completion settlement review link. Research on technical methods of cost control. There are many methods of project cost control at present, and these cost control methods have certain reference and guiding significance for the actual implementation of the project. Reference [14] proposed the use of the cost index for dynamic control of the project cost. He pointed out that the pricing basis or the cost document prepared by the engineering cost management agency or the enterprise or the engineering cost consulting unit should have the quantity and unit price of labor, main materials, and main machinery shifts, rather than the complete unit price, and should match the basis of the pricing. The project cost index is regularly compiled, so that the dynamic management and control of the project cost can be put into practice. Reference [15] applied value engineering to the research on cost control in the construction phase of construction projects, and pointed out that in order to realize the cost control of value engineering in the construction phase, the following aspects should be started: value analysis of the engineering design, analysis of construction plans, manual configuration analysis, material comparison analysis, mechanical equipment analysis, subcontracting plan analysis, and construction team selection analysis. In view of the fact that the research and practice of quality, cost, and schedule at home and abroad are generally independent and fragmented, the literature [16] proposes a new concept of comprehensive control technology for the reliability of the three objectives of construction project quality, cost, and schedule. To ensure that the three goals are in a relatively ideal state during the construction process, a new and feasible way has been explored. In [17], the earned value principle is used in the control research of the construction project cost. In the research, a numerical analysis method is introduced to convert progress deviation originally expressed as cost deviation in the earned value principle into time deviation, and at the same time, the grey number sequence prediction theory is used to establish a progress-cost deviation prediction GM (1, 1) model, and realize computer-aided application of earned value control methods. Reference [18] proposes to establish an earned value management system to implement dynamic integrated management of engineering costs.

In order to improve the effect of the construction project cost budget, this paper applies the dynamic distributed clustering algorithm to the analysis of project cost budget data and constructs an intelligent cost budget control system to promote the reliability of the project cost budget.

2. Dynamic Distributed Clustering Control

We first give the following lemma, which is of great significance to the convergence analysis of the TSPI algorithm.
\[ V^{l,0}_{i}(e_i(k)) \leq V^{l,1}_{i}(e_i(k)), \]
\[ V^{l+1,0}_{i}(e_i(k)) \leq V^{l+1,1}_{i}(e_i(k)), \]
\[ V^{l+0,1}_{i}(e_i(k)) \leq V^{l+0,1}_{i}(e_i(k)). \]

**Proof.** We next prove it by mathematical induction. First, we set \( l = 1 \) and then we have
\[ V^{1,0}_{i}(e_i(k)) = c_i(e_i(k), u^0_i(k)) + aV^{0}_{i}(e_i(k + 1)), \]
\[ = \min_{u_i(k)}\{c_i(e_i(k), u_i(k)) + aV^{0}_{i}(e_i(k + 1))\}, \]
\[ \leq c_i(e_i(k), u^0_i(k)) + aV^{0}_{i}(e_i(k + 1)), \]
\[ = V^{0}_{i}(e_i(k)). \]

When there is \( j_i = 0 \), we can get
\[ V^{1,1}_{i}(e_i(k)) = c_i(e_i(k), u^1_i(k)) + aV^{1}_{i}(e_i(k + 1)), \]
\[ \leq c_i(e_i(k), u^0_i(k)) + aV^{0}_{i}(e_i(k + 1)), \]
\[ = V^{0}_{i}(e_i(k)). \]

When there is \( j_i = 1 \), we can get
\[ V^{2,1}_{i}(e_i(k)) = c_i(e_i(k), u^1_i(k)) + aV^{1}_{i}(e_i(k + 1)), \]
\[ \leq c_i(e_i(k), u^1_i(k)) + aV^{1}_{i}(e_i(k + 1)), \]
\[ = V^{0}_{i}(e_i(k)). \]

We set \( j_i = q, q \) to be a positive integer and satisfy \( q \in (1, N_l) \), then we have
\[ V^{q+1}_{i}(e_i(k)) = c_i(e_i(k), u^1_i(k)) + aV^{q}_{i}(e_i(k + 1)), \]
\[ \leq c_i(e_i(k), u^0_i(k)) + aV^{q+1}_{i}(e_i(k + 1)), \]
\[ = V^{q+1}_{i}(e_i(k)). \]

