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The Impact of Digital Twin Technology on BIM Technology in the Building Life Cycle Analysis

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Abstract. With the continuous development and improvement of civil engineering technology, BIM technology has been widely used in the building life cycle analysis, but data isolation is one of the serious problems in building life cycle, which limits the intelligent development of building facilities and the further application of BIM technology. Some researchers have found that the use of digital twin (DT) technology in combination with BIM technology can solve the problem of data isolation, but the combination of the two at various stages of the life cycle is on process. Therefore, by collecting the influence before and after the combination of DT technology and BIM technology in building facilities, this paper introduces, analyzes and summarizes, and probes into the three stages of design, construction and operation and maintenance respectively. It is found that the combination of BIM technology and DT technology can make the design more reasonable and elaborate in the design stage of building facilities; In the construction phase, it can make the construction facilitate collaboration, make the construction more safe and efficient; In the operation and maintenance stage, the operation and maintenance of the building can be more energy efficient, further save costs, and promote the sustainable and healthy development of the building.

Keywords: BIM, digital twin, construction project management, The Building Life Cycle

1. Introduction

With the development of technology, more and more advanced technologies are being used throughout the life cycle of buildings. For example, Integrated building Information modeling (BIM) and Digital Twin (DT) technologies offer a unique opportunity to improve the sustainability of building facilities. From the research of Honghong, while the new DT technology, which is primarily used in the operation and maintenance phases, has great potential to shape a DT-enhanced BIM framework to fully enable whole life cycle digital construction, BIM has been instrumental in bringing about revolutionary and systematic changes over the past ten years, particularly for the design and construction stages in bridge engineering [1]. In addition, although dynamic sustainability assessment requires the integration of advanced technologies like the Internet of Things and the management of real-time data, BIM is currently limited in these areas. The DT concept, which offers a real-time digital representation of physical assets, shows promise in overcoming these limitations [2]. It is clear that the use of BIM technology has a positive impact on

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the whole building life cycle. However, the problem remains, BIM has a significant problem of data isolation throughout its life cycle. The purpose of this study is to clarify that DT techniques can help solve such data isolation problems. Specifically, in the building life cycle, how to correctly use DT technology to solve the problem of data isolation is also a problem we need to solve.

BIM has been at the front of the digital transformation in the engineering and construction industries. BIM facilitates the creation of intricate digital models that accurately depict the physical and functional characteristics of a structure. These models enable stakeholders to share information and make more informed decisions at every stage of the project lifecycle. However, the need for increasingly sophisticated digital tools has grown along with business expectations [3].

Alongside the DT concept, BIM has evolved in recent years. In order to maximize the value of information and conserve physical resources, DT technology develops a virtual environment where industrial operations can be forecasted and simulated alongside the real world. With the help of DT, designers can completely express their creativity in order to optimize the structural design, and organizational managers can improve the integration of social resources by implementing more efficient management strategies. In the end, DT will support the digitization of the construction sector and the enhancement and upgrading of industrial buildings [4].

2. Case study

With the rapid development of building technology, the life cycle of buildings is getting longer and longer. After combining the research results of many scholars, this study believes that the whole life cycle of A building is composed of three parts: design stage, construction stage and operation and maintenance stage [5, 6]. Nowadays, more and more researchers and construction experts combine BIM technology to study the building life cycle, hoping to reasonably plan various periods of the building life cycle and further improve production efficiency. It is true that BIM technology has been of great help to the whole life cycle of buildings. However, for today's buildings, Farsangi showed, gave us points that there is still far from enough, and the study also found that there is a problem of data isolation [3]. In study of Gourlis and Kovacic, there is information lag in multi-professional collaborative design and in the design stage [7]. There is cooperation barrier in the construction stage, and there is static limitation in the operation and maintenance of BIM models, and it is believed that DT technology can be used to assist and adjust BIM technology, thus making up for the data isolation defects existing in BIM technology [2, 4]. However, the relevance of BIM technology and DT technology in data exchange and the advantages of cooperation in the whole engineering life cycle are still unclear. Our research will introduce the problems and solution in three stages.

2.1. Design stage

In the design stage of construction engineering, design quality is very important, which means that the design scheme can ensure the accuracy and integrity of the design document while meeting the function and safety. The core of design quality is to provide high-quality design results that meet the specifications through optimization design and innovation, and lay the foundation for subsequent construction and operation and maintenance.

