



# Research Progress of Digital Twin: An Empirical Study of China's Library

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**Abstract.** Digital Twin has been providing strong technical support for the high-quality development of smart libraries and green libraries. This paper is aiming at studying the research status of the application of Digital Twin in Chinese library and providing some knowledge base and reference for the high-quality development of Chinese library in the future. This paper utilizes visualization technology to construct, analyze and study the visualization map of the existing academic achievements related to the application of Digital Twin in Chinese library from three aspects: development process, subject of study, research hotpots and main subject. It points out that we should further promote the in-depth application of Digital Twin in Chinese library from the aspects of enhancing the cooperation of research subjects and strengthening the research practice of information ethics.

**Keywords:** Digital Twin; Chinese library; virtual-real fusion; visualization analysis.

## 1 Introduction

Digital Twin, a new technology, can achieve many functions, such as the reconstruction of library space, the organic connection between library physical space and library virtual space, the deep integration and sharing of library information resources, and the deep integration of library physical information. All this ones will support the high-quality realization of real-time interaction, environmental governance, precision service and personalized service's need in library, as well as helping the high-quality development of smart libraries and green libraries. In addition, the overall service quality and level of library will be improved once again<sup>[1-3]</sup>. Therefore, Digital Twin has been quickly introduced into the library, and has been highly concerned and valued by experts and scholars of the Chinese library, and has been producing a large number of theoretical achievement and practical experience. This paper is aiming at

analyzing the relevant academic achievements on the application of Digital Twin in Chinese library and clarifying the development process, subject of study, research hotspots and main subject. And then, we anticipate all this status could promote the in-depth development of the application of Digital Twin in Chinese library. On the basis of referring to relevant literature<sup>[4-7]</sup>, the paper analyzes and researches the application progress of Digital Twin in Chinese library based on information visualization technology, and puts forward some development strategies for helping the high-quality development of the application of Digital Twin in Chinese library.

## 2 Research Methods and Data Sources

Visualization is to transform a large amount of data, information and knowledge into a visual form of human beings, and to visually express, explain, analyze, discover or reveal the characteristics and laws of data in order to improve human understanding of data<sup>[7]</sup>. This paper utilizes visualization technology to construct, analyze and study the visualization map of the development process, subject of study, research hotspots and main subject of the application of Digital Twin in Chinese library, in order to reveal the characteristics and shortcomings of the current application of Digital Twin in Chinese library, and put forward some suggestions for the future development of the application of Digital Twin in Chinese library for helping the high-quality development of the application of Digital Twin in Chinese library.

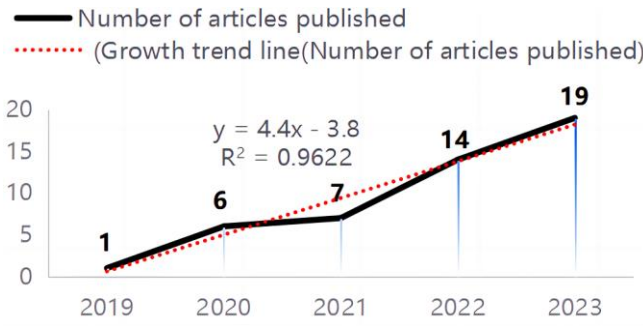
On July 6, 2024, firstly the authors used (TI = 'Digital Twin' \* 'Library' OR KY = 'Digital Twin' \* 'Library' OR (TI = 'Digital Twin' AND KY = 'Library') OR (KY = 'Digital Twin' AND TI = 'Library')) to retrieve relevant academic literature in CNKI that is the world's largest Chinese database. The publication year of the relevant academic literature is up to 2023, and a total of 76 relevant academic literature data were retrieved. Secondly, after 70 relevant academic literature data retrieved were deduplicated and irrelevant literature<sup>[8, 9]</sup> was removed, 47 valid relevant academic literature data for subsequent visual analysis were obtained. Finally, this paper utilizes visualization technologies to construct, analyze and study the visual map of the development process (year of publication), subject of study (author and institution of publication) and research hotspots and main subject (text keywords) of these 47 valid relevant academic literature data, and puts forward some suggestions for the future development of the application of Digital Twin in Chinese library.

## 3 Results Analysis

### 3.1 Development Process

The Development Process analysis is based on the annual number of published papers on the application of Digital Twin in Chinese library to construct, analyze and study the visual map<sup>[10]</sup>, so as to reveal the current development status, annual academic attention and future development trend of the application of Digital Twin in Chinese library. Fig.1 is the distribution map and trend map of the annual number of published

papers on the application of Digital Twin in Chinese library(Growth trend line(Number of articles published) indicated that the publication of linear trend line in this field.).