When there is \( l = n \), inequality (8) obviously holds. Next, we assume that inequality holds when there is \( l = n \) and then we have
\[ V^{n+1,0}_{i}(e_i(k)) \leq V^{n+1,1}_{i}(e_i(k)), \]
\[ V^{n+0,1}_{i}(e_i(k)) \leq V^{n+0,1}_{i}(e_i(k)). \]

Therefore, we need to prove that inequality holds when there is \( l = n + 1 \), that is,
\[ V^{n+1,0}_{i}(e_i(k)) = c_i(e_i(k), u^{n+1}_i(k)) + aV^{n}_{i}(e_i(k + 1)), \]
\[ = \min_{u_i(k)}\{c_i(e_i(k), u_i(k)) + aV^{n}_{i}(e_i(k + 1))\}, \]
\[ \leq I_i(e_i(k), u^{n+1}_i(k)) + aV^{n}_{i}(e_i(k + 1)), \]
\[ = V^{n+1}_{i}(e_i(k)), \]
\[ = V^{n+0}_{i}(e_i(k)). \]

When there is \( j_i = 0 \), we can get
\[ V^{n+1,1}_{i}(e_i(k)) = c_i(e_i(k), u^{n+1}_i(k)) + aV^{n+1}_{i}(e_i(k + 1)), \]
\[ \leq c_i(e_i(k), u^{n+1}_i(k)) + aV^{n+1}_{i}(e_i(k + 1)), \]
\[ = V^{n+1}_{i}(e_i(k)). \]

When \( j_i = 1 \), we can get
\[ V^{n+1,2}_{i}(e_i(k)) = c_i(e_i(k), u^{n+1}_i(k)) + aV^{n+1}_{i}(e_i(k + 1)), \]
\[ \leq c_i(e_i(k), u^{n+1}_i(k)) + aV^{n+1}_{i}(e_i(k + 1)), \]
\[ = V^{n+1}_{i}(e_i(k)). \]

Furthermore, it can be obtained that
\[ V^{n+1}_{i}(e_i(k)) = V^{n+1,0}_{i}(e_i(k)) \leq V^{n+1,1}_{i}(e_i(k + 1)), \]
\[ \leq V^{n+0,1}_{i}(e_i(k + 1)), \]
\[ \leq V^{n}_{i}(e_i(k)). \]

Therefore, when there is \( l = n + 1 \), the conclusion holds and the certificate is completed.

**Proof.** First, we define the following two value function sequences, namely,
\[ \{V^{1,0}_{i}(e_i(k))\} = \{V^{0}_{i}(e_i(k)), V^{1,0}_{i}(e_i(k)), \ldots, V^{1}_{i}(e_i(k))\}, \]
\[ \{V^{2,0}_{i}(e_i(k))\} = \{V^{0}_{i}(e_i(k)), V^{1,0}_{i}(e_i(k)), \ldots, V^{2}_{i}(e_i(k))\}, \]
\[ j_i = 0, 1, 2, \ldots, N_l, \]
\[ \{V^{3,0}_{i}(e_i(k))\} = \{V^{0}_{i}(e_i(k)), V^{1,0}_{i}(e_i(k)), \ldots, V^{3}_{i}(e_i(k))\}. \]

**Proof.** First, we define the following two value function sequences, namely,
It is not difficult to find that \( \{ V_l(e_i(k)) \} \) is a subsequence of \( \{ V^i_{l}(e_i(k)) \} \). According to Lemma 3, \( \{ V^i_{l}(e_i(k)) \} \) is a monotonically nonincreasing one. Therefore, we only need to prove that \( \{ V^i_{l}(e_i(k)) \} \) is a convergent sequence, so that \( \{ V^i_{l}(e_i(k)) \} \) is also convergent, and they have the same limit value \( V^*_l(e_i(k)) \), that is,

\[
\lim_{k \to \infty} V^i_{l}(e_i(k)) = \lim_{k \to \infty} V^i_{l}(e_i(k)) = V^*_l(e_i(k)).
\]

The following theorem mainly gives the stability analysis results of the closed-loop multiagent system under the proposed optimal control law (4).

