

The Application of Digital Construction Technology in the Process of Smart City Construction

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Abstract. Digital construction technology is essential to achieving high-quality construction in smart cities. This article introduces the application of digital construction technology in smart city construction from the background of smart cities, such as 3D modeling technology, digital twin technology, and artificial intelligence technology. This article conducts qualitative research through literature analysis, exploring the application process, significance, and value of digital construction technology in the process of smart city construction, then discussing its current situation and shortcomings and proposing suggestions. Digital construction technology has been extensively utilized in various fields such as intelligent manufacturing and smart cities and has been introduced into the construction industry. However, model accuracy, data effectiveness, real-time interaction, and comprehensiveness need to be improved, which cannot fulfill the requirements of deep-level applications. In the future, cities will further promote the upgrading of infrastructure and software for digital construction technology, as well as the integration and innovation of AI technology and digital construction technology. Smart cities are anticipated to reach an advanced level of city intelligence and achieve sustainable, efficient, and people-oriented high-quality city development.

Keywords: Digital construction technology, smart city, artificial intelligence technology, Innovative applications.

1. Introduction

Currently, with the rapid development of urbanization, more than traditional construction techniques are needed to meet the needs of smart city construction.

In 1998, the United States was the first country to put forward the "Digital Earth" concept, that is, the establishment of a public open system with human activities and information technology closely integrated to achieve data sharing and interoperability [1]. In 2008, the International Business Machines Corporation presented the concept of Smart Earth. Smart city in the digital city is based on the introduction of a new generation of information technology to achieve smart city planning, construction, management, and services [2]. In China, the report of the 20th Party Congress pointed out that it is essential to strengthen the overall layout of the construction of digital China, build a new digital infrastructure, promote the application of 5G on a large scale, promote the digital transformation of industries, and develop smart cities. In 2020, the Chinese government proposed a policy to promote urban modernization by improving the application level of big data, cloud computing, artificial intelligence, and other technologies. In July 2022, the Chinese government proposed to promote the construction of urban infrastructure and promote the further transformation of smart cities [3].

Smart cities characterized by data-driven information sharing, intelligent applications, and cross-departmental collaboration have become a pursuit for city construction. Therefore, the development of digital construction technology and its application in smart city construction have become the current top priority. Digital construction technology can quickly and efficiently access and process the complex information of cities and establish a wide connection of urban elements such as people, buildings, and the environment. On the one hand, smart cities use 3D modeling technology to create digital city models and then fully integrate the information of various elements of the city to realize the digital twin city. On the other hand, intelligent life forms are built based on artificial intelligence,

participate in decision-making in the form of virtual and real interoperability, and finally realize the intelligent monitoring of smart cities.

This article mainly discusses the influence mechanism and role of digital construction technologies such as 3D modeling technology, digital twin technology, and artificial intelligence technology in smart city construction. It analyzes the current situation and then conducts qualitative research through literature analysis to discuss its advantages and disadvantages and make suggestions.

2. The Application of Digital Construction Technology in Smart City Construction

Through digital construction technology, urban information infrastructure construction is carried out, and a digital management platform is built to comprehensively integrate information from various city elements and make them interconnected, thereby building a smart urban ecosystem and ultimately achieving smart urban management.

2.1. Three-dimensional Modeling Technology

Three-dimensional modeling technology enables real-world urban information to participate fully in the whole process of urban operation and assumes an essential role in smart city construction. 3D modeling technology is used to collect urban geographic information in real time employing advanced surveying and mapping technology. Then, the results can be visualized using 3D computer-aided modeling (CAD) technology and 3D geographic information system (GIS) technology. The 3D building information model (BIM) is then used to efficiently organize and manage all the information of urban construction projects [4]. In the construction process of a city park project, the use of CAD, BIM, and GIS technology jointly established a three-dimensional technology model and project management platform, effectively breaking through the terrain to create a high degree of difficulty in controlling the control of the complexity of the integrated management, poor quality controllability, low efficiency, and other issues, to increase the efficiency of the diverse production activities, to ensure that the project is efficiently constructed [5]. However, in addition to the building model, the city also contains a large amount of infrastructure and geographic information. The three-dimensional urban spatial model and the organic synthesis of this urban information is the city information model (CIM) [6]. The CIM foundation platform is an essential primary capability platform for promoting a smart city. Owing to the evolution of the CIM infrastructure platform, more intuitive and rich urban real-time information can be fully involved in the whole process of city design, planning, and operation. The static traditional digital city model is upgraded to a perceptible, real-time, dynamic smart city model that interacts with reality, providing critical data support for comprehensive urban management and refined governance [7].

