Research Article

Research on Engineering Project Management Method Based on BIM Technology

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Construction projects require a significant amount of money and other resources in order to carry them out in an effective way. Cost control is a critical step in ensuring the success of the project and increasing its value. Nowadays, the large-scale application of BIM technology has ushered a technical change in the development of construction projects, which has greatly increased the level and efficiency of project management. Due to BIM technology, the construction engineering quality is significantly improved which really helped in obtaining the social and economic benefits. However, the BIM technology in our country is started relatively late and the technical force is not strong enough; then correspondingly, we must deal with many problems in the process of developing and using BIM technology based projects. In view of the fact and to address this issue, this paper establishes a three-dimensional architectural model based on the relevant information and data of the construction project using the BIM technology. The proposed model optimizes the clustering of construction project information data and adaptively configures the whole life cycle process of the construction projects. In addition, the performance of the proposed system has been compared and tested with the other systems as well which shows how good the proposed system is, as compared to the other systems. Further, the proposed model makes the artificial intelligence efficiency of the project management better. The simulation results show that the model not only has good access and query capabilities but also greatly improves the intelligence level of the project management.

1. Introduction

The 21st century is the era of technology and innovations. The use of smart technologies and developments in these technologies have made people's lives easier, facilitating every aspect of life such as healthcare, agriculture, industries, and construction projects. Regardless of the faster growth and development of the new technologies in the modern era, many underlying concerns, such as project delays, cost overruns, and low efficiency and performance, continue to plague construction projects [1]. The construction sector in China, as well as many other nations, has been criticized for having a large number of stakeholders, a long project cycle, a high level of risk and instability, a lack of coordination among construction stakeholders, and a lack of data exchange and resources integration [2, 3]. Most of the construction companies are suffering from a survival dilemma in today's construction business, as the market is growing saturated and the economy is bleak [4]. Nowadays, there is tough completion among the construction companies, and if a company wants to take its place in the high rank and get an advantage, it has to offer quality services at low price by reducing the cost of the company, and at the same time, it will give assurance of high-quality services. Similarly, the clients like those products that are of high quality and value in the market and have low prices. A construction project requires more resources for that it needs more funds, and using those resources and funds in an efficient way is one of the most important factors to determine the success of a project.

The demand and quality of a project, management level of the project, and the benefits associated with the project have been improved significantly due to the use of these technologies [5]. Scheduling of a task is considered as one of the most important aspects of a project in the modern project management systems and has a great

impact on both the economic and social benefits of the engineering projects.

China's construction industry has achieved great success in recent years. As the intention of the construction projects, whole life management is necessary. Therefore, it is very important to find a suitable way to realize this purpose. Despite the continuous increase and updating in the architectural scale and complex construction problems, it is not possible for the numerous participants of a project involved in many large projects of project management to carry out the missing information and to integrate the information. Since the degree of information integration is very low, it becomes a big headache for the project manager to deal with all the participants of a project and the communication and coordination that takes place between the project participants. In addition, due to these issues, the organization pattern technology cannot meet the requirements of the construction of large projects. The emergence of the Building Information Model (BIM) had brought new opportunities to the whole life cycle of the management of construction projects. BIM is a process that involves the creation and administration of digital representations of physical and functional aspects of places and is backed by a variety of tools, technologies, and contracts. BIM has various applications in different fields such as visualization, fabrication, code reviews, cost estimation, construction sequencing, forensic analysis, facilities management, project management, collision, conflict, and interference detection. It introduces information technology into the whole life cycle of the project, unifies all stages of project management with digital means, and coordinates simulation and optimization through the realization of a visualization system. Professional and expert people figured out with the help of experiments that high-quality services cannot be achieved using the traditional project management functions and approaches, while the BIM technology helps in the effective coordination of the cooperated building parties' communication and achieved the high-quality services. Considering the present situation and the application of BIM at home and abroad, for the whole life cycle of project management, various research studies have been conducted [6].

With the start of urbanization, more and more construction projects come up, and for that there are needs of vital management policies for those projects. It is feasible to use BIM technology to manage the construction projects in an effective way [7]. Professor Chunk Eastman of Georgia Institute of Technology, "the Father of BIM," founded the idea of BIM. There are three periods which are significantly charming to the exploration of BIM technology: embryonic, generation, and development stages. In the process, the penetration and acceptance of the technology are increasing. The concept and technology contact of BIM in our country began after 2002. This technology was emphasized in the 11th Five-Year Plan of our country and is considered as the most effective method to solve the optimization of construction schemes. Another prominent role of BIM technology in management of engineering projects is to improve the accuracy of the project. In the engineering project management practice, the improvement precision can strengthen the management from a more subtle angle, so the quality of management will be further improved. In the concrete use of BIM to create the database, and then through the existence of a 5D associated database, a great progress has been made in the performance of engineering, so the construction budget has been greatly improved. With the high level of engineering components, it is possible and effective for a management to afford information in time and preceding the information quickly [8]. In short, with the use of BIM technology, the accuracy calculation of the whole project is more reliable, and the management based on the precision calculation also realizes further optimization. On the basis of overall optimization, the improvement of management effect is obvious, which is the outstanding effect of the application of BIM technology in precision.