**Theorem 1.** We assume that the leader is the root node in the communication topology network \( \mathcal{G} \). For any agent and \( i \), and the optimal control law \( u^*_i(k) \) satisfies (4). Then, the closed-loop error system is asymptotically stable, and there is \( \lim_{k \to \infty} e_i(k) = 0 \). The trajectory that all follower agents can track on the leader is \( \lim_{k \to \infty} e_i(k) = 0 \).

**Proof:** since the optimal value function \( V^*_l(e_i(k)) \), we can get

\[
c_i(e_i(k), u^*_i(k)) = V^*_l(e_i(k)) - aV^*_l(e_i(k + 1)),
\]

at the same time, and then we have

\[
\alpha^k c_i(e_i(k), u^*_i(k)) = \alpha^k V^*_l(e_i(k)) - \alpha^{k+1} V^*_l(e_i(k + 1)).
\]

We define \( \alpha^k V^*_l(e_i(k)) \) as Lyapunov function, then we have

\[
\Delta(\alpha^k V^*_l(e_i(k))) = \alpha^{k+1} V^*_l(e_i(k + 1)) - \alpha^k V^*_l(e_i(k)).
\]

According to the formula, it can be written as

\[
\Delta(\alpha^k V^*_l(e_i(k))) = -\alpha^k c_i(e_i(k), u^*_i(k)) < 0.
\]

Thus, it is stated that the closed-loop error system is asymptotically stable, that is, \( \lim_{k \to \infty} e_i(k) = 0 \). Then, according to Lemma 1, it can be obtained that when there is \( k \to \infty \), there is \( e_i(k) \to 0, \xi(k) \to 0 \). Therefore, the optimal tracking control problem is solved. The critic network is shown in Figure 1.

The error function \( e_{ai}(k) \) of the evaluation network is defined as

\[
e_{ai}(k) = e_i(k - 1) + a\tilde{W}_ai\psi_{ai}(Y^T_{ai}z_{ai}(k)) - \tilde{W}_ai\psi_{ai}(Y^T_{ai}z_{ai}(k - 1)).
\]

For the evaluation network, the goal of network training is to minimize the following objective function.

\[
E_{ai}(k) = \frac{1}{2}\kappa_{ai}(k)e_{ai}(k),
\]

The gradient descent method is used and we can get the weight update rules of the evaluation network.

\[
\tilde{W}_ai(l + 1), = \tilde{W}_ai(l) - \kappa_{ai}\frac{\partial E_{ai}(k)}{\partial e_{ai}(k)} \frac{\partial e_{ai}(k)}{\partial \tilde{W}_ai(k)}
\]

\[
= \tilde{W}_ai(l) - \kappa_{ai}\psi_{ai}(Z_{ai}(k))\left[c_i(k - 1) + a\tilde{V}_i(k) - \tilde{V}_i(k - 1)\right]^T, \times a\psi_{ai}(Z_{ai}(k)) - \psi_{ai}(Z_{ai}(k - 1)).
\]

Among them, \( Z_{ai}(k) = Y^T_{ai}z_{ai}(k), \kappa_{ai} \) is the learning rate. Execution networks are used to approximate iterative control laws. The output of this network is represented as

\[
\tilde{u}_i(k) = \tilde{W}_ai^T\psi_{ai}(Y^T_{ai}z_{ai}(k)).
\]

Among them, \( z_{ai}(k) \) is the input data of the execution network, the input data is \( e_i(k); \psi_{ai}(z_{ai}(k)) \) to represent excitation function, and \( \tilde{W}_ai \) is the network weight parameter from the hidden layer to the output layer. The structure of the execution network is shown in Figure 2.

The error function of the execution network is defined. The error function is the difference between the value function \( \tilde{V}_i(k) \) and the expected final cost target \( U_i(k) \), that is,

\[
e_{ai}(k) = \tilde{V}_i(k) - U_i(k).
\]
Among them, the expected final cost target $U_i(k)$ is set to zero.

