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Application of Machine Learning and BIM Technology in the Design and Construction Safety Management of Next Generation Library Space

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Abstract Due to the wide use of AI (artificial intelligence) technology, machine learning has also obtained better development opportunities and has been more widely applied. At present, the library is in an important transformation stage. In order to adapt to new developments and changes, libraries must adapt to the trend of the times and make corresponding adjustments in functional forms, service methods, reading modes, as well as spatial design and construction management. How to ensure the smooth construction of the library through innovative spatial design methods and safe construction management, so as to provide users with more humanized and in line with the trend of the times for learning and communication, is an important issue in the current development of libraries. In order to better promote the spatial design and construction safety management of libraries, this article introduces machine learning and BIM technology. Through exploring and practicing the two, it is found that using machine learning and BIM (Building Information Modeling) technology in library spatial design and construction safety management is feasible. Compared to traditional library spatial design and construction implementation methods, this method can increase the lighting score in the library space function design by 15.5 and the material design score by 10.7. The score of furnishings design increased by 11.7, the score of decoration design increased by 13.3, and the score of infrastructure design increased by 12. At the same time, this method can also make the principles and requirements of library space design more in line with the current needs, and make the library space design more scientific and reasonable. In addition, the research on machine learning and BIM technology in this text can also enrich the application scope of AI and network physical systems, and broaden their application fields and methods.

Index Terms Next Generation Library Space, Machine Learning, BIM Technology, Space Design and Implementation

I. Introduction

As the AI technology gets matured, the needs of libraries have gradually changed. The emergence of intelligent libraries is also increasing, and various intelligent devices and self-service devices have also begun to enter the library, providing users with faster and easier query services. However, due to the relatively quiet characteristics of traditional libraries, users cannot freely communicate and exchange knowledge in the library, which means that the space design reform and transformation of the next generation of libraries is imperative. In the context of Internet plus, libraries should comply with the needs of the development of the current era and actively seek the transformation and optimization of the space design of the next generation of libraries. To achieve this transformation, it is necessary to pay more attention to the functional design, spatial planning, and construction safety management of the next generation library. In order to better promote the spatial design and construction safety management of the next generation library, this article combines the current popular machine learning and BIM technology, hoping that this method can better promote the spatial design of the library and achieve the safety management of library construction, and provide more theoretical basis for the design of next-generation libraries, and also hope that the exploration of machine learning and BIM technology can promote the more comprehensive application of artificial intelligence in libraries.

As for library space, many scholars have studied it in different aspects and pointed out the importance of library space design. Bangani, Siviwe studied the use of library space. He discussed the use of library space by university graduate students and said that library space needs to be reviewed regularly to ensure its continuous and optimal use. He also pointed out that the design and construction of library space can help improve the return on investment [1]. Trembach, Stan studied the reasons and methods for the evaluation of academic library space. He expressed the need to change the way of evaluation and use of academic library space, and advocated the

construction of user-centered library space, emphasizing the importance of user design of library space [2]. Munip, Lana studied the comprehensive integration of library space, services and resources. He surveyed how library users participate in services and resources and how library services meet user needs. He analyzed the importance of library space design, and also put forward a library space design method to make it more suitable for the current needs after the epidemic [3]. Akanmu, Williams P studied the environmental quality of the interior space of university libraries. He evaluated the indoor environment quality of the Nigerian University Library under the operating conditions and during the peak period of use. He pointed out that library space design can effectively improve the quality of its indoor environment, so people must pay attention to library space design [4]. These scholars' research on library space can enrich its theoretical content, but there are also certain deficiencies.

However, some scholars combine BIM technology with architectural space design and discuss the optimal application of BIM technology in architectural space design. Xiao, Yanwu studied building design and optimization based on BIM technology. In order to promote the better application of BIM technology in prefabricated building space design, he established the conceptual model of project control plan collaborative design, thus optimizing the accuracy of BIM model and promoting the better application of BIM technology in the field of building space design [5]. Mehrbod, Sarmad studied architectural design coordination with BIM. By discussing the characteristics of BIM technology in the coordination process of architectural space design, he identified the bottlenecks in the application of BIM technology in space design. It provided methods to optimize BIM technology, thus promoting the coordinated application of BIM technology in architectural space design [6]. These scholars' research on BIM technology and space design can provide some theoretical support for this text. Because of its wide range of research, it does not focus on the design and implementation of the space of the next generation library, which makes the research unable to be well applied. It can be seen that the application of machine learning and BIM technology in the design and implementation of the next generation library space is a relatively new field, and its theoretical performance is still relatively blank, which needs to be continuously studied.

In order to better promote the space design and construction safety management of next-generation libraries, this article proposes methods for optimizing the space design and implementation of next-generation libraries based on theoretical analysis of machine learning and BIM technology, combined with previous scholars' exploration of library space. Through empirical research, it is found that the methods proposed in this article are more scientific and reasonable, and also more conducive to promoting the transformation and upgrading of libraries, Make the library more intelligent and informationized, ultimately enabling it to better meet current needs. Compared with traditional library space design methods, the innovation of this model method lies in its attention to the importance of machine learning and BIM technology and its application in spatial optimization design. This helps to better meet the actual needs of users and make it more in line with today's development.