Jia et al. [9] stated that, due to the current schedule management problems of the project management companies, the project schedule is lagging behind, and combined with the cutting-edge research in the field of schedule management, a buffer-based approach to the whole process schedule management of the project is constructed. Both of the settings of the progress buffer and the deviation standard are included in our proposal and then are supervised by themselves. Thus, it can obtain a relatively better accuracy and enables that the project is completed to some extent. However, the accessibility and efficiency of this method are not strong. Paulman and Dirks [10] do really well in the management level and efficiency of teaching engineering projects in colleges and universities, based on the exploration and practices of Dalian University. Their study was mainly based on the detailed analysis of the user needs and business processes of teaching project management. They designed a teaching project management platform based on the web technology, and the information management of the project is recognized. It has effectively promoted the standardization and systematization of project management, improved work efficiency, and promoted the information construction of teaching management in the colleges and universities. In the process of large-scale construction, construction safety is the premise for effective project implementation, and safety management should be highly valued. Jin [11] collected the data of construction loss, analyzed the change trend of the safety accident, and then established the copy dynamic equation model of construction safety through the return matrix. They further discussed the necessity of the construction safety management in the Bureau and made the profit and loss balance analysis according to the evolutionary stabilization strategy of the people in the Bureau. The results show that, under the premise of maximizing interests, the players in the Bureau will choose the game strategy with the minimum loss. However, the method has limited access capability and limited application scope. The main contributions of the proposed study are listed below:

(i) This paper proposes an approach building a 3D learner to handle the effectiveness which takes BIM as a foundation by optimizing the scheduling and do cluster analysis of the overall data to improve the

quality of construction projects over the entire life cycle.

(ii) The recognition model is applied to the adaptive configuration of construction projects, and a three-dimensional rendering method is used to construct a dynamic data analysis model for project management.

(iii) Using BIM technology to obtain the basic data will improve the level of project management.

(iv) Finally, various simulation experiments are conducted to verify the superiority of the method in optimizing the intelligentization of engineering project management.

The rest of the paper is organized as follows. Section 2 represents the BIM data analysis and database construction for construction project management and Section 3 shows the BIM technology optimization of engineering project management, while Section 4 illustrates the simulation results and experimental analysis. We conclude our paper in the last section, i.e., Section 5.

2. BIM Data Analysis and Database Construction for Construction Project Management

In the management of construction engineering, the BIM technology makes the original abstract management content through the model and then enables the manager to observe, analyze, research, and coordinate various management work from the holistic perspective to improve the quality of engineering information management [12]. In practical engineering management, the application of BIM has the following characteristics:

(i) *Analogue.* The simulative experiments, the simulation design of the buildings, and the things that cannot be operated in the simulated reality show the analogue characteristics of BIM technology, for example, the simulation of emergency evacuation and sunshine. In addition, in the process of cost control, BIM can be used to manage, so that the builders and the project side will get more economic benefits [13].

(ii) *Coordination.* In the construction project management, there will be problems that need each department to cooperate with each other. If the problem is difficult to solve immediately in the construction of the project, it is necessary to hold relevant meetings, organize a management staff to discuss the problem, point out the reason of the problem, and make an effective remedy [14, 15]. But there are some limitations in this way of dealing with problems. The emergence of BIM can make use of its coordination to arrange and lay out the building internal components reasonably and coordinate the elevator shaft construction and other constructions.

(iii) *Visibility.* Under the continuous development of the society, the architectural form is going to gradually diversify and becoming complicated with the passage of time. Under the requirements of modern construction, the traditional construction drawings have lost their value and appeared unsuitable nowadays. The construction form of the construction workers' own imagination will not only obstruct the smooth construction of the whole construction project, but also lead to the difficulties in construction and project management [16, 17]. The duration of the work is extended. After the appearance of BIM, it can be displayed to the three-dimensional solid objects of the building before the construction project begins and can also present the internal components of the building in front of people through the visual BIM. So, using BIM can guide the construction workers to smooth the construction. In addition, the construction workers can also share information resources with the other construction workers. Improving the efficiency of process management is of great significance.