It is found in many articles in this field that BIM technology is used in the design of a large number of construction operations, and BIM technology is mainly used in the architectural design stage, but there are still many problems.

DOI: 10.54254/2755-2721/2025.GL24417

2.1.1. Case 1 in design stage

Gourlis and Kovacic said the application of BIM technology in the design stage has the following problems [7]. After the designer uses the design model made by BIM, if it is to be converted into a model suitable for DT, additional data processing and simplification are required. This means that some details and information in the BIM model may be lost when converted into the DT model, and even need to be re-entered, which can lead to problems such as data incompleteness and consistency. In traditional design, since the subsystems of the facility are usually optimized in isolation, the overall work efficiency is low. To this end, Gourlis and Kovacic proposed a whole DT ecosystem, which integrates all subsystems into a unified environment through hybrid simulation to achieve collaborative optimization among systems [7]. In addition, the phenomenon of data isolation caused by BIM is particularly obvious when multiple areas of expertise are involved in multi-department collaborative design. Although BIM technology is conducive to the collaboration among various professional departments, in actual use, the BIM software and data file formats used by each expert are different, and there are differences, resulting in compatibility and format problems when data is transferred between different professions, forming data islands and leading to sharing obstacles.

Table 1: DT technology provides decision making

NO.	Key Point	Description
1.	BIM as Data Source	Directly extract data from BIM models, eliminating data conversion.
2.	Dynamo for Efficient Data Extraction	Semi-automated data extraction reduces errors and ensures data accuracy.
3.	Model Simplification and Optimization	Simplify models to improve efficiency while retaining critical design information.

However, the use of DT technology can be a good solution to the above problems (in Table 1. DT technology provides decision making.).

First of all, the workflow proposed in this study is able to create and parameterize DT models by obtaining first-hand construction-related data directly from BIM models. This shows that the designer is using BIM for the design, but also lays the foundation for the subsequent DT model layout, without additional data conversion or re-entry work.

Secondly, designers can use Dynamo technology for semi-automated data acquisition, which can efficiently extract and organize building information from BIM models. This not only reduces the time spent and errors generated compared to manual operation, but also ensures the accuracy and integrity of the data, providing reliable data support for the establishment of DT models.

In addition, in the research of these scholars, when the BIM model data is transformed into the DT model, the workflow appropriately simplifies and abstracts the model. This helps to improve the efficiency of the model while preserving key information about the design.

2.1.2. Case 2 in design stage

Farsangi included, also, there are many problems in the design phase. Of course, in addition to BIM software, designers may also use other professional design tools, such as CAD, structural analysis software, etc [3]. The data integration and conversion between BIM models and these tools are incompatible, resulting in data loss and errors during the conversion between these different tools, so a lot of manpower and resources are needed to ensure the consistency of data. In addition,

DOI: 10.54254/2755-2721/2025.GL24417

BIM models are usually static in the design stage, so it is difficult to update the model data synchronously with the further optimization of the design after the design is completed. This makes the BIM model unable to reflect the latest changes in the design in a timely manner, resulting in a disconnect between the data and the actual design progress, forming data silos.

In the same way, in their research, these experts propose the following excellent ways to solve the series of problems brought about by the BIM technology reset stage.

Table 2: Part of the help of DT technology to BIM in design

NO.	Problem	Solution	Methodology
1.	Information silos, poor communication	Unified virtual environment, real-time collaboration	DT
2.	Inaccurate performance prediction	BIM model, performance simulation	BIM, DT
3.	Evaluation difficulties, low customer satisfaction	Immersive experience, intuitive presentation	VR, AR
4.	Lack of innovation, low efficiency	AI analysis, data-driven design	Artificial Intelligence, Machine Learning

From the Table 2. Part of the help of DT technology to BIM in design, some key words that use DT technology to solve problems in the design phase are shown.

First, a real-time dynamic DT platform is established by using DT technology in the design stage, so that designers, engineers and customers can operate and communicate in the same virtual environment. This helps all parties to share and modify the design scheme in real time in the design, reduce misunderstandings, and improve the quality and efficiency of the design.

Second, based on the integration of BIM models and real-time data, DT models can simulate and analyze building performance in terms of energy consumption and structural safety at the same time during design. This provides a more comprehensive decision basis for designers, so that they can make better decisions in the design process to meet the performance objectives.