2.2. Digital Twin Technology

Digital twin technology is the technology that builds virtual models of natural objects. It builds a model from 3D data of a physical object and simulates the behavior of the object through real-time data transmitted by the sensors on it. Analyzing from the field of urban planning and construction, digital twins not only have the intuitive and comprehensive capabilities of building information models but also can comprehensively collect all information of cities and perform simulation integration.

The utilization of digital twin technology in smart cities is based on the CIM city information model. The target is not simply a building or an event but the information it needs for the overall operating cycle of the city. Integrate and collect, through simulation and calculation, combined with the city's operating status, deduce the city's operating mechanism, predict problems, and propose solutions.

The combination of digital twin and urban planning and construction in China was proposed in 2018. As of now, it still needs problems such as low general universality, low degree of data

integration, and obstacles such as the impact of environmental interference. Only some cities in China have fully applied digital twin technology for comprehensive management, and more often than not, it is through the integration of digital twin technology and other management technologies that the application mode of urban management is needed [8]. Scenic spot flow measurement can be based on each scenic spot ticket data, image collection data, and vehicle traffic. For each scenic spot passenger flow situation for estimation and calculation, at the same time, it can be based on historical data situation, holiday situation, natural weather conditions, data fitting, and the formation of scenic spot passenger flow model accurate integration. The management and prediction of tourist flow in scenic spots through digital twin technology is comprehensive and accurate, and the data information provided will be more accurate under the expansion of data volume and the enhancement of intelligent capability. Although the application of digital twin technology is still not extensive enough, it has many advantages, such as comprehensive application and strong integration ability, which will provide diversified support for the construction and evolution of smart cities [9].

2.3. Artificial Intelligence Technology

Artificial intelligence technology and digital construction technology are highly integrated, and AI large models drive the intelligent upgrade of urban construction, AI has immense computing power, automatically processes and analyzes data, and improves urban efficiency [10-12]. AI Internet of Things builds a smart urban ecosystem. AI big data to create a data-driven urban development model.

The entire application of the Internet of Things and cloud computing technology can achieve centralized storage, processing, and sharing of data, helping managers extract helpful information. Simultaneously, the data-sharing function it provides can improve the collaboration ability of various departments in the city [13]. The application of AI and big data will supply more accurate and efficient urban development solutions. The integration of sustainable buildings and green technologies will drive cities towards more environmentally friendly and sustainable development [14].

In the future, artificial intelligence will be a bridge to the construction of the smart city. With the progress of intelligent perception technology, urban governance has entered an era where everything is possible to be quantified because data can be used for computation, and the future society will be a "computational society". A city is a diverse, complex, and dynamic living entity, and it is also a carrier of economy, commerce, and life. The mission of artificial intelligence and big urban models is to learn, understand, and analyze urban bodies [15]. Concurrently, driven by the construction of smart cities, artificial intelligence technology is also ushering in industrial upgrading and innovative development [16].

Beijing, Shenzhen, Xiongan New Area, and other regions have performed well in the application and innovation capabilities of digital construction technology in smart city construction, along their comprehensive strength is outstanding. Beijing starts from the outstanding problems of urban governance, takes urban events as the traction, and coordinates the management of the grid. Unify the list of urban operation items and build a "4+1" urban operation "one network unified management" application system of cities, districts, streets, residences, and residents that is "horizontal to the edge and vertical to the bottom". Xiongan New Area takes the lead in promoting the construction of digital twin cities. By innovating the new standard system, policy system, and process system, it explores the model of pre-construction, prediction, and prevention of digital cities to support the high-quality development of real cities and to create a digital platform that displays multi-dimensional urban space.

Shenzhen is building a Pengcheng intelligent body with deep learning capabilities. Through the integration and application of artificial intelligence technology and information technology, Shenzhen will build an urban digital base to create an urban intelligent center and then promote business integration and integration to achieve global perception network-wide collaboration, as well as full-scenario wisdom.