(iv) *Optimization.* BIM can change the traditional management mode in the construction engineering management. A project manager can use the BIM technology to carry on the virtual construction, take the visualization and integrated 4D construction way, and achieve the effect of optimizing the construction management mode. In order to effectively connect the building information model and construction schedule, concentrating on the information of the construction resources and site layout, using the construction information model of the 4D effect will dynamically and centrally control the equipment information, cost information, human information, material information, and so on and can also visualize the construction process and realize the related personnel [18, 19]. The purpose of reasonable cooperation between them, and on the basis of the network management platform, the participants of the project can use the network to examine and approve audit documents and map files and so on, so as to realize the rapid sharing of information. It does well in improving the efficiency of engineering management [20].

(v) *Improvement.* Taking the advantage of BIM in the construction project management will help in the reduction of construction time of the construction projects greatly. Further, it will improve the speed of the building engineering, promote the intelligent development of the building equipment, and ensure the construction quality of the construction engineering. At the same time, the use of BIM can coordinate and adjust all kinds of engineering data, promote the improvement of management efficiency, save more human resources, material resources, etc., and is more beneficial for the society and building [21].

2.1. Data Analysis of Construction Engineering Management Project.
In order to analyze the data in an effective way, there is a need to build a data management system platform.

When the number of managements is enlarged, various software functions of BIM technology have become more powerful, and more model-based systems have been investigated for the fusion of information of items [22]. This paper uses the combination of database, BIM technology, and network to share the virtual model and data and set up a data management platform based on BIM to realize the integration, management, analysis, and sharing of mass information in the construction phase of the project. Further, it provides a platform for high efficiency information communication and cooperative work for each participant. Before the system platform is set up, the following problems should be solved: (1) the integration and optimization of model data; (2) how to solve the problem of display and smooth operation of BIM model in web; (3) how to relate the engineering data and information to the 3D model; (4) how to implement the data for different participants in a unified management platform; (5) sharing and retrieval. Thus, establishing a system management platform reasonably according to the functional requirements is important. Through the in-depth study of the current BIM technology, Web3D, database management, data management, and other related technical fields, the functional framework of three major plates, such as data service layer, functional platform layer, and extensible application layer, is presented, as shown in Figure 1.

Realizing the optimization management items of the BIM database of construction engineering systems, on the basis of the abovementioned platform, it should build the relevant learners of BIM database, assuming that it is the construction project management BIM. This shows the quaternion (E_i, E_j, d, t) trust relationship among data and attributes $A = \{A_1, A_2, \ldots, A_m\}$ of management [23]. Express the BIM local database as the subsystem as follows:

$$\text{Infor}(x, y) = \frac{x_i u_i}{\sum_{j=i}^{N} \left(2m_j / \sum_{k=j+1}^{N+1} L_k p_k - \sum_{k=j}^{N} E_k\right)} - 1, \quad i = 1, \ldots, N+1. \tag{1}$$

In the expression, i.e., $x_i \in R^n$, it is the state vector of the BIM database system for building engineering project management, and the input vector of the BIM database index control for construction engineering project management, $u_i \in R^m$. In general, for the BIM data association rule, metadata, and structural attenuation channels for original construction project management by integrating the initial query of BIM data relation $A = \{A_1, A_2, \ldots, A_m\}$ of construction engineering project management are calculated. Further, the index control input of BIM database subsystem of local construction project management in BIM database system of construction engineering project management is also calculated. In order to form a relative query result S and a relaxed query result and execute entity difference query on $\tilde{Q}$, let $z^* = z \ggg 25$, and z^* and z are bit permutations. The mathematical model of the BIM database system can be expressed as follows:

$$K_i = key_i \boxplus W_i, \quad i = 0, 1, \ldots, 15,$$
$$p_k(S_k - S_{i-1}) + p_{k+1}(S_i - S_k) = p_i(S_i - S_{i-1}), \tag{2}$$

where the value of "i" ranges in $i = 16, 17, \ldots, 63$. The 3D building model is established according to the related information and the BIM number is provided by many other ways. The schematic diagram of the relative correlation state system according to the library is shown in Figure 2.

2.2. Database Construction and Feature Reorganization.
Construction of database system using B/S (Browser/Server) structure, users as IE, and shared connections to networks all over the world can realize the information. Most of the servers are implemented through the network connection between two terminals; and one can get instant data transmission and processing integration through it. Such system architecture is divided into 3 layers: the operation layer, application layer, and data service layer. The first layer is the user interface, for the end user group (including the owner, the design unit, the general contractor, the subcontractor, and the end-users) through the web browser. The user group is within the network license (special line, VPN, and even the whole WAN), through the HTTP network protocol, and through the identity, i.e., IP. The identification and corresponding operating authority wait after entering the system and related operation. The middle one is used for different applications which are interconnected into networks while the third one is the data service.