II. Theoretical Research on the Space Design and Implementation of the Next-Generation Library

II. A. Overview of Next-Generation Library Space

II. A. 1) Library Space

Library is an important carrier of human civilization, a treasure house of human knowledge and the birthplace of intelligence. The information resources, facilities and service level of the library are important criteria for evaluating the overall strength level of the school. Even some experts believe that the library is the core of the school, so its importance is self-evident. Library space is not only a social space, but also a place to realize material production and reproduction of production relations. Library space is also created by the practical activities of users and librarians. All kinds of spaces in the library are generated on the basis of users' learning, communication, work and entertainment.

The fundamental difference between the next-generation library and the traditional library is its function. The traditional library only has the function of collecting books, while the functions of the next-generation library are complex. According to the degree of openness, the library is divided into five areas, namely, public area, reading area, special area, collection area and auxiliary area. The public area is the most open area in the library, and mainly undertakes the functions of reception, consultation and information inquiry. The reading area is a relatively open place. Its function is to provide a good reading environment for readers. The special area is relatively closed and basically independent, such as training room, self-study room, etc. The collection and cataloging area is not open to the public and belongs to the working place of library staff. The auxiliary area mainly includes the transportation space and toilet of the library. The main functional areas of the library are shown in Figure 1:

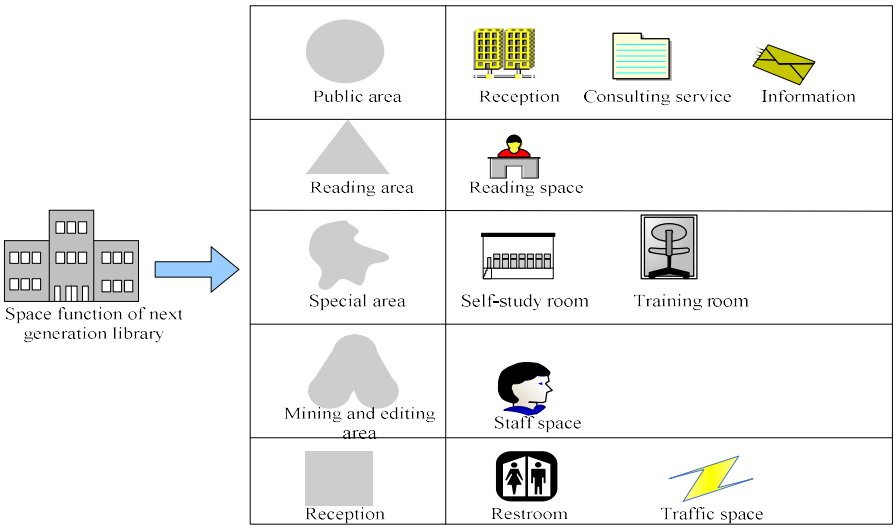


Figure 1: Main functional areas of the library

II. A. 2) Key Points of Space Design of the Next Generation Library

The first is the design of the entrance space of the library. The entrance space is the first space for users to enter the library, which can be said to be the face of the library. Therefore, the design of the entrance space would directly affect the overall impression of users on the library. In addition, the entrance space is also the concentration and flow area of people. This area generally provides services such as consultation, book borrowing, document retrieval, flow guidance, logo, etc., so it is necessary to fully consider the reasonable use of space and human-centered design of it.

Secondly, it is the design of library collection space. With the progress of science and technology, many libraries have launched the electronic library model. Users can read through the network, reducing the dependence on text books, and at the same time optimizing the library collection space. In the past, the evaluation of libraries was based on the number of books, but the book-based evaluation model can no longer meet the development needs of the next generation of libraries. Therefore, it is necessary to optimize the collection space of the library and change the form at the same time. The optimization of library collection space can take high-quality books and books with high borrowing rate as the collection standard. In addition, the traditional text book collection mode should be gradually transferred to the text and electronic book collection mode. In the design of library collection space, designers should fully consider the safety issues of book layout, air humidity, lighting, fire prevention, insect prevention, etc.

After that, it is the design of reading and learning space of the library. Library reading and learning space is a comprehensive space that organically combines reading, learning, scientific research, communication and other functions. This requires that the reading room be equipped with modern electronic reading equipment and provide users with various reading modes according to their different reading habits. Therefore, according to the different uses of readers in the reading space, it can be divided into different reading spaces to meet the actual needs of different readers.

In addition, in the space design of the next generation library, the design of leisure space is also an important design point. It is a place with strong attraction for library users. In the design of leisure space in the library, attention should be paid to creating a humanized atmosphere, and relaxation should be achieved, so that users can fully experience the comfort of the space, so as to obtain leisure and relaxation. In the use of colors, people should try to choose bright colors and combine them with lighting design to create a more comfortable effect.

Finally, it is the design of library display space. The next generation library display space is mostly located at the entrance and corridor. Of course, it can also be divided into separate exhibition areas according to its area for a series of displays of art, works and recommended books.

II. A. 3) Construction Safety Management of the Next Generation Library

(1) Question

Manage progress. When contemporary libraries carry out excavation of foundation pits, due to considerations of library construction safety, they also need to carry out pile driving work for slope protection piles and cut-off curtain piles, as well as relevant treatment work such as well point precipitation, which has delayed the construction period. At the same time, due to the incomplete understanding of the actual situation on site by the construction unit in the

early stage, the underground pipelines had to be relocated during construction, resulting in insufficient electricity load capacity provided by the construction unit, difficulty in using pile drivers simultaneously, and delayed construction progress, resulting in increased construction costs and reduced construction safety.