In the development of smart city construction, artificial intelligence technology and digital construction technology are critical in the construction of urban digital infrastructure, showing a rapid

development trend. It accelerates the all-around speeding up of the communication network, accelerates the all-around perception of terminal equipment, accelerates the construction of big data centers, accelerates the integration and enhancement of AI infrastructure, and accelerates the infrastructure construction of blockchain technology. Secondly, digital construction technology also promotes the deepening construction of the urban public service system, realizing "one-screen wisdom to enjoy". Government agencies to deepen the "release of administrative services" and other measures to reform, the implementation of the "digital citizen" program, the promotion of "seconds to report the integration of second approval" and other services to promote public services, to achieve the "one screen to share, all-in-one". The goal of "one-screen enjoyment and one-person operation" has been realized. Third, the smart city, through artificial intelligence technology, enhances the level of intelligence in the field of people's livelihood services and thus achieves the goal of strengthening urban governance "one linkage". In the process of exploring the "digital twin city", people have built an intelligent city hub, improved the intelligence level of public health protection, promoted technology-enabled grass-roots governance, strengthened the construction of the social credit system, and deepened the cooperation of smart cities. Fourthly, digital construction technology cultivates "new kinetic energy" for the development of a digital economy in smart cities. Through the cultivation of the data factor market, it can promote the innovative growth of the digital economy industry, accelerate the application of "cloud computing and digital intelligence", implement the "cloud city" action, and ultimately realize the fast growth of the digital economy. Fifth, digital construction technology can build a strong network security protection "firewall". It can strengthen network information security management, overall network security protection, and security technology application innovation.

In short, the integration of artificial intelligence and digital construction technology is conducive to efficiently promoting the transition of smart cities from intelligence to intelligence.

3. Shortcomings and Challenges

Through the induction and sorting of existing literature, the relevant research results have provided a multi-dimensional analysis perspective for this article. The deep integration and innovative application of digital construction technology not only achieves the intelligence and precision of city management and services but also significantly improves urban operational efficiency, enhances urban governance capabilities, and provides essential assistance for smart city construction. However, several issues remain that need to be further addressed.

3.1. Inability to Fully Meet Deep Application Requirements

Digital construction technology currently needs to improve in model accuracy, data validity, real-time interaction, and comprehensiveness, and cannot satisfy the requirements of a deep-seated application. After analyzing the application progress of digital construction technology at home and abroad in the entire product life cycle (including its iterative product design, manufacturing process intelligence: decision-making, real-time operation and maintenance control, accurate fault prediction, and health management), it is pointed out that the current international. There is a lack of a joint and public digital construction technology software platform, the business model of the manufacturer is immature, the supporting technology requirements are high, the standard system is not unified, and the data capabilities are not perfect. These problems have hindered the application and promotion of digital construction technology in smart city construction.

3.2. Lack of Access to Accurate Services

3D modeling technology needs to be more complex in the process of model construction and application, resulting in specific urban problems or application needs that cannot be accurately served. However, Digital twin technology focuses on the analysis and mining of "big data" while neglecting the value of "small data" in the use of data. The excessive pursuit of "infinite real-time" for digital

twin virtual real interaction has led to difficulties and considerable costs in implementation. In the combination of digital construction technology and AI, emphasis is placed on twin data processing and analysis. There are still areas for improvement in the application of AI in the rapid construction of digital twin models, dynamic scheduling optimization of twin data computing resources, and other aspects.

3.3. Poor Integration with Reality

Digital construction technology needs to be more closely integrated with reality in the actual implementation process, with unclear application scenarios and unclear application advantages. Moreover, relying solely on the actual data of physical entities to predict possible future changes cannot evaluate the changes in multiple scenarios in complex environments. Moreover, most of its modeling and simulation methods still need improvement, such as poor flexibility, complex configuration, and error-proneness, and it cannot achieve high confidence in digital twin models. The combination of artificial intelligence and digital construction technology is not close, and the massive amount of urban information and data processing needs more accurate and robust processing methods.

3.4. Data Security

The proliferation of massive data has a double effect on smart city construction: on the one hand, these data provide rich resources for city intelligence; on the other hand, they bring unprecedented information processing challenges. To extract valuable insights from these vast datasets and apply them to smart city construction, efficient analysis along with intelligent decision support through big models are required. With its competent processing capability of large-scale data and self-learning potential, big models have become a key technical solution to support the evolution of smart cities [17]. With the increasing reliance of smart cities on big data, ensuring that data security and personal privacy are not violated while improving the efficiency of city operations and the convenience of residents' lives will become a significant challenge that must be faced and solved in the development of smart cities. In the future, smart cities will require the use of advanced data encryption technologies and strict data management systems to ensure privacy protection and data security.