Among them, the data stream synchronization trigger is an important component of BIM. For the realization of the system in the database, the trigger is an application loaded in the database of all data table-space. Using the components, current application instructions issued by any operation (search, insert, delete, etc.) can be the synchronous trigger in database integration and user feedback to the corresponding operation. In a general information management system, if someone wants to use the data if the components of the system are not integrated, then the system cannot provide the integrated data, the database, or will be unable to provide each part of the project to integrate the data management function as shown in Figure 3.

The number of features in the BIM database is less than that of the original features, so the elements x_t in X are satisfied as

$$P(x_t | x_{t-1}, x_{t-2}, \ldots, x_1) = P(x_t | x_{t-1}, x_{t-2}, \ldots, x_{t-n}). \tag{3}$$

That is, x_t is only related to n elements of the relevant construction project. $x_t \in B$ is defined as the number of times of S passing through $\theta_{i_1, i_2, \ldots, i_{n+1}}(x)$, X, and equal states to i_1 in i_{n+1}. The feature set is set to $t = 0.5$. If the feature dimension is too low, the classification accuracy is the lowest and then the number of association rules should be carried out. According to the structural distribution reorganization, the binary vector is used to describe the feature to optimize
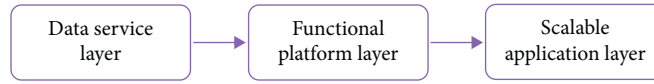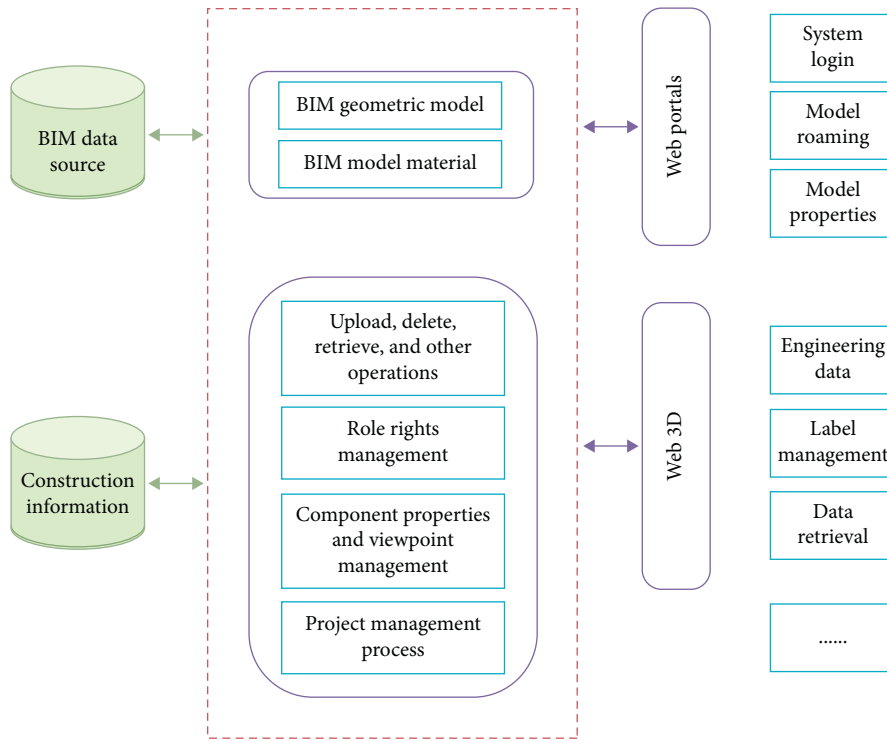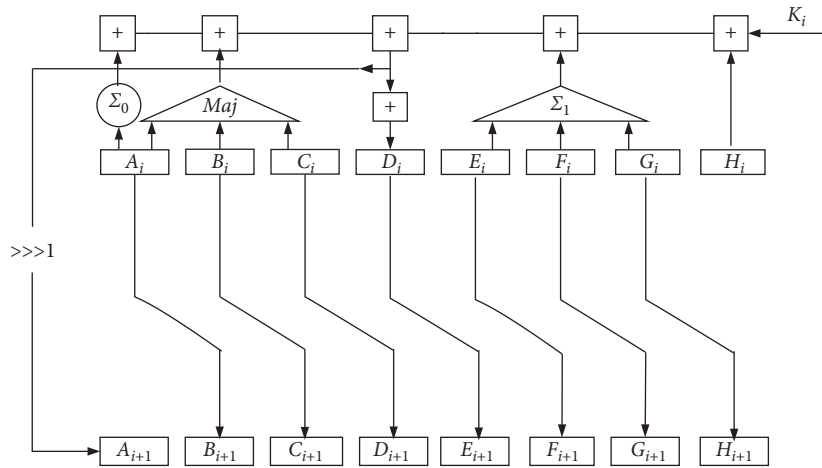
FIGURE 1: Data management system platform.