Third, DT models can combine technologies such as virtual reality (VR) and augmented reality (AR) to bring immersive visual experience to designers and customers at the design stage, where they can more intuitively view and evaluate the design scheme, so that problems can be detected in advance and adjustments can be made, thereby improving the accuracy of the design and customer satisfaction.

Fourth, designers utilize artificial intelligence (AI) and machine learning algorithms based on DT technology, which can learn from historical data and existing designs, stimulate designers' creativity, and promote the development of designs in a more efficient and sustainable direction.

In this way, the use of DT technology can improve the design quality, thereby improving efficiency at the design level. While saving time in the early stage, the construction Angle of the building in the later stage can improve the quality of decision-making and the efficiency and cost of operation and maintenance.

2.2. Construction stage

It is found in many articles in this study that BIM technology is used in the design of a large number of construction operations, and BIM technology is mainly used in the architectural design stage, but there are still many problems, and the researchers found the following questions.

DOI: 10.54254/2755-2721/2025.GL24417

2.2.1. Challenge in construction stage

Table 3: A review on the problems and impacts of BIM in the construction stage.

Ref.	Issues	Impacts
[1]	Incomplete, outdated, or fragmented data in the bridge operation phase	Restricted application, insufficient support for maintenance decisions, reduced data value, and increased circulation costs
[2]	Lack of real-time data and dynamic change integration capabilities	Restricted full lifecycle application, impacts real-time evaluation and decision-making efficiency during operations
[8]	Lack of dynamic behavior models, especially in behaviors not observed by sensors	Restricted operation and maintenance applications, impacts advanced fault detection and diagnosis, reduces operational efficiency and sustainability
[9]	Confronting data silos, incomplete information, and underutilized data	Low monitoring efficiency, poor timeliness, increased building energy consumption, and impedes material sustainability

In the construction stage, Table 3. A review on the problems and impacts of BIM in the construction stage lists the problems and impacts of BIM without DT technical support, which are described in detail as follows:

Data update is not synchronized:

Due to the numerous on-site projects during construction, data such as progress and material changes often cannot be timely fed back into the BIM model, resulting in a disconnect between the original BIM design model and the actual construction situation. If the size or position of some prefabricated components is changed due to force majeure or human factors during construction, and the BIM model does not update the data in time, the subsequent construction arrangement and corresponding detection based on the BIM model will have deviations and misjudgments, which will affect the construction efficiency and quality, and increase the construction cost and safety risks.

Field data is disconnected from the model:

The BIM model generated in the design stage often cannot completely cover all the data on the construction site, among which, the inspection report and monitoring data generated on the site often exist independently without establishing correlation with the elements in the model. When concrete is poured, it is not associated with the corresponding component in BIM, and information such as the pouring record of a component cannot be visually viewed in BIM software. In this way, the informationization advantages of BIM cannot be brought into play, which is not conducive to the fine management and quality control of the construction process.

Barriers to data sharing among participants:

Similar to the design phase, the construction phase involves multiple participating departments that may use different BIM software, data formats, and management platforms, making data sharing and collaboration difficult. Extend the project duration and increase the coordination cost.

In many studies, researchers have realized the real-time correlation and synchronous update between the physical construction site and the virtual BIM model through the construction of the DT model. What's more, the blockchain technology in DT is used to distribute ledger and immutable characteristics to record and update data during the construction process, thus ensuring the authenticity and traceability of data. Enhance the credibility of data and facilitate data sharing and collaboration.

DOI: 10.54254/2755-2721/2025.GL24417

2.2.2. Innovation in construction stage

The researchers specifically proposed the following innovations:

Real-time data integration and model updating:

Using DT as a platform, researchers use Internet of Things (IoT) devices and a variety of sensors to collect real-time construction site data through monitoring LIDAR measurement system, and integrate it with BIM model to realize dynamic update of the model, timely obtain displacement data of building structure, and realize real-time monitoring and analysis of building deformation [9]. Using real-time data integration and model updates, the construction team is able to understand the reality of the construction site in real time, so as to adjust the construction plan and resource allocation in a timely manner, and further improve the construction efficiency and quality.

Construction schedule management and optimization:

The combination of BIM and DT technology is used to simulate and analyse the bridge construction process, further optimize the construction schedule, and improve the controllability and predictability of the construction schedule [1]. In this way, construction managers can identify potential construction bottlenecks and risks in advance, and adjust and optimize them through corresponding measures, thereby shortening the construction period and reducing costs.

