

Research status of smart city based on BIM technology in China

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Abstract: Taking CNKI as the literature source, the quantitative analysis of journal literature shows that the research on smart cities based on BIM technology has been increasing in recent years. To understand the actual research situation, it is necessary to classify the research in recent years. Based on the literature research content, various smart city research based on BIM technology is analyzed and reviewed.

Keywords: BIM, smart city, research classification.

1. INTRODUCTION

BIM technology has been developing rapidly in China in recent years. At present, there are mainly two definitions of BIM. One is an enterprise represented by Autodesk, which defines BIM as an application of building software [1]. One kind of academia represented by the national academy of architecture defines BIM as an information architecture model. One of the two definitions emphasizes the information model, that is, modeling. One emphasis is on the process of information modeling. There are both relations and differences between the two, but in general both emphasize the extraction and application of information in building models. And this coincides with the construction idea of smart city, which is discussed more at present. Smart cities also emphasize the use of various information technologies or innovative ideas to integrate the city's constituent systems and services to improve the efficiency of resource utilization, optimize urban management and services, and improve the quality of life of citizens. Therefore, it is necessary to combine BIM technology with research on smart city construction [2]. In recent years, more and more scholars have connected the two, and this paper has conducted some analysis on these studies [4]

2. QUANTITATIVE ANALYSIS OF SMART CITY RESEARCH BASED ON BIM TECHNOLOGY

2.1 Development of journal papers on smart city research based on BIM technology

This study uses literature output index to analyze the research situation of BIM. The data is from the database that has been included in CNKI, including all data recorded from the beginning to the end of 2012. All journal literatures with the title of "BIM smart city" were searched as samples. After identifying them one by one, articles that did not represent "building information model" were excluded. It was found that BIM technology-based smart city research in China first appeared in the

7th China smart city construction technology seminar held in 2012. Glodon company proposed that building intellectualization is the core of "smart city", and advanced information technologies such as BIM, Internet and cloud computing are important supports for smart city construction. Since then, the research road of applying BIM technology in smart city construction began. Among them, only 4 journal articles were published in 2013 and 2014, 4 were published in 2015, 11 were published in 2016, and 5 were published in 2017, and 7 have been published in the past 18 years, as shown in figure 1. From the perspective of quantity, the research on the application of "BIM technology in smart city" in China is in gradual development.

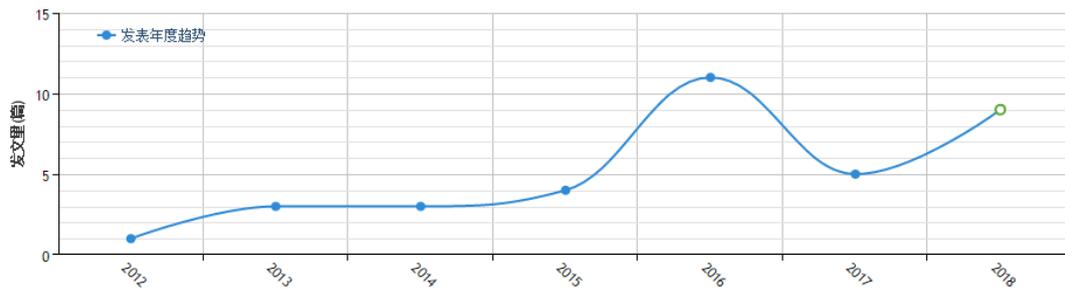


Fig. 1 2012-2018 "BIM smart city" research journal number variation diagram

2.2 The paper distribution of smart city research journal based on BIM technology

Since 2012, the subject has included all kinds of literature of "BIM smart city", including 21 journals, 7 master's theses, 6 conferences, newspapers and so on. It can be seen from these literatures that the related research topics are very rich, as shown in figure 2, including more than 30 topics such as BIM, GIS, smart city construction, talent cultivation, etc., which indicates that China's research in this aspect is in a diversified exploration stage, and most of them belong to interdisciplinary research. Most of the research on "BIM smart city" focuses on the field of engineering technology and explores the methods of applying BIM technology to smart city construction.