For the execution network, the goal of network training is to minimize the following objective function:

$$E_{ai}(k) = \frac{1}{2} e^T_{ai}(k) e_{ai}(k).$$  \hfill (25)

The gradient descent method is utilized to design the weight parameter update rules of the implementation network as follows:

$$\tilde{W}_{ai}(l + 1) = \tilde{W}_{ai}(l) - \kappa_{ai} \frac{\partial E_{ai}(k)}{\partial \tilde{W}_{ai}(k)} = \tilde{W}_{ai}(l) - \kappa_{ai} \tilde{W}_{ci}^T(k) \psi_{ci}, Z_{ci}(k) \tilde{W}_{ci} \psi_c, C_{ci}, \psi_{ai}, Z_{ai}(k).$$  \hfill (26)

Among them, $Z_{ai}(k) = Y_{ai}^T \sigma_{ai}(k), \psi_{ci} = \partial \psi_{ci}, Z_{ci}(k)/\partial Z_{ci}(k), C_{ci} = \partial Z_{ci}(k)/\partial u_i(k), \kappa_{ai}$ is the learning rate.

It is worth noting that this method only needs system data $x_i, x_j$ and $u_i$ to obtain the optimal control strategy, thus avoiding the requirement of accurate system model information.

The algorithm based on the actor-critic neural network can realize an online update, that is, the iterative step $l$ and the time step $k$ can be updated synchronously. In particular, with the help of actor-critic neural networks, the proposed learning process is a data-driven approach, that is, it does not require an explicit system model and only uses the system state and input data of current and past steps.

By repeating the experiment, the initial weights of the appropriate execution network are selected, and the initial admissible control strategy under the completely unknown system dynamics can be obtained. This admissible control strategy can stabilize the system and ensure the convergence of performance index function.

3. Numerical Simulation Analysis

In this section, we demonstrate the effectiveness of the proposed method through a numerical simulation example. A network topology is considered as a leader-follower multiagent system as shown in Figure 3. Among them, vertices 1, 2, 3, and 4 represent followers, and vertices 0 represent leaders.

According to the interactive network topology, the non-zero element of the adjacency matrix $A_G$ can be obtained as $\mathcal{S} = \text{diag}(1, 0, 0, 0)$. The leader adjacency matrix is $a_{01} = a_{02} = 1$. The weight matrix in the performance indicator function is set to $Q_{11} = Q_{22} = Q_{33} = Q_{44} = I_{2x2}$, $R_{11} = R_{22} = R_{33} = R_{44} = 1$, $S_{21} = S_{31} = S_{41} = 1$ and $S_{12} = S_{14} = S_{23} = S_{24} = S_{34} = S_{43} = 0$.

The system matrix of leader and tracker agents is

$$A = \begin{bmatrix} 0.9950 & 0.0798 \\ -0.0798 & 0.9950 \end{bmatrix}, B_1 = \begin{bmatrix} 0.2047 \\ 0.0898 \end{bmatrix}, B_2 = \begin{bmatrix} 0.2147 \\ 0.2895 \end{bmatrix},$$  \hfill (27)