3.5. Inadequate Information Sharing

The laying of intelligent infrastructure needs to be more comprehensive, and the information interoperability between different governance units is insufficient, resulting in information islands [18]. The main body of urban management fails to build various types of intelligent management systems, such as intelligent transportation, intelligent energy, and intelligent environmental protection, according to the urban governance units, and accordingly lay intelligent infrastructure and open the information channels between different governance units to create a digital integrated governance platform. The digital platform realizes the sharing of information between different management units. It ensures the rapid flow of governance information between different departments, thereby improving decision-making efficiency and resource utilization efficiency and providing systematic data support for urban governance.

4. Suggestions

The construction and outlook of new smart cities is a long-term, complex, and challenging process. It requires the joint participation and collaboration of government, enterprises, research institutions, and the public, among other aspects of society, to achieve intelligent, humanized, and sustainable development of the city through continuous technological innovation, management innovation, and model innovation. The future smart city will not only be an efficient and convenient "urban brain", but also a "smart home" entirely of humanistic care, ecological friendliness, and livability. Therefore, suggestions for the future development of digital construction technology are as follows.

Digital construction technology should fully integrate multi-source data with urban construction mechanisms, accurately build a smart city system driven by digital and analog integration, and provide decision-making optimization methods to meet various application needs. The Beijing Daxing International Airport project adopted digital twin technology during the construction process, comprehensively simulating all aspects of the airport, improving construction efficiency and quality, while ensuring the safety and comfort of the airport. Throughout its digital construction process, the successful application of digital twin technology lies in the overall coordination of information from various aspects such as architecture, structure, electromechanical, equipment, urban planning, aviation industry, design, construction, and operation, fully reflecting the importance of integrating multi-source data from multiple sources.

Further, smart cities explore the infinite possibilities of AI digital construction technology. They should explore transparent and explainable digital construction technology to apply AI algorithms and further integrate AI technology to empower the application scenarios of digital construction technology in urban construction.

Smart City forms a digitally driven smart city management system through the development of a smart city management platform that integrates the core functions of smart city model construction, digital data processing, and virtual-reality dynamic interaction; in the product manufacturing process during city operation, digital construction technology is used to build a multi-level system in various fields to form a multi-model fusion manufacturing ecosystem, including a factory digital management system, product digital management system, supply chain digital management system. The integration of the three systems in the product manufacturing process dramatically improves the synergistic operation and optimizes the management process between the various areas.

To allow users to use digital construction technology with confidence, the government should build relevant physical security mechanisms, privacy protection, and digital city asset security systems.

Cities should strengthen international exchanges and cooperation and further reach consensus through the development of relevant international standards such as digital models, data, and applications. In the future, digital construction technology will also be further integrated with internationally leading system engineering to serve the needs of smart city construction better.

5. Conclusion

Digital construction technology, as a critical technology for the digital transformation and intelligent upgrading of smart cities and an essential booster for the integration of traditional industries with the digital economy, has been extensively applied in the development of smart manufacturing and the construction of smart cities. The in-depth integration and innovative application of digital construction technologies such as 3D modeling technology, digital twin technology, and artificial intelligence technology will significantly promote smart city construction. As the critical key to realizing the wisdom of the city, digital construction technology is not only conducive to the realization of intelligent and precise urban management and services but also can significantly improve the efficiency of urban operation, promote the modernization of the urban governance system, and governance capacity, and promote the transformation of the city from "tangible construction" to "intelligent operation". It will promote the transformation of cities from "physical construction" to "intelligent operation".

Therefore, the main body of urban management of the smart city should actively promote the development of digital construction technology and then promote the digital transformation of urban governance, multiple initiatives to achieve the modernization and intelligence of urban governance, to build an all-round intelligent city system, so that the construction of the smart city as early as possible to enter the new era of digital construction.

The construction and outlook of a smart city is a long-term, complex, and challenging process. This paper only covers the progress and application of digital construction technology. However, it

is still an important research topic at the current stage concerning how to efficiently and sustainably improve residents' quality of life while realizing the harmony and unity of economic growth, social progress, and environmental protection. It is hoped that the joint efforts of experts and scholars will summarize a development path of digital construction for smart cities with Chinese characteristics.

In the future, artificial intelligence will be a bridge to the construction of new smart cities. It is hoped that under the synergistic effect of artificial intelligence, it is anticipated that smart cities will realize an unparalleled level of urban intelligence, promote the way of urban development from intelligence to intelligence, and further enhance the sense of well-being and satisfaction of urban residents to realize high-quality, sustainable, efficient, and people-centered urban development.

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