Construction site management. In the safety production construction of library engineering, construction site management is essential. At the construction site, for example, the arrangement of material sites and the scheduling of access routes will have a profound impact on issues such as construction progress, quality, and cost control. This type of production problem requires comprehensive management and is also quite difficult. So, the importance of on-site management is obvious. In the construction process of library engineering, there are certain problems in safety construction management, such as the disorderly placement of construction materials on site, placing power cables on top of the materials required for construction. At the same time, the safety awareness of the staff is relatively poor, and some professional staff do not wear safety helmets.

Environmental pollution. In today's society, environmental pollution is a very serious problem, and the government has also introduced many policies and regulations to ensure that the environment is not polluted. Green GDP has also been put on the agenda. However, the construction of library projects has a significant impact on the environment. During the construction process, a large amount of dust, harmful gases, waste, high-altitude falling objects, and other types of pollution and safety issues will be generated. These problems will have a significant impact on society and the living environment of surrounding residents, and will also cause psychological and physiological damage to people, increasing construction risks.

(2) Countermeasures

Strengthen the control and management of construction progress. In the construction of the library, the construction unit should ensure safe construction progress according to the contract and construction organization design, ensure the smooth completion of each sub project, and avoid delays in the construction period of key lines. However, the key to ensuring the smooth progress of the project is to establish a scientific construction organization design before construction. Among them, the construction schedule should include the time safety of each sub project in the project, and use network plan diagrams with single or double codes. If necessary, use bar charts to adjust, so as to reasonably arrange the construction period, save time, and reduce time safety costs.

Utilize advanced construction techniques, environmental protection measures, and internationally advanced management concepts during the construction process to avoid the generation and diffusion of harmful gases and reduce the generation of waste and noise. During the construction process, strict selection of engineering materials is necessary. A high-quality material that can control pollution to the maximum extent, its main function is to ensure the quality and safety of the project and reduce the risk of safety hazards during construction. At the same time, it also avoids personal injury to users of the construction unit due to substandard materials. Strengthen the supervision of details in the construction process, and each detail in the process should be controlled and managed according to the engineering quality standards, in order to reduce the incidence of uncivilized and uncivilized construction. Establish a sound and standardized system for site management. Strictly implement all construction discipline to avoid safety accidents caused by management negligence. In addition, it is also necessary to continuously improve the operation methods and measures, pay attention to the living, working, and dining environment of employees, and improve the on-site operation environment. The civilized construction of enterprises should start from the construction site to avoid the phenomenon of "dirty, disorderly, and poor" at the construction site. Regular inspections should be conducted on each construction sub project.

II. B.Machine Learning and BIM Technology

II. B. 1) Overview

Machine learning is an important technology in AI technology. Its essence is to analyze and process data through calculation, so that machines can rely on learning to reason and predict data, and simulate human behavior [7], [8]. Machine learning technology is a learning process, that is, analyze a large amount of data, gradually establish a prediction model, and then continuously modify and improve the accuracy of the model [9]. The machine learning process is shown in Figure 2:

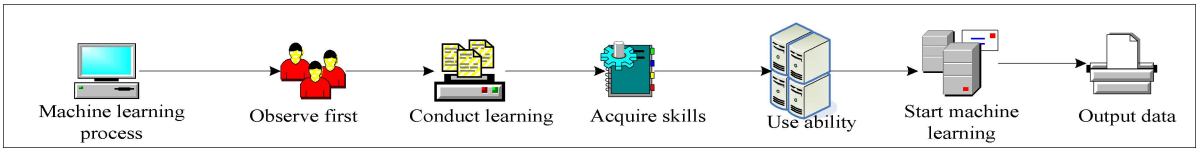


Figure 2: Machine learning flow chart

The first level of BIM technology is the construction of information model, which uses digital technology to display the physical and functional characteristics of the project management project, thus forming a resource for information sharing, and providing reliable data support for the entire cycle of the project [10]. The second level is model application, that is, to establish and use project data in the whole life cycle. All parties involved in the project can share data through various technical platforms to apply relevant information. The third level is the control of operation, which is actually to use the support of information and other technologies in the building information model to achieve effective control and management of information and business processes related to the whole life cycle of the project and obtain more benefits [11]. The specific structure of BIM technology is shown in Figure 3:

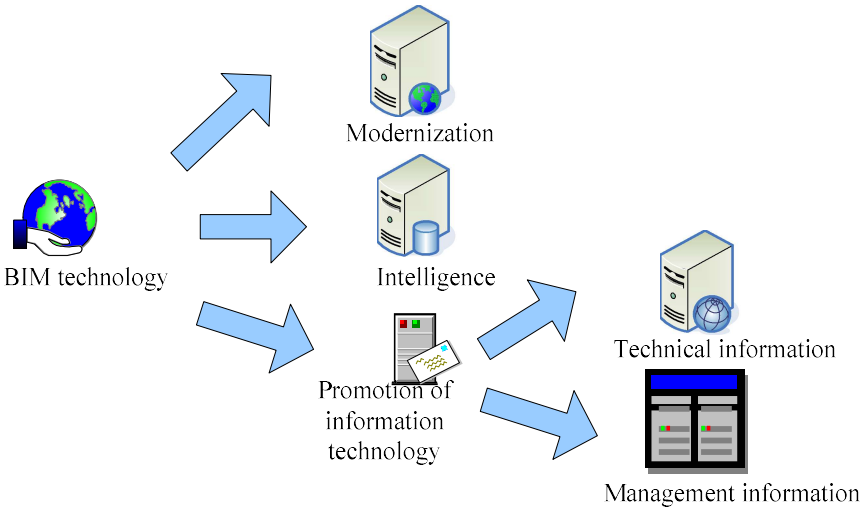


Figure 3: BIM technical framework

BIM technology is realized through the gradual development and improvement of three levels. It can be seen that the essence of BIM technology is a product that can integrate different resources and ultimately form a digital representation. In general, BIM technology refers to the use of digital models of buildings to plan, analyze, simulate and count different stages of the project, including the design of buildings and the maintenance in the later stage [12].