Construction quality monitoring and control:

DT, combined with automated monitoring robots and GNSS technology, monitors and analyses key indicators such as displacement and inclination of building structures in real time, so as to find and deal with construction quality problems in time [9]. This monitoring method integrates multiple data sources, makes the construction quality information source more comprehensive and accurate, helps the construction team find and solve problems in time, and then improves the construction quality.

Security risk early warning and management:

DT technology can not only monitor construction quality, but also combine environmental monitoring sensors and safety monitoring equipment to conduct real-time monitoring of temperature, humidity and wind speed on the construction site, control safety risks such as fire and collapse, and conduct safety risk analysis and early warning in combination with BIM model, so that construction personnel can take measures to prevent safety accidents [9].

Resource optimization and cost control:

Through the combination of DT and blockchain technology, Figueiredo mentioned monitor and analyse the use of resources on the construction site in real time, realizing resource optimization and cost control over the whole life cycle of construction projects, making resource utilization more effective and cost management more transparent [2]. In this way, the construction team can more accurately grasp the use of resources, optimize the allocation of resources, so as to avoid resource waste and cost overruns, and improve the economic efficiency of the project.

Multi-party collaboration and data sharing:

The VIM framework built by Yoon said that based on DT technology realizes the application of BIM and DT models in multi-party cooperation, enabling all parties to share and process data collaboratively in real time during the construction phase, reducing communication misunderstandings and repetitive work, and improving communication efficiency, cooperation effect and overall management level [8].

Through these highlights, the application of DT technology in the construction phase not only improves construction efficiency, quality and safety, but also optimizes resource allocation and cost control, providing strong support for the smooth implementation of construction projects.

DOI: 10.54254/2755-2721/2025.GL24417

2.3. Operation and maintenance stage

BIM technology is extensively utilized not only during the design and construction phases but also during the operation and maintenance phases. Similar to the design and building phases, BIM technology has several drawbacks throughout the operation and maintenance phase. Among them, the static BIM model, which is common in the design stage and construction stage, is out of step with operation and maintenance data; delayed updating of operation and maintenance data leads to delayed decision-making; lack of data standardization leads to limited data sharing and interoperability between different departments, etc. In the operation and maintenance stage, this study will not be detailed. After analyzing the views of experts in Table 4. Key words of research on assisting BIM based on DT in operation and maintenance stage, this paper discusses the shortcomings of BIM technology in the aspects of data failing to support dynamic analysis and simulation, insufficient data management in the whole life cycle, and difficult integration of data with other operation and maintenance systems.

Table 4: Key words of research on assisting BIM based on DT in operation and maintenance stage

Ref.	Methodology	Research Content	Conclusion
[4]	BIM+IoT, Real-time Monitoring, Digital Twin	Building Operation and Maintenance, Predictive Maintenance, Resource Optimization	Improve Efficiency, Optimize Management, Sustainability
[10]	BIM+LCA, Environmental Assessment	Structural Systems, Energy Consumption, Environmental Impact	Reinforced Concrete Has the Greatest Impact, Optimization Strategies
[11]	Digital Twin+BIM+IoT, Predictive Modeling	Real-time Monitoring, Renewable Energy Integration	Improve Energy Efficiency, Reduce Carbon Emissions
[12]	BIM+Digital Twin, Real-time Monitoring	Facility Management, Data Analysis	Data Quality, Interoperability
[13]	Real-time data; Lifecycle management; Open standards; Predictive maintenance	Environmental impact; Resource efficiency; Resilience; Data interoperability	Sustainability improved; Data compatibility; Full lifecycle support
[14]	IoT sensors; AI algorithms; Scenario simulation; AR/VR	Data collection; Energy optimization; Cloud platform; Data security	Efficiency improved; Maintenance costs reduced; Energy savings; Data security

2.3.1. Deficiencies in operation and maintenance stage

In the operation and maintenance stage, experts put forward that dynamic analysis and simulation of the operation of the building may be needed [4, 11]. However, BIM model mainly provides static analysis in the aspect of management, and lacks the support of real-time data. Therefore, data such as energy consumption simulation and personnel flow simulation of the building cannot be obtained in real time, and the operation strategy cannot be dynamically optimized. For example, it is not possible to simulate the elevator use in different time periods according to the real-time personnel flow data, so that it is impossible to arrange the elevator operation reasonably, affecting the personnel traffic efficiency, causing energy waste, and limiting the scientific and forward-looking decision-making in the operation and maintenance stage.