FIGURE 2: Schematic diagram of the relative associated state structure of the BIM database for construction project management.

the structure, $S = \{s_1, s_2, \ldots, s_n\}$, and the reconstruction process is obtained as shown in Figure 4.

3. BIM Technology Optimization of Engineering Project Management

3.1. Dynamic Data Analysis of Project Engineering Management. Associated with the knowledge-based data, in this paper, we build a 3D building model to improve the effectiveness of management. The whole model is expressed as follows:

$$Q_{\text{rev}}(\tau) = \frac{(1/N - \tau)\sum_{i=1}^{N-\tau}(x_i - x_{i+\tau})^3}{\left[1/N - \tau\sum_{i=1}^{N-\tau}(x_i - x_{i+\tau})^2\right]^{3/2}}, \quad (4)$$

where q_i construction items have n_i nearest feature $d_i = (d_{i1}, d_{i2}, \ldots, d_{\text{in}_i})$; there are
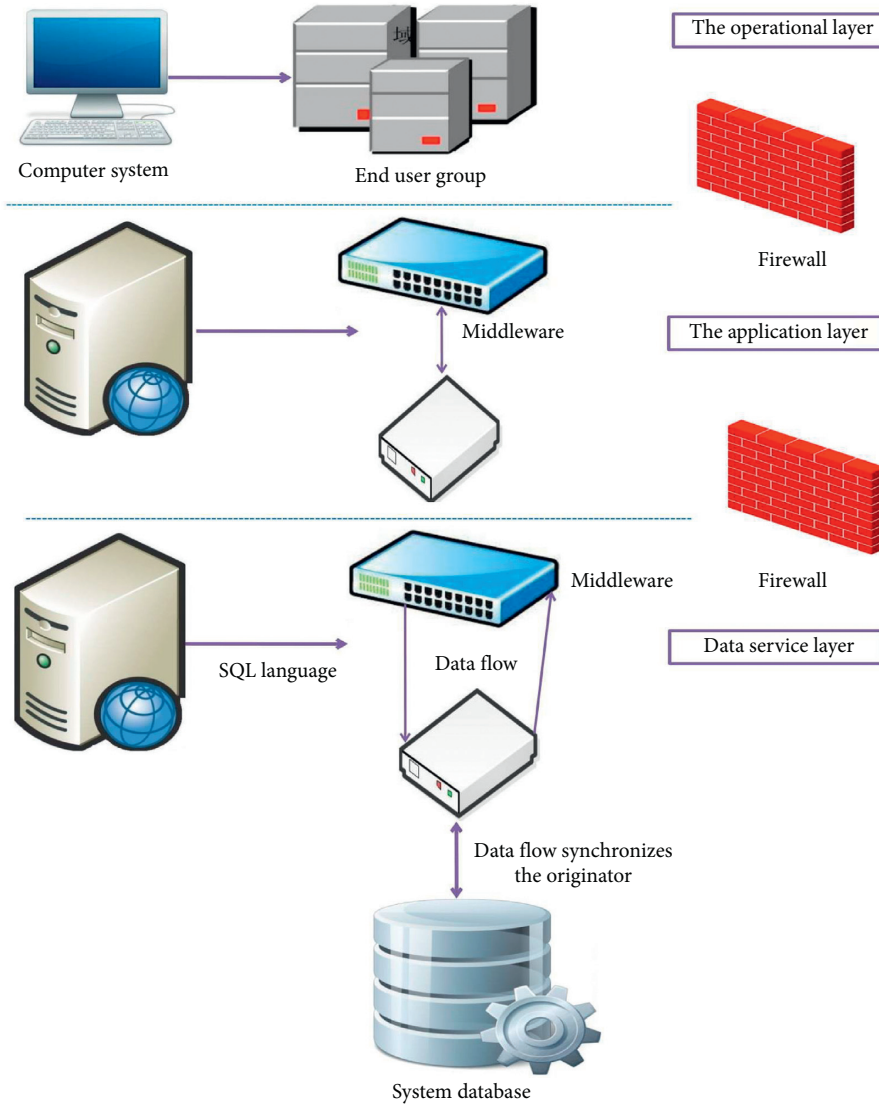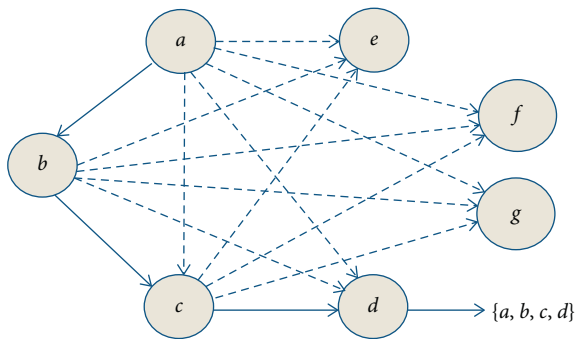
FIGURE 3: Database network architecture.