The key of BIM technology is information. For the same information at different stages of its project, due to the different organization of participants, different management and use methods, this causes redundancy of information. That is, multiple engineering documents contain the same information, but the way of expression is different. Therefore, to explore the practical application of BIM technology, it is also necessary to focus on collecting and saving various information [13]. The process of forming the BIM technology information platform is shown in Figure 4:

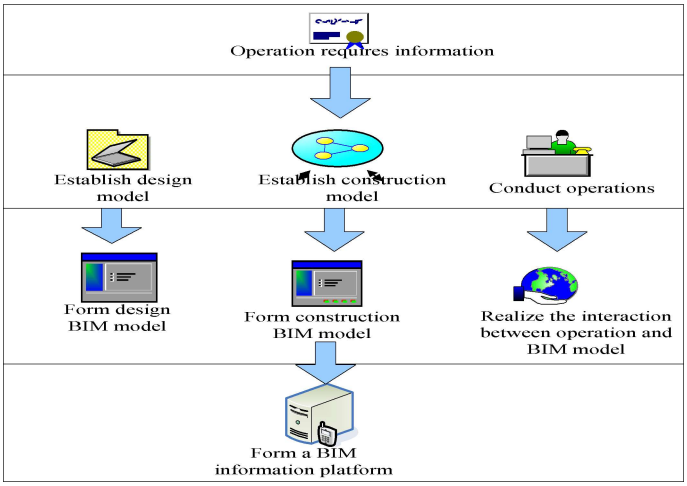


Figure 4: Process diagram of BIM technology information platform

II. B. 2) Application of Machine Learning in Library

At present, machine learning has many applications in libraries. In the retrieval system of the library, the use of machine learning technology can provide the relevance of knowledge concepts, thus improving the intelligence of document knowledge [14]. In addition, the personalized recommendation system based on machine learning can match the books that users care about with the books collected in the library, thus reminding users that the books collected can be borrowed in the library. In addition, the establishment of an appropriate procurement model based on machine learning can achieve the balance between users and library procurement.

In the resources, services and management of libraries, machine learning technology can effectively improve the service and management level of libraries. However, from the actual situation, the current application of machine learning in the library is very little, and more lies in the theoretical application. It has only been applied in personalized retrieval in the fields of resource retrieval and reference consultation to some extent, while in other fields, most of them are in the initial stage [15]. Therefore, how to better introduce machine learning technology into library and its space design is an urgent problem to be solved.

II. B. 3) Application of BIM Technology in Library Design and Construction Safety Management

As an important way of current architectural design and implementation, BIM technology has a good application in the design and implementation of libraries. First of all, BIM technology can be improved and optimized in the design stage, and effective construction management can be realized in the construction stage, which has significantly improved the overall project quality of the library, reduced the project cost, and improved the construction progress. The application of BIM technology not only realizes the optimal utilization of library resources, but also realizes the reasonable allocation of construction personnel, and improves the management quality and level of library projects. In the process of construction, detailed planning shall be carried out for each important node, and corresponding resources shall be reasonably allocated, so as to better control the project progress and investment cost of the library. In addition, BIM technology can achieve reasonable and in place monitoring facilities for library security management, which can be viewed even on mobile devices. In the field layout stage, the monitoring viewpoint view function in the software can be used to fully grasp the monitoring range and monitoring blind area. For library construction areas with many hazard, such as cross operation, multi machine construction in turn, 360 degree all-round monitoring can be carried out to ensure that no dead corner is left. By utilizing the BIM collaboration platform, video links can be directly input into mobile phones through external network channels. Regardless of which construction unit's staff, as long as the application is downloaded and the management personnel activate permissions, they can observe every move on the construction site anytime and anywhere, which can maximize the effectiveness of video monitoring. And it can also be saved in the cloud for emergencies.

However, although BIM technology has been well applied in the design and implementation of libraries, some problems have also occurred.

During the design of the library, the design result submitted by the design unit is a two-dimensional plan. Only the BIM technology is used for scheme comparison, and the BIM software is not used for drawing design, which lacks the in-depth application of BIM technology. In the late stage of the library design project, many models were handed over to the construction department for processing, but the problems encountered in the design drawings were not solved in time, resulting in the lag in the processing of engineering design problems. At present, the application of BIM technology in the field of library space design is not mature and is still in its infancy. At present, BIM technology has a relatively small field of practical application, a relatively low level of application, and a relatively simple understanding of BIM technology, which has not been vigorously promoted. At the same time, due to the existing hardware and software constraints, the application of BIM in engineering is not comprehensive.

From the above, it can be seen that the application of machine learning and BIM technology in library design and construction safety management has a certain theoretical basis. In order to better meet the space needs of the next generation library and optimize library space design, this article combines machine learning and BIM technology to propose a new method for library space design and implementation.