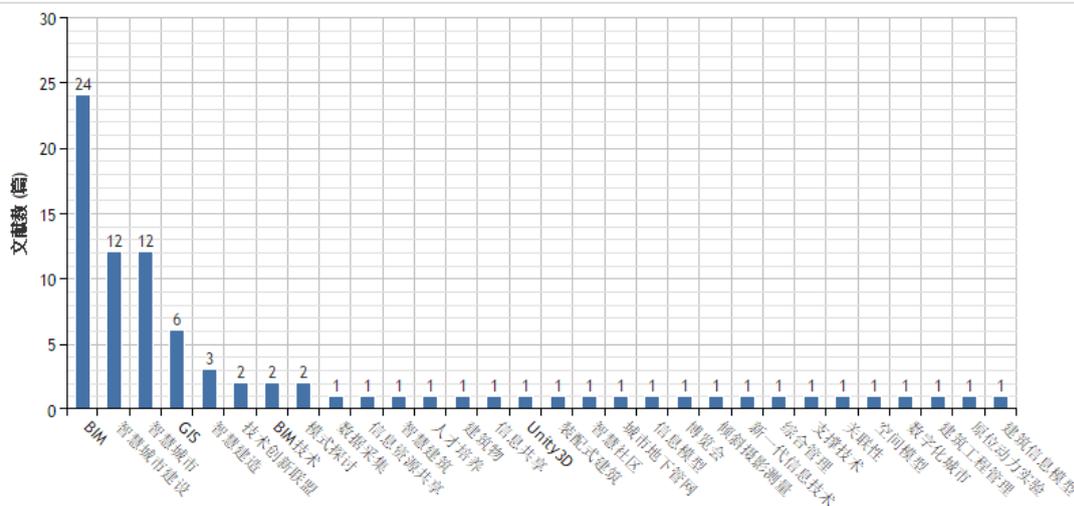


Fig. 2 Research distribution of "BIM smart city" in China from 2012 to 2018

3. CONTENT ANALYSIS OF SMART CITY RESEARCH BASED ON BIM TECHNOLOGY

Based on the analysis of relevant literature in the knowledge network since 2012, this study divides it into three main research contents. The first is the exploration of smart city construction based on BIM technology, that is, how to apply BIM technology to the construction of smart city. Secondly, the combination of BIM and other technologies in smart cities; Third, the combination of BIM technology and smart city related fields [5-12].

3.1 Exploration of smart city construction based on BIM technology

BIM is a technical means to realize the informatization and intellectualization of the whole process in the whole life cycle of buildings [13]. Therefore, BIM can go deep into every subtle place of urban construction in urban construction and extract the data needed for smart city construction. The application of BIM technology to build smart cities is mainly reflected in smart buildings and smart municipal services. These two aspects are combined to connect the buildings, roads, transportation and pipelines of the whole city and establish common and interconnected relations, thus making the city develop towards a more comfortable, energy-saving, efficient and intelligent direction. "Smart" of the city to build, to build complete smart city system, it needs to have for urban information such as location, environment, state of awareness, to the city's huge amounts of data processing capabilities, as well as information sharing Internet application ability and sustainable development ability, etc., these can be through the BIM related technical or BIM implemented to integrate with other related technologies[14]. The most important role of BIM in the construction of smart city is that BIM can digitize the actual buildings, and it can turn our buildings and even the buildings of the whole city into digital input computer, so that we can carry out corresponding processing according to these data and get the result that the builder wants. Moreover, BIM technology is not only applied to a certain construction stage of the building, but also a technical means that can be applied to the whole life cycle of the design, construction, management and operation of the building[15-18].