For the evaluation network and the execution network, the parameters are configured as follows: discount factor $\alpha = 0.95$, network learning rate $\kappa_{ai} = 0.03$, $i = 1, 2, 3, 4$. The choice of excitation function is: $\psi_{ci} (k) = [e_{i1}^2(k), e_{i2}^2(k), \tilde{u}_{i1}(k), e_{i2}^2(k), e_{i1}^2(k), e_{i2}^2(k), \tilde{u}_{i1}(k), \tilde{u}_{i2}(k), \tilde{u}_{i2}(k), \tilde{u}_{i1}(k), \tilde{u}_{i2}(k), \tilde{u}_{i1}(k), \tilde{u}_{i2}(k)],$ $\psi_{ci} (k) = [e_{i1}^2(k), e_{i2}^2(k), \tilde{u}_{i1}(k), \tilde{u}_{i2}(k), \tilde{u}_{i2}(k), \tilde{u}_{i1}(k), \tilde{u}_{i2}(k), \tilde{u}_{i1}(k), \tilde{u}_{i2}(k), \tilde{u}_{i2}(k), \tilde{u}_{i1}(k), \tilde{u}_{i2}(k), \tilde{u}_{i1}(k), \tilde{u}_{i2}(k)],$ $\psi_{ai} (k) = e_{i}(k).$ We set the number of subiterations to be $N_l = 5$, and the computational accuracy of the algorithm to be $\varepsilon = 10^{-5}$. The initial value $\tilde{W}_{ai}(0)$ of the evaluation network is zero, and the initial value $\tilde{W}_{ci}(0)$ of the execution network is randomly selected from $[0, 1]$. The initial values of the system state of the leader and follower are $x_{i0}(0) = [0.6311, 0.0889]^T$, $x_{j1}(0) = [0.9954, 0.3321]^T$, $x_{j2}(0) = [0.2973, 0.0620]^T$, $x_{j3}(0) = [0.2982, 0.0464]^T$, and $x_{j4}(0) = [0.5054, 0.7614]^T$.

The evolution process of the local consistency errors $e_{ci}$ and $e_{ai}$ is shown in Figure 4, and local consistency errors can eventually converge to zero after iteration. The state evolution process of all agents is shown in Figure 4. It can be seen that the states of all followers converge to the state of the leader.

In order to illustrate the tracking process more clearly, Figures 5(a) and 5(b) show the 2D phase-plane diagram and the 3D phase-plane diagram of the state evolution of the leader-follower multiagent system, respectively.

To further verify the effectiveness and superiority of our method, Figure 6 compares the evolution process of the local consistency error of TSPI and the classical PI method. It can be seen that our proposed method can quickly reduce the error in the learning process, which means that our method can achieve better performance in the tracking control process of multiagent systems.
4. Construction Cost Budget Control and Effect Evaluation

The design goal of the construction project budget auxiliary management system is to use the design method combining computer technology, database technology, and NET technology to build a project budget information management system based on the current situation of the project budget in China. On the basis of integrating some excellent functions of the previous software, it further combines a series of problems encountered by the majority of users in the current practical work to further improve the performance of the system. While providing users with powerful functions, the construction project budget auxiliary management information system has made great progress in the ease of use of the system, the security of the system, and the management of the system, which greatly improves the work efficiency of the majority of users.

To strengthen project budget management, it is necessary to do the following: (1) It is necessary to reasonably determine the cost composition of the project cost. The cost of construction projects in China is mainly composed of direct project costs, indirect costs, planned profits, and taxes. This is reflected in the current construction management

Figure 4: The evolution process of the local consistency error $e_i$ ($i = 1, 2, 3, 4$). (a) Evolution of the local consistency error, $e_{i1}$. (b) Evolution of the local consistency error, $e_{i2}$.