II. C.Algorithm Based on the Combination of Machine Learning and BIM Technology

Structural optimization is an important direction of library space design. The architectural space design and activities of the library are mainly aimed at functional requirements and engineering costs. When carrying out the space design of the library, people should consider both technology and function to make its space design scheme optimal and the implementation cost optimal, which is the successful space optimization design. Therefore, this text introduces machine learning and BIM technology to achieve the best design of contemporary library space through machine learning and BIM technology under the condition of meeting the design requirements.

In order to optimize the space design of the library, it must first establish a mathematical model based on polyhedron. The distance operation between polyhedral models is converted into data optimization, and then the optimal solution of the problem is obtained by encoding the data and relying on immune genetic algorithm under machine learning.

A library model with a finite point set $\{a_1, \cdots, a_m\}$ can be expressed as:

$$\{a_1, \cdots, a_m\} = \left\{\sum_{n=1}^{j} \theta_n \gamma_n | \gamma_n \in z, \theta_n \geq 0, n = 1, \cdots, j; \sum_{n=1}^{j} \theta_n = 1, j \in Y_+\right\} \quad (1)$$

Y_+ is the set of all positive integers.

Assuming that the minimum distance D_{WX}, b and c of the two models W and X are at any point on the model W and X, the following formula can be obtained:

$$D_{WX} = \left\|\sum_{n=1}^{j} \vartheta_n b_n - \sum_{i=1}^{m} \omega_i c_i\right\| \quad (2)$$

Y_+ is the set of all positive integers.

Assuming that the minimum distance D_{WX}, b and c of the two models W and X are at any point on the model W and X, the following formula can be obtained:

$$D_{WX} = \left\|\sum_{n=1}^{j} \vartheta_n b_n - \sum_{i=1}^{m} \omega_i c_i\right\| \quad (2)$$

Among them:

$$\sum_{n=1}^{j} \vartheta_n = 1, \sum_{i=1}^{m} \omega_i = 1, \vartheta_n \geq 0, \omega_i \geq 0 \ (n, i = 1, \cdots, m) \quad 3)$$

Suppose $\sum_{n=1}^{j} \vartheta_n b_n$ is a point b in model W and $\sum_{i=1}^{m} \omega_i c_i$ is a point c in model X, then ϑ_n and ω_i must meet the following conditions:

$$\text{st} \sum_{n=1}^{j} \vartheta_n = 1, \vartheta_n \geq 0, n = 1,2, \cdots, j \quad (4)$$

$$\text{st} \sum_{i=1}^{m} \omega_i = 1, \omega_i \geq 0, i = 1,2, \cdots, m \quad (5)$$

In this way, the shortest distance problem can be abstracted into a nonlinear problem with constraints. The preconditions for collision when the model is solved are shown in Table 1:

Table 1: Prerequisites for model collision

Serial number	Prerequisites	Results
1	$D_{WX} > 0$	No collision
2	$D_{WX} < 0$	Collision occurred
3	$D_{WX} = 0$	Collision occurred

Through the established mathematical model, people can know that the coordinates of the W and X models are finite, so the time complexity of the optimal solution of this method is an important problem. Here, the optimal solution of data can be obtained by immune genetic algorithm.

Then the point optimization problem in the space design of the library can be converted into a minimization problem, which can be expressed by the formula:

$$\begin{cases} min\ h\big(b(1), b(2), \cdots, b(q)\big) \\ g(i) \leq b(i) \leq k(i), i = 1,2, \cdots, q \end{cases} \quad (6)$$

In the formula: $b(i)$ - the ith optimization variable;

$[g(i), k(i)]$ - value range of $b(i)$;

q - number to be optimized;

h - Objective function.

The last step is to calculate the affinity. In the process of evolutionary search, the calculation of affinity is the key. Choosing an appropriate affinity function can prevent the algorithm from falling into local optimization. Generally speaking, when the value of a function increases, its individual affinity would become lower, and vice versa. For this purpose, the affinity function value can be defined by the formula:

$$\mathrm{H(n)} = \begin{cases} 1/h^2(n) & h(n) \neq 0 \\ J_{max} & h(n) = 0 (1 \cdots j) \end{cases} \quad (7)$$

In the formula: J_{max} - large enough positive number.

Through the BIM technology and the genetic immune algorithm under machine learning, the distance calculation problem between models can be effectively turned into the optimization problem for communication and understanding. This can stimulate users' interest in the design of library space, and is more conducive to the design of a better, more scientific, more in line with the technical requirements and functional requirements of the next generation library, realizing the optimal design and implementation of library space.

III. Empirical Analysis on Space Design and Construction Safety Management of Next Generation Libraries

On the basis of analyzing the requirements for space design and implementation in next-generation libraries, this article proposes a method that better meets the requirements of space design in next-generation libraries, combining the application of machine learning in libraries and the application and shortcomings of BIM technology in library space design and construction safety management. To verify the practical effectiveness of this method, this article also needs to conduct empirical exploration.