FIGURE 4: Data structure distribution reorganization process for construction projects.

$$W\left(q_i, d_{ij}\right) = \frac{g\left(q_i, d_{ij}\right) \times \log_2\left[f\left(d_{ij}\right) + 1\right]}{\sum_{j=1}^{n_i}\left\{g\left(q_i, d_{ij}\right) \times \log_2\left[f\left(d_{ij}\right) + 1\right]\right\}}. \quad (5)$$

Average M_i metrics are used for thresholds of the multilevel time attribute of BIM database, h-dimensional

data matrix is reached, and the maximum value $C = [X_1, X_2, \ldots, X_n]'$ is obtained to realize the construction workers. Characteristic analysis of multilevel time attributes in process project management BIM database assuming the distribution scale $X(t)$ of the BIM database recommended by the multimodel for construction project management is to be standardized in the form

$$X'(t) = \frac{X(t)}{\|X(t)\|}, \quad (6)$$

where $\|X(t)\|$ represents the Euclid norm of $X(t)$ and maps the BIM data points near the origin to the upper half plane through adaptive threshold optimization. The multimodel recommendation relationship diagram is constructed, and the project is built by utilizing three-dimensional method. The analysis model of engineering management, the information of BIM data node of information construction project management is defined as (x_i, y_i), and the attribute

weight of multilayer temporal attribute access channel is assigned as follows:

$$Hw(t) = \frac{\left|p_{i,j}(t) - \Delta p(t)\right|}{p_{i,j}(t)} \frac{p'\pi}{2} = \alpha' = \arctan\left(\frac{\tan \alpha}{M^2}\right).$$

(7)

The spectral estimation value of BIM data access for construction project management is expressed as follows:

$$(x, v)x = \frac{t}{S}, \quad v = f * S.$$

(8)

In order to realize the multimodel recommendation, the database will produce repeated access features after exchanging the BIM data, which is to input the BIM data. The row is patched, and then the BIM data for building project management that matches areas that are duplicated outside the area forms a new mapping in multiple source nodes and is given as follows:

$$x_n = [x(0), x(1), \ldots, x(N - 1)]^T.$$

(9)

In the construction of BIM data temporal distribution in construction engineering project management, the temporal attributes of BIM database in construction project management are assumed which defines the distance between two points, i.e., n_1 and n_2, as a normal distribution and defines consistency index, $N = \Delta x^2$, in interval $[-\Delta x/2, \Delta x/2]$ and is completely consistent.

3.2. Database Optimization Access Technology for Construction Project Management. This section represents the use of BIM technology and database optimization techniques to process the management data. The multimodel recommendation algorithm is used to reconstruct the multilevel time attributes of the BIM database of construction project management. The binary vector description feature is used to optimize the structure of the model, and the BIM database is set up for instruction scheduling. The geometric features of the BIM data of multidimension state construction project management can be obtained from the N samples $x_1, x_2, \ldots, x_N$, and the differential cumulative function features of the BIM database can be obtained:

$$y[n] = \sum_{i=0}^{M} a_i x[n - i] + \sum_{i=1}^{M} b_i y[n - i],$$

(10)

where $a_0, a_1, \ldots, a_M$ denotes differential cumulant vector and $a_i (i = 0, 1, \ldots, M)$ and $b_i (i = 1, \ldots, M)$ are characteristic coefficients of differential cumulative function. In BIM data fusion center of the model is obtained as follows:

$$\min_{A,S} \frac{1}{2\sigma^2} \|AS - X\|^2 + \sum_{i,t} |s_i(t)|.$$

(11)

In the BIM database access system of construction engineering project management, the fuzzy clustering algorithm is used for data clustering analysis, and the multilayer temporal attributes of BIM database are obtained as follows:

$$X_p(u) = g'_\alpha(u)\exp\left[-j\pi t^2 \tan\left(\frac{\alpha}{2}\right)\right].$$

(12)