Figure 5: Evolution process of all agent states $x_i$ ($i = 0, 1, 2, 3, 4$). (a) Evolution of the state $x_{i1}$. (b) Evolution of the state $x_{i2}$.
system, the calculation is more complicated, and the fee bases and rates vary from place to place, which brings inconvenience to companies undertaking projects across regions in compiling project budgets, and is far from the internationally accepted way of collecting fees. According to the analysis of product value composition, the construction cost has three parts: material consumption expenditure, labor remuneration (wage) expenditure, and profit. The project budget cost should fully reflect the three aspects of product value composition. At present, the cost structure of the project cost is artificially divided into two parts, that is, the labor consumption of production workers is included in direct costs, and the labor consumption of management personnel is included in indirect costs and on-site expenses, which cause the complexity of budget collection. Therefore, materialized labor should be separated from living labor, so that the budgetary cost structure is simpler and easier to operate, and the construction cost structure tends to be internationalized. (2) It is necessary to strengthen the cost budget management in the whole process of project construction. Through the calculation of the economic indicators of the completed project, the reasonable project investment estimation indicators and design estimates are determined. By strengthening investment estimation management and implementing quota design, the static investment of the project is reasonably determined, and the dynamic investment is fully predicted, so as to ensure sufficient funds for construction project decision-making. Moreover, it is necessary to strengthen the control of the cost in the design stage. In the process of project construction and completion acceptance, we pay attention to check against the design plan, and design changes with greater impact must be approved by the original project approval authority. Projects that have not been approved and agreed will not be recognized when reviewing the cost, and the relevant departments should also be held accountable. (3) It is necessary to further improve the construction project budget management system. At present, China’s capital construction system stipulates that “preliminary design must have an estimated budget, engineering design must have a budget, and project completion must have final accounts,” which is called “three calculations.” A review system is also specified at each stage. However, many projects in actual work have the phenomenon of “three calculations and three superpositions.” The reasons are objective factors, such as material cost increase and labor cost adjustment, but there are imperfections in the project budget management system. Therefore, it is necessary to improve the project budget management system, establish and improve various basic construction laws and regulations, and regulate the construction market according to the needs of the market economy system. At the same time, it is necessary to establish a project budget control mechanism among the contractors, contractors, designers, supervisors, and government agencies, and to improve the abovementioned project budget responsibility sharing system. (4) A good job needs to be carried out of extra-budgetary expenses and on-site visa work. Settlement value = project budget + extra-budgetary expenses (on-site visa). Infrastructure construction activities are characterized by strong comprehensiveness, wide coverage, and great changes in production conditions at the construction site. To correctly reflect the cost of a project, in addition to adjusting, supplementing, and revising the original budget, various unforeseen expenses will be incurred, which are collectively referred to as extra-budgetary expenses. Due to various complex factors, the project cost fluctuates greatly, and the actual cost after completion is about 10–20% higher than the budgeted cost at the start of construction, and some are even higher. When the budget exceeds the estimated budget and the settlement exceeds the budget, it is very unfavorable for capital construction investment and the national financial balance.
Therefore, the construction unit should strive to improve the technical level of design, strengthen equipment, materials and on-site supervision, and management. Moreover, the visa for extra-budgetary expenses must be well-founded and reasonably measured, and it is not allowed to make a name for it, increase the cost, and take care of this link.

The functional structure diagram of the system constructed by combining the dynamic distributed clustering algorithm in this paper is shown in Figure 7.

On this basis, the clustering effect of budget data and the effect of project cost budget control of the system in this paper are evaluated, as shown in Table 1 and Figure 8.
Table 1: Evaluation of the budget control effect of the construction cost budget control system based on the dynamic distributed clustering algorithm.

<table>
<thead>
<tr>
<th>Num</th>
<th>Budget clustering</th>
<th>Budget control</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>91.41</td>
<td>85.48</td>
</tr>
<tr>
<td>2</td>
<td>85.69</td>
<td>83.08</td>
</tr>
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<td>89.42</td>
<td>82.63</td>
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<td>90.67</td>
</tr>
<tr>
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Figure 8: Statistical diagram of the budget control effect of the construction project cost budget control system based on the dynamic distributed clustering algorithm.
Through the above research, it can be seen that the dynamic distributed clustering algorithm proposed in this paper has a good effect on the construction cost budget control system, which can effectively improve the reliability of construction cost budget control.

5. Conclusion

The project cost index reflects the degree of influence on the project cost due to price changes in a certain period of time. The project cost index can intuitively, accurately, and timely indicate the change trend of labor, material, machinery prices, and final construction costs in the reporting period compared with the base period, and is also an important basis for project cost adjustment. To realize the dynamic management of the whole process of the project cost, this requires the compilation and development of the project cost index. The reason is that in the feasibility study stage, the project cost index provides the basis for determining the investment estimate and is the main basis for the owner to make decisions. In the design stage, the project cost index can be used to calculate the estimated cost, which provides a reliable reference cost for the quota design and reasonable selection of design schemes. In order to improve the effect of the construction project cost budget, this paper applies the dynamic distributed clustering algorithm to the data analysis of the project cost budget. The research results show that the dynamic distributed clustering algorithm proposed in this paper has a good effect on the construction cost budget control system, and can effectively improve the reliability of construction cost budget control.

Data Availability

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

Conflicts of Interest

The authors declare that there are no conflicts of interest.

References