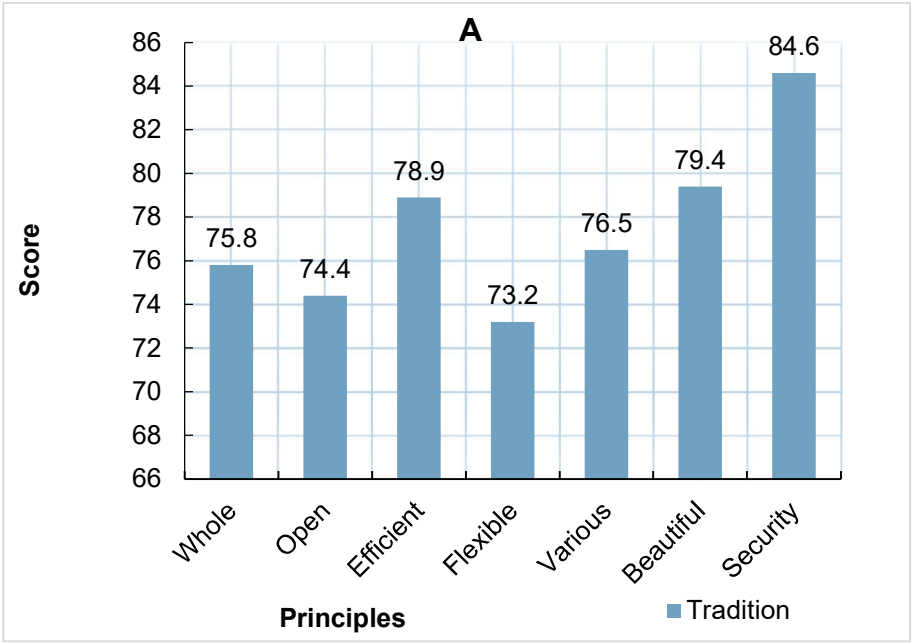
III. A. Research Methods for Space Design and Construction Safety Management of Next Generation Libraries

To verify the practical role of machine learning and BIM technology in the space design and construction safety management of next-generation libraries, this article selects a local university's new and old libraries as the research object. The new library uses the method proposed in this article for space design and implementation, while the old library uses traditional methods for space and transformation. Afterwards, this article compared the scores of new and old libraries in terms of spatial design principles, spatial functional design, and spatial implementation requirements under two different methods through expert scoring, and drew relevant conclusions.

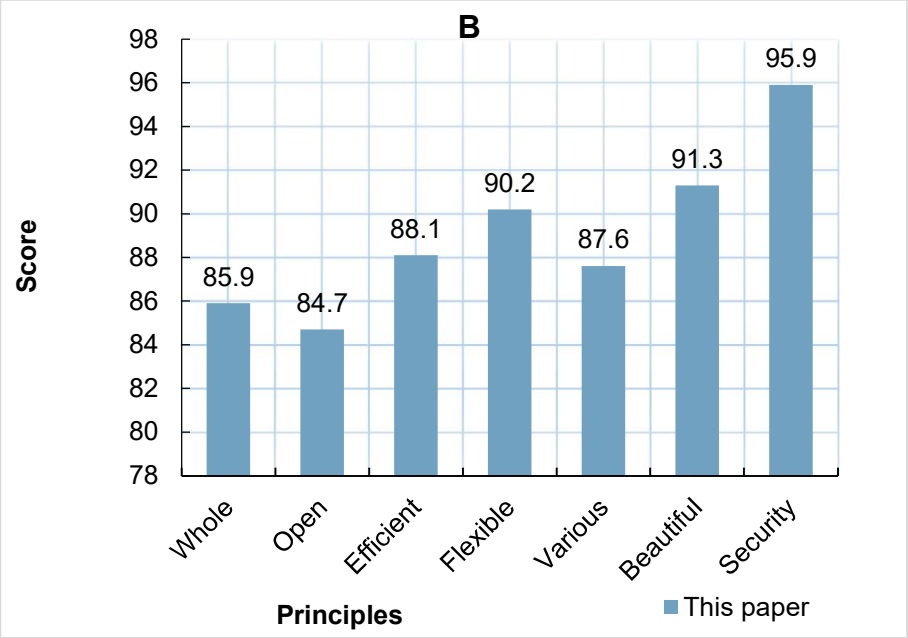
III. B. Analysis of the Results of Space Design and Construction Safety Management for the Next Generation Library

III. B. 1) Space Design Principles

The space design of the next generation library of empty library needs to fully consider its design principles. From the perspective of library management users, we should design a library learning and exchange space that conforms to the principles, has reasonable functions, is active, and has rich connotations. Compliance with the principles of library space design is an important standard for measuring the safety management of library space design and construction. The main principles of space design for the next generation of libraries include integrity, openness, efficiency, flexibility, diversity, aesthetics, and safety. The specific scoring results of experts on the spatial design principles of new and old libraries under two methods are shown in Figure 5:

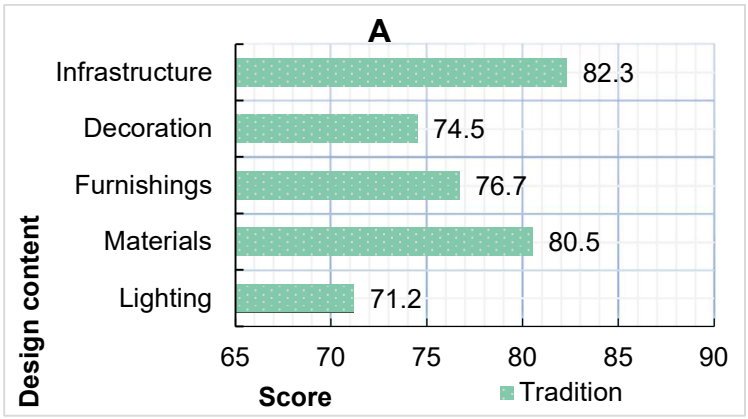


(A): The score of the spatial design principles of the old library under the traditional method