Based on the k-order origin moment estimation of the depth of the BIM data of multilayer temporal attribute, the multilayer temporal attribute of the BIM database of the above construction project management satisfies the multimodel recommendation feature, which is expressed as

$$g'_\alpha(u) = A_\alpha \int_{-\infty}^{+\infty} \exp\left[j\pi(u - t)^2 \csc \alpha\right]g(t)\mathrm{d}t.$$

(13)

4. Simulation Results and Experimental Analysis

This section of the paper represents the experiments performed and the simulation results carried out via those experiments. Multiple simulation experiments were conducted on the BIM data management and engineering project organization management and adopted the BIM data combination method for CWT200G construction project management. We established a project management BIM database structure model for the network text information construction project in the real environment. The random sampling method has obtained more than 100,000 BIM data for construction project management and conducted experiments. Multiple experiments were performed using various parameter settings. Among the experiments and simulation results the top two are discussed here. There are some important parameters that need to be set with proper values such as data sampling iteration step, loop iteration count, data size, correlation coefficient, support threshold value, and minimum support threshold value. All the experiments have been performed on a laptop computer (Intel Core-i7, 7th generation, having a processor of 2.7 GHz, RAM of 16 GB, and the operating system on which it operated was Windows 10).

In experiment one of the construction project management, the BIM data sampling iteration step was set to 0.003, the loop iteration count is 100, the data size is 200 T bits, and the correlation coefficient is 0.25. In the construction project management, the minimum association rule function of the BIM database data structure is obtained. The support threshold is set to 2.0% and the minimum support threshold of the database is set to 30.0%. According to the above simulation environment and parameter settings of the project management model, a 3D rendering method is used to construct a dynamic data analysis model for project engineering management.

On the basis of 3D dynamic management, the performance comparison of data optimization management is obtained as shown in Figure 5.

From the analysis of Figure 5, it is obvious that when the number of data instances increases, the BIM data matching efficiency of the project management of system 1 method is increasing gradually, and it reaches the maximum value of 410 kbits/s. The BIM data matching efficiency of the engineering project management of system 2 methods is also increasing gradually, and the data matching efficiency
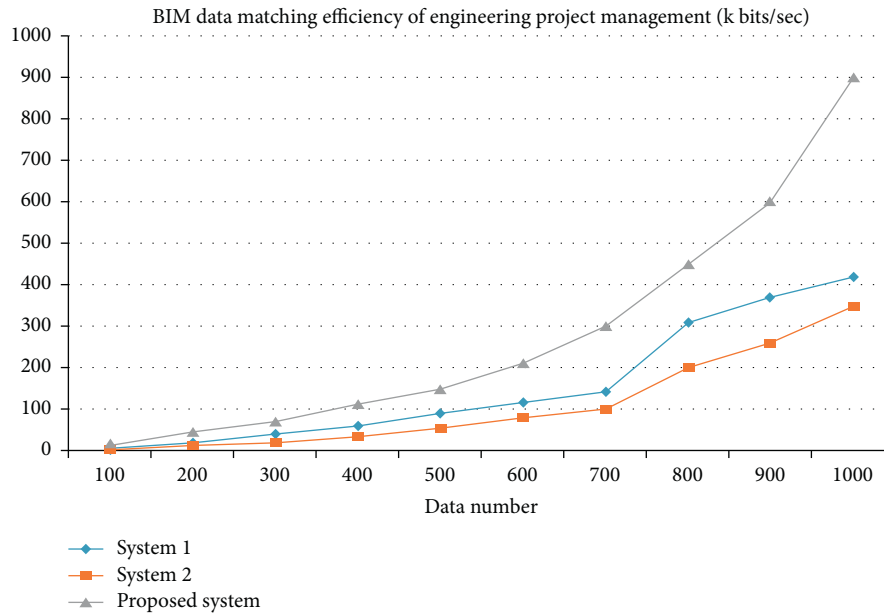
BIM data matching efficiency of engineering project management (k bits/sec)

FIGURE 5: Performance comparison analysis of experiment one.