Among them, the lack of real-time data feedback makes it impossible to conduct real-time monitoring and analysis of the actual operating performance and further performance optimization

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in the intelligent building facilities, so that performance optimization and predictive maintenance based on real-time data cannot be realized [4, 11]. For example, equipment failure cannot be predicted through real-time monitoring data, and can only be repaired after equipment failure, increasing maintenance costs and downtime.

In addition, Badenko put forward the sustainability principles of BIM and DT in infrastructure [13]. First of all, due to the lack of DT integration, the BIM model itself is difficult to integrate environmental monitoring data such as air quality and noise, resource consumption data such as water resources and maintenance consumables with its own model in the operation and maintenance stage, which limits the assessment of facility environmental impact by facility managers and the optimal utilization of resources. At the same time, BIM model is more difficult to realize the complete integration and management of the whole life cycle data, resulting in the lack of integrity and continuity of the data chain in the operation and maintenance stage, affecting the current state assessment of the facility and the future transformation and upgrading.

Similarly, without the help of DT, the BIM model cannot quickly simulate the results of different response schemes in an emergency due to the inability to make full use of real-time data and artificial intelligence algorithms for in-depth analysis, and it is difficult to provide intelligent decision support, affecting the safety of emergency situations and failing to make accurate and scientific decisions [14].

Furthermore, data usually exists in the BIM model in the form of static data, which is difficult to effectively interact and integrate with other dynamic operation and maintenance systems. As a result, in the operation and maintenance stage, BIM not only fails to make full use of the real-time data of other systems, but also fails to provide data support for other systems, forming data islands [4].

These problems are unique in the operation and maintenance stage, and different from the data isolation problems in the design and construction stage, and in the absence of combined DT technology, these problems are more prominent in the application of BIM, affecting the value of BIM in the operation and maintenance stage.

2.3.2. Improvements in operation and maintenance stage

In the following studies, scholars have integrated DT and BIM to improve the traditional single BIM:

Multi-source data fusion:

DT can help integrate static data from BIM models with dynamic data from different systems, including BIM models, sensor data, historical operating data, maintenance records, etc., and form a comprehensive building operation data portrait, enabling facility managers to view and analyze all types of building information on a unified platform. The tedious process of switching between multiple systems and integrating data is avoided [4, 10].

Dynamic performance monitoring:

Based on multi-source data fusion and the combination of DT and BIM, the model is no longer a static design document, but a dynamic model that can reflect the actual operation of the building [11]. When the facility fails or is replaced, the DT system can immediately update the relevant information in the BIM model and optimize the adjustment, ensure the consistency of the model with the actual situation, and overcome the limitations of the traditional BIM model in static analysis [4].

Real-time data integration:

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DT technology can integrate the real-time data collected by IoT sensors with the BIM model, such as equipment operating status, energy consumption, environmental parameters, etc., and feed these data back into the BIM model, so that the BIM model can reflect the actual operating status of residential buildings in real time, solve the problem of delayed data update, and realize the dynamic update of the model [4, 10].

Full life cycle data management:

Scholars put forward the sustainability principle of BIM and DT in infrastructure, apply DT technology to realize data integration and management of facilities throughout their life cycle, combine BIM model with actual operational data such as environmental monitoring data and resource consumption data, help facility managers assess and manage the impact of facilities on the environment, and form a complete data chain. Optimize the use of resources [13].

Scenario simulation and emergency response:

Managers use artificial intelligence algorithms such as machine learning in DT to conduct in-depth analysis of data in BIM model and real-time operation data, predict possible equipment failures, realize preventive maintenance, and quickly simulate the effects of different response schemes in emergency situations to help managers choose the best emergency measures. Intelligent decision support for facility managers [4, 10, 14]. This not only reduces equipment downtime, but also reduces maintenance costs.

Cross-system data fusion:

BIM data can be easily integrated with various operations and maintenance systems, including building automation, energy management, and facility management systems, thanks to DT technology's unified data platform [4]. Data sharing and cooperation between various systems are made possible by DT through the use of programming interfaces (apis) and data exchange standards like Message Queue Telemetry Transfer (MQTT) and OPC unified architecture.

Data visualization and interaction:

Based on DT technology, BIM provides an intuitive data visualization interface. Through 3D visualization and interactive functions, users can quickly locate problems, so that operation and maintenance personnel with non-technical background can easily understand and operate the BIM model, and improve decision-making efficiency [4].