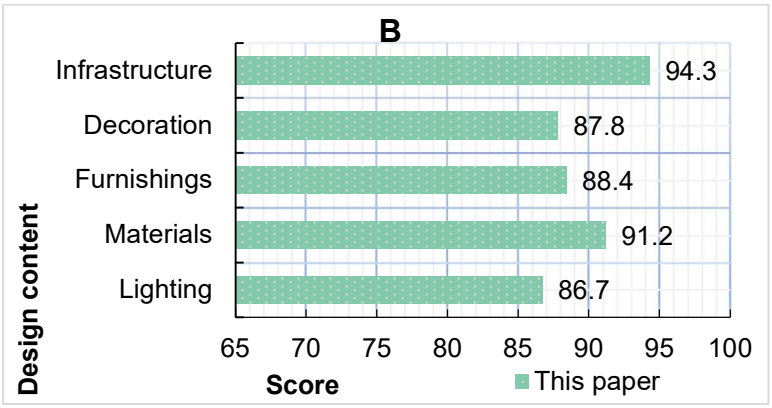


(B): The score of the new library space design principles under the method of this text

Figure 5: Comparison of principle scores of space design of new and old libraries under the two methods



(A): The score of the spatial function design of the old library under the traditional method



(B): The score of the spatial function design of the new library under this method

Figure 6: Comparison of scores of space function design between new and old libraries in two ways

It can be seen from Figure 5 (A) and Figure 5 (B) that the overall score of the old library space design under the traditional method is 75.8, and the opening score is 74.4. Efficiency score is 78.9, flexibility score is 73.2, and diversity score is 76.5. The aesthetic score was 79.4 and the safety score was 84.6. The overall score of the new library space design under this method is 85.9, the score of openness is 84.7, and the score of efficiency is 88.1. The flexibility score is 90.2, the diversity score is 87.6, the beauty score is 91.3, and the safety score is 95.9. Compared with the traditional method, the overall score of the new library space design under this method is 10.1 higher and the openness score is 10.3 higher. Efficiency score was 9.2, flexibility score was 17, and diversity score was 11.1. The aesthetic score was 11.9 and the safety score was 11.3. It can be seen that the library space design under this method is more in line with the principles and practical needs of contemporary library space design. This may be because the method in this text uses machine learning and BIM technology for design and construction modeling, so as to effectively find and improve its spatial design deficiencies.

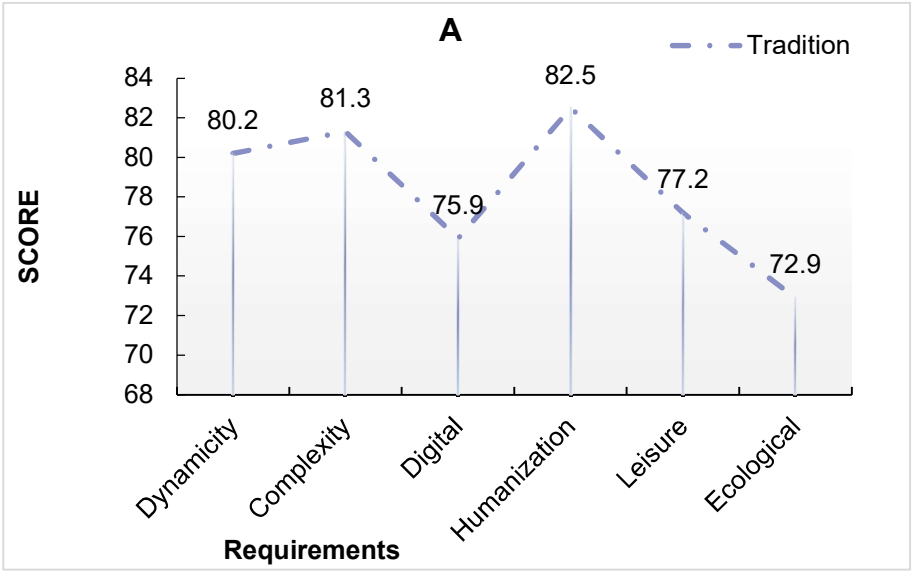
III. B. 2) Space Function Design

Library space function design is an important content of space design, which is also an important embodiment of the scientific and rational nature of library space design. This text compares the design scores of lighting, material, furnishings, decoration and infrastructure in the space of the new and old libraries under the two methods. The specific results are shown in Figure 6:

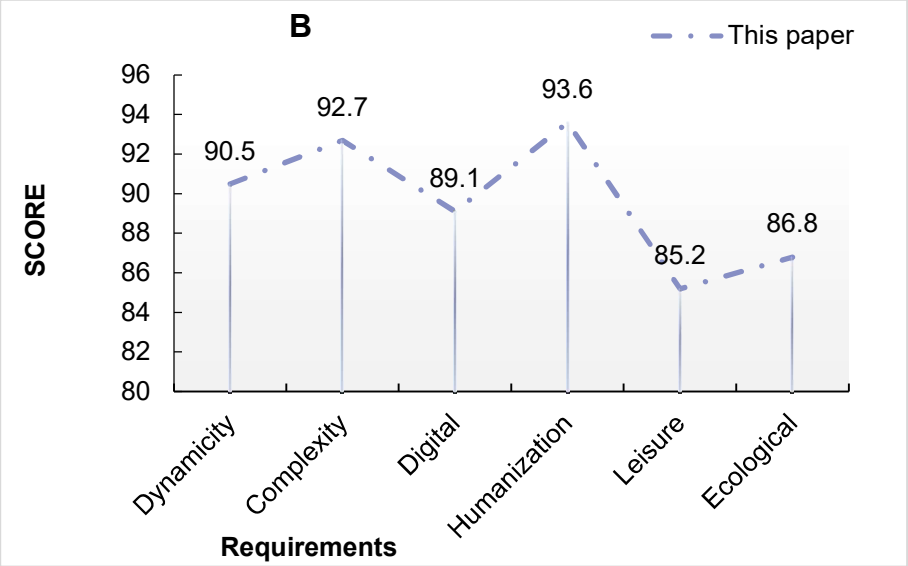
It can be seen from Figure 6 (A) and Figure 6 (B) that the lighting design score in the space function design of the old library under the traditional method is 71.2, and the material design score is 80.5. The score of furnishings design is 76.7, and the score of decoration design is 74.5. The infrastructure design score is 82.3. The lighting design score of the new library space function design under this method is 86.7, and the material design score is 91.2. The score of furnishings design is 88.4, decoration design is 87.8, and infrastructure design is 94.3. Compared with the traditional method, the lighting design score of the new library space function design under this method is 15.5 higher and the material design score is 10.7 higher. The score of furnishings design is 11.7, decoration design is 13.3, and infrastructure design is 12. It can be seen that the space function design score of this method is higher, which means that this method can effectively improve the rationality and scientificity of library space function design. This is because this text combines BIM technology with machine learning, optimizes the spatial structure of the library, makes the allocation of library resources more reasonable, and makes the spatial function of the library more reasonable.

III. B. 3) Space Implementation Requirements

Compared with the traditional library space design, the requirements of the next-generation library space design are also different. The main requirements of the next-generation library design are dynamic, complex, digital, humanized, recreational and ecological. Whether it meets the requirements of space design is an important way to measure the standardization of library space design. The scoring results of experts' requirements for the implementation of new and old library space under the two methods are shown in Figure 7:



(A): Scores of space implementation requirements of old libraries under traditional methods



(B): The score of the implementation requirements of the new library space under this method

Figure 7: Comparison of scores of space implementation requirements of new and old libraries under the two methods

It can be seen from Figure 7 (A) and Figure 7 (B) that the dynamic score in the space implementation requirements of the old library under the traditional method is 80.2, and the composite score is 81.3. The digital score is 75.9, the humanization score is 82.5, the leisure score is 77.2, and the ecological score is 72.9. The dynamic score of the new library space implementation requirements under this method is 90.5, and the composite score is 92.7. The digital score is 89.1, the humanization score is 93.6, the leisure score is 85.2, and the ecological score is 86.8. Compared with the traditional method, the dynamic score of the new library space implementation under this method is 10.3 higher and the composite score is 11.4 higher. The digital score was 13.2 higher, the humanization score was 11.1 higher, the leisure score was 8 higher, and the ecological score was 13.9 higher. This shows that the implementation of library space under this method is more in line with the new requirements of the space design and implementation of the next generation library. This is because this method combines machine learning and BIM technology, pays attention to the actual needs of the current library, makes the library design more intelligent, and the implementation of library engineering projects more efficient and reasonable.

In summary, through empirical research on next-generation library space design and construction safety management based on machine learning and BIM technology, it was found that the overall score in library space design under this method is 10.1 more than traditional methods, the openness score is 10.3 more than traditional methods, the efficiency score is 9.2 more than traditional methods, the flexibility score is 17 more than traditional methods, and the diversity score is 11.1 more than traditional methods, The aesthetic score is 11.9 points higher than traditional methods, and the safety score is 11.3 points higher than traditional methods; In addition, the lighting score in the functional design of library space under the method of this article is 15.5 higher than that of traditional methods, the material design score is 10.7 higher than that of traditional methods, the display design score is 11.7 higher than that of traditional methods, the decoration design score is 13.3 higher than that of traditional methods, and the infrastructure design score is 12 higher than that of traditional methods. This indicates that the method proposed in this article can more effectively promote the rationalization and scientificity of library space design and implementation, so that the space design and construction safety management of the next generation library can better meet its actual needs, and ultimately promote the transformation and upgrading of the library.

IV. Conclusions

Due to the rapid development of artificial intelligence and network systems, artificial intelligence technology and machine learning have also been widely applied and have had different impacts on people's lives. However, in the field of architectural space design, the application of artificial intelligence and machine learning still needs improvement. The theme of this article is the application of machine learning and BIM technology in the design and construction safety management of next-generation library spaces. Firstly, a brief introduction is given to the research background of the article, followed by a summary and analysis of the advantages and disadvantages of

previous scholars in library space design research. Afterwards, this article combines relevant theoretical content to analyze and propose methods for optimizing the design and implementation of next-generation library spaces, By utilizing machine learning and BIM technology, we aim to improve the space design and construction safety management of the next generation library. To verify the feasibility of this method, this article also conducted practical verification at the end. The experiment found that the method proposed in this article has certain practical value. It can make the principles and requirements of library space design more in line with current needs, make the functional space design of the library more scientific and reasonable, and provide comprehensive services for users in the library, promoting the development of intelligence and informatization in the library.

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