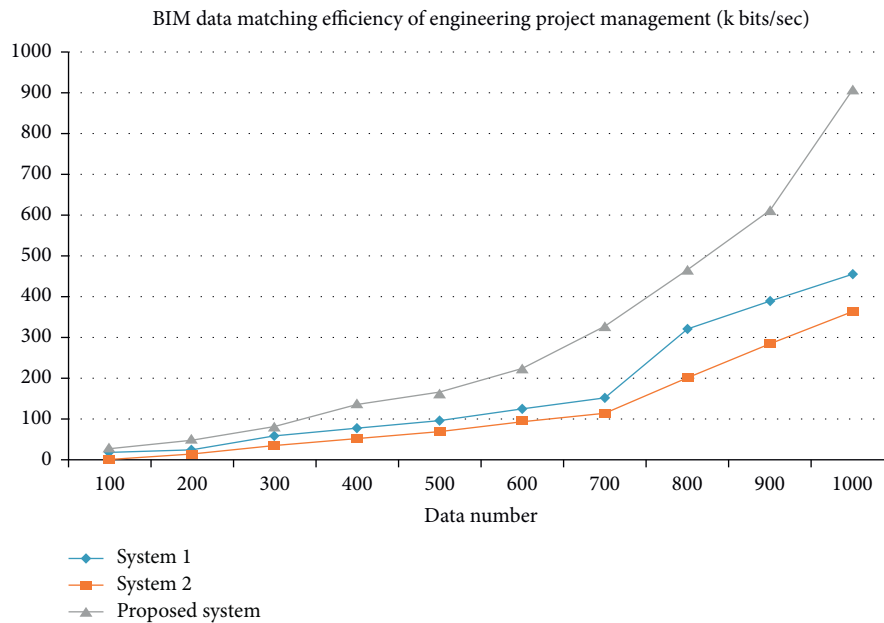BIM data matching efficiency of engineering project management (k bits/sec)

FIGURE 6: Performance comparison analysis of experiment two.

reached to the maximum value of 360 kbits/s, which is the lowest of the three utilized methods. The method proposed in this paper attained the highest spot in this competition. The BIM data matching efficiency of the project management method proposed in this study increased gradually as the size of data increased. When the number of data reached 1000, it reached 900 kbits/s, which was the highest of the three methods used in this study. Therefore, the model is applied to project management, and the retrieval ability of relevant information data is good, and the database access efficiency is high.

In the second selected experiment of the construction project management, the BIM data sampling iteration step was set to 0.005, the loop iteration count is set to 110, the data size selected is 200 T bits (same as the experiment one), and the correlation coefficient is 0.30. In the construction project management, the minimum association rule function of the BIM database data structure is obtained. The support threshold is set to 2.0% and the minimum support threshold of the database is set to 25.0%. According to the above simulation environment and parameter settings of the project management model, another 3D rendering method is used to construct a dynamic data analysis model for project engineering management.

Figure 6 shows a comparison of the performance of data optimization management based on the 3D dynamic management of the three utilized methods in this study.

Figure 6 illustrates that the BIM data matching efficiency is directly proportional to the increase of data instances; i.e., when the number of data instances increases, the BIM data matching efficiency is increasing for all the methods used in this paper. The BIM data matching efficiency of the project management of system 1 method is increasing gradually, and it reaches the maximum value of 460 kbits/s when the data number reached 1000. The BIM data matching efficiency of the engineering project management of system 2 methods is also increasing gradually, and the data matching efficiency reached the maximum value of 385 kbits/s when the data number reached 1000. The method proposed in this paper outperformed the two utilized methods and attained the highest spot in terms of performance. The BIM data matching efficiency of the project management method proposed in this study increased gradually as the size of data increased. When the number of data reached 1000, it reached 910 kbits/s, which was the highest of the three methods used in this study. The lowest performance was observed for system 2 in both of the experiments while system 1 attained the second spot in the performance competition. Keeping the performance and data matching efficiency of the method proposed in this study, the model is highly efficient to be applied to the project management, as the retrieval ability of relevant information of the data is impressive, and the database access efficiency is very high. In short, this model will be highly valuable and helpful for the managers and team of the construction engineering project management to carry out their projects in a smooth and efficient way.

5. Conclusions

The construction business is continually evolving; building projects are becoming larger and more complicated, and construction periods are becoming longer, all of which raise the bar for project management. Maintaining and decreasing the cost of engineering projects are significantly important to improve the economic benefits of engineering projects. In this study, a 3D architectural model is established by using the fuzzy balanced scheduling in order to decrease the complexity of scheduling and clustering analysis of corresponding information data for the construction project. The model uses various parameters and is used throughout the life cycle of the construction engineering project management. The proposed system is based on the BIM technology that coordinates different positions and departments and accurately displays resource consumption. In addition, the proposed system uses a 3D rendering technique along with the optimized database access technology to build a dynamic model to capture the basic project management data and to deliver a project within time and budget. Further, different experiments have been performed for measuring and tracking the performance of the proposed system. Performance of the proposed system has been compared with two other state-of-the-art approaches. The experimental result shows that the proposed system performed significantly better as compared to the other systems. The proposed system is anticipated to be highly helpful and valuable for the construction engineering management projects. Future work of this study includes using more data, parameters, and scheduling algorithms that really reduce the project management time and proposing more optimization algorithms in order to deliver a project within budget.

Data Availability

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

Conflicts of Interest

The author declares that he has no conflicts of interest.

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