3.2 Research on smart city construction based on BIM and other technologies

3.2.1 The combination of BIM and GIS technology

GIS is a geographic information system, which is a spatial system based on the information collection, storage, management, calculation, analysis, display and description of the actual geographic situation [19]. And BIM is detailed architectural features and characteristics of 3 D information model, the current BIM has been widely used in urban architectural environment planning analysis, building the professional 3 D design, sunshine lighting analysis, spatial optimization and so on many aspects, through the whole life period of project construction planning, design, bidding, construction and operational stages[20-22]. Therefore, the smart city based on BIM and GIS will be a fusion of mature technologies. It also contains accurate urban 3d modeling, developed urban sensor network and real-time urban flow monitoring, making people's life in the city more intelligent and convenient.

3.2.2 BIM and tilt photogrammetry

As a new technology in the field of photogrammetry, tilt photogrammetry can collect image data from multiple perspectives (vertical image and tilt image), and finally process and restore the real 3d model in line with human visual habits. Inclined aerial photography, with its advantages of convenient and rapid data acquisition and highly automated modeling, is the main means to obtain three-dimensional

urban data at present. However, it lacks information inside the building, so it can only stop outside the building. And BIM technology carries all the information of the dynamic changes of the building life cycle, and provides the dynamic basic data that can be used for various applications for the construction of smart city[23]. Therefore, the combination of the two can analyze the detailed information of the whole city.

3.2.3 BIM and the Internet

BIM can be combined with Internet technologies such as the Internet of things, cloud computing and IT[24]. After building information is gathered, BIM services can be transformed into BIM cloud services by taking advantage of cloud computing. Based on the powerful ability of cloud computing, large amount of computing work in BIM can be transferred to cloud computing. Through IT technology, BIM and cloud computing are continuously optimized.

3.3 Combination of BIM technology and smart city related fields

3.3.1 BIM technology and assembly building

By applying the integrated concept of BIM technology, the information of building engineering can be fully displayed in the approval process of the comprehensive management of prefabricated buildings in smart cities, the application of the whole life cycle can be realized, and BIM can be implanted more conveniently, so as to improve the efficiency of approval. The application of BIM technology in assembly structure helps to ensure the construction safety management quality of temporary support, reduce the probability of collision between components, improve the storage and management level of components, and ensure the safety of component lifting[25].

3.3.2 BIM and underground integrated pipe gallery

Smart pipe gallery based on BIM system can realize intelligent maintenance and operation of pipe gallery and pipeline, reduce construction cost and operation cost, improve maintenance level, improve ability to respond to emergencies, and improve pipeline safety of pipe gallery, which is an important part of smart city[26]. The application of BIM information management platform in the underground integrated pipe gallery has the advantages of high degree of visualization, realization of animation roaming, high degree of information correlation and convenient operation and maintenance management.

3.3.3 BIM and smart community endowment

By building a BIM based smart community endowment management platform that includes data acquisition layer, data transmission layer, public platform layer and comprehensive application layer, functions such as intelligent elderly life management, smart medical service management, smart community service management and smart living environment management can be realized. Make full use of the design phase and construction phase of the project information for intelligent community endowment management, maximum limit to achieve information sharing, consistent, and the coordination, operations and data information generated in the process of smart endowment also can feedback to the design and construction stage, for future projects to provide reference basis for smart endowment, the intelligence community endowment development will be improved[27].

3.4 BIM and urban rail transit

In order to adapt to the orbit transportation construction in smart city's development needs, make full use of BIM technology in building construction model geometry information accurately, attribute

information rich and easy to manage and maintain advantages, combined with GIS in spatial analysis, the overall control and the advantages of the scene shows, not only to build a complete orbit traffic three-dimensional model, meet the large-scale scene display, should also implement various analytical applications of rail transit, realize the management and operation of the intellectual type[28-29].

4. CONCLUSION

BIM technology is gradually playing an increasingly important role in smart cities, and the development of smart cities cannot be separated from BIM technology. However, BIM technology alone is not enough for the construction of smart cities, which requires more technologies and more cooperation in various aspects to jointly support. Therefore, the research on the application of BIM technology in smart cities still needs to be strengthened to open up ideas and explore new paths.

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