Through these brilliant applications, DT technology not only solves the problem of data isolation in the BIM operation and maintenance stage, but also significantly improves the efficiency, quality and sustainability of building operation and maintenance.

In general, whether in the design stage, construction stage or operation and maintenance stage, the combination of DT technology and BIM technology has been the trend of The Times.

3. Suggestions

With the vigorous development of the civil engineering industry, the combination of civil engineering and intelligent technology is becoming more and more close. In the current situation, the combination of BIM technology and DT technology is the trend of The Times. This article discusses it from three perspectives: design, construction and operation and maintenance.

First of all, in terms of design, this study believes that good use of the combination of BIM and DT in the design stage will greatly improve the design efficiency, and also lay a good data foundation for future construction and operation and maintenance. When designing large buildings or facilities, BIM should be promoted to integrate with multi-source data such as topographic Maps, DTM, DSM and Google Maps, and a unified data format and interface specification should be formulated to achieve smooth data flow [15]. In this way, the accuracy and detail level of BIM

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model can be further optimized, making it more in line with the requirements of DT technology on the model, while improving the computational efficiency of the model and reducing resource consumption, so as to meet the needs of large-scale urban road planning [16]. It can be seen that the combination of BIM technology and DT technology is the general trend in the design stage.

Secondly, this study believes that the most important place for the combination of BIM technology and DT is the construction stage, and the combination of the two in the construction stage will completely change the current situation of human-intensive construction and further promote the intelligent construction. Opoku proposed that construction parties should actively promote the formulation of digital industry standards, promote the integration and upgrading of BIM and DT, clarify key elements such as data formats, interface standards and model accuracy, and ensure data compatibility and interoperability between different software and platforms [17]. Shishehgarkhaneh believed that construction enterprises should cooperate with information technology enterprises, communication technology enterprises, scientific research institutions and other companies in construction, promote the further integration of BIM, IoT and DT technologies, enable data sharing in all aspects of construction, protect data security, improve the credibility of data, and steadily promote safe construction [18]. Therefore, the combination of BIM technology and DT technology in the construction stage is the trend of The Times.

Finally, in the operation and maintenance stage, this study believes that the integration of BIM and DT in the operation and maintenance stage is the basis for sustainable and healthy development of buildings. At the user level, BIM is optimized by DT technology to create an intuitive and easy-to-use interactive management interface for building users, display building usage, building health status and other information, and encourage users to actively participate in building operation and maintenance [15, 19]. At the level of building managers, data storage, management, analysis and sharing of BIM, IoT and DT technologies are promoted based on open building data platforms, so as to break information silos and realize efficient use of data [18]. In order to increase the overall operational efficiency of the city and encourage its healthy development, smart cities are incorporated into the use of BIM and DT technologies at the city level. An intelligent urban infrastructure management platform is developed based on the Internet of Things, big data, artificial intelligence, and other technologies. All things considered, the current trend is the integration of DT and BIM technologies throughout the operation and maintenance phase.

4. Conclusion

Although BIM technology is crucial for building lifecycle management, the industry's overall sustainability and efficiency are still limited by its data isolation problems. Through real-time data sharing, dynamic model updating, multi-source data fusion, and other techniques, the integration of DT technology offers a creative solution to this issue and greatly enhances efficiency and teamwork during the design, building, and operation phases.

DT technology facilitates real-time data exchange and dynamic updates during the design phase, addresses issues with data compatibility and information lag in multi-professional collaborative design, and enhances the effectiveness and caliber of the design. By using IoT devices and sensors to gather data in real time during the building process, DT technology improves construction productivity and safety by resolving issues like data disconnection and cooperation hurdles. Through multi-source data fusion and real-time monitoring, DT technology overcomes the static limits of BIM models throughout the operation and maintenance stage and achieves intelligent management.

The construction industry will enter a new age of increased efficiency, intelligence, and sustainability in the future thanks to the integration of BIM and DT technologies. Advanced

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technologies like blockchain and artificial intelligence will further deepen the interaction between BIM and DT and offer more potent assistance for construction applications over their whole life cycle. The government and businesses should encourage the uniform use of technology and improve market marketing and policy advice. In order to provide more value for society, the construction industry will progressively realize the shift from the conventional model to the digital and intelligent model.

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