**Fig. 1.** The distribution map and trend map of the annual number of published papers on the application of Digital Twin in Chinese library

Fig. 1 shows:(1) The research on the application of Digital Twin in Chinese library began in 2019. The paper discusses the application of virtual technology such as Digital Twin in the innovation of library service mode<sup>[11]</sup>, and officially opened the prelude to the research on the application of Digital Twin in Chinese library.(2) The current research on the application of Digital Twin in Chinese library is divided into two stages. The first stage is the introduction period (2019), which mainly discusses the important value of Digital Twin in library, and the related academic achievements are less. The second stage is the period of rapid development (2020-2023). This stage deeply analyzes the application of Digital Twin in Chinese library from the aspects of spatial reconstruction, information resource integration and sharing, precision service, green library construction, virtual and real interaction, related system design and implementation, etc., and the relevant academic achievements are significantly higher than the first stage.(3) From the perspective of the annual publication trend line ( $y = 4.4x - 3.8$ ,  $R^2 = 0.9622$ ), the research on the application of Digital Twin in Chinese library has been on the rise, which not only shows that the academic attention of the research on the application of Digital Twin in Chinese library has been steadily increasing, but also shows that experts and scholars in Chinese library are also very concerned about and attach importance to the research and practice of Digital Twin in Chinese library. Meanwhile, it also shows that the relevant achievements of the research on the application of Digital Twin in Chinese library will continue to grow steadily in the future. The application of Digital Twin in Chinese library will also be further deepened and expanded.

### 3.2 Subject of Study

The analysis of Subject of Study is mainly based on the authors, institutions and published journals that publish the academic achievements related to the application of Digital Twin in Chinese library to construct, analyze and study the visualization map of subject of study, so as to provide some reference for the exchange and cooperation

of the application of Digital Twin in Chinese library in the future, promote the in-depth exchange and cooperation between research subjects in this research field, improve the high-quality output of interdisciplinary academic achievements, and further enhance the academic influence of this research field<sup>[12-13]</sup>. Fig.2 is the distribution cloud map of the top authors of the application of Digital Twin in Chinese library (Number of publications $\geq$ 2). Fig.3 is the distribution map of the top institutions of the application of Digital Twin in Chinese library (Number of publications $\geq$ 2). Fig.4 is the distribution map of the top publishing journal of the application of Digital Twin in Chinese library (Number of publications $\geq$ 2).

Fig. 2, Fig. 3 and Fig. 4 shows:(1)At present, the research subjects of the application of Digital Twin in Chinese library mainly include Jing Wang, Lu Wang, Xingwang Zhang , Wang Jia Ling, Peng Wang and Xiangtan University, Guilin University of Technology, China University of Mining and Technology, Harbin Institute of Technology, East China Normal University, Changchun Normal University, Qufu Normal University, Tongling College, Zhengzhou University, etc., these research subjects have made a very important contribution to the development of the research and the improvement of academic influence for the application of Digital Twin in Chinese library. And the most important research subjects are Jing Wang, Lu Wang, Xingwang Zhang and Xiangtan University, these research subjects not only make a very important contribution to the research and practice of the application of Digital Twin in Chinese library, but also effectively promote the development of the application of Digital Twin in Chinese library, provide an important knowledge base for the further development of the application of Digital Twin in Chinese library at present and in the future, and provides a reference source of important knowledge for relevant researchers of the application of Digital Twin in Chinese library.(2)According to Price 's law, the current high-yield research subjects of Digital Twin in Chinese library include Jing Wang, Lu Wang, Xingwang Zhang , Wang Jia Ling, Peng Wang, Xiangtan University, Guilin University of Technology, China University of Mining and Technology, Harbin Institute of Technology, East China Normal University, Changchun Normal University, Qufu Normal University, Tongling College, Zhengzhou University. The research subjects in Fig.2 and Fig.3 are all high-yield research subjects in this research field. However, further analysis of the percentage of the cumulative number of published papers of these research subjects in the total number of published papers ( 17.05 % and 48.28 %, respectively ) shows that the research field has not yet formed a core research subject group, which is not conducive to the in-depth and expansion of the research on the application of Digital Twin in Chinese library.(3)'Information Studies: Theory & Application' has made the greatest contribution to the publication and dissemination of the relevant academic achievements of the application of Digital Twin in Chinese library, and is also an important knowledge base of the application of Digital Twin in Chinese library at present and in the future, followed by 'Research on Library Science', 'Library', 'Hebei Library Journal of Science and Technology', 'New Century Library', 'Journal of Academic Library and Information Science' and other journals.(4)According to Bradford 's law, 'Information Studies: Theory & Application', 'Research on Library Science', 'Library', 'Hebei Library Journal of Science and Technology' and 'New Century Library' constitute the

core journal group in the field of the application of Digital Twin in Chinese library, These core journal groups have made a very important contribution to the external publication and dissemination of academic achievements in this research field of the application of Digital Twin in Chinese library, strongly supported the development of this research field of the application of Digital Twin in Chinese library, and are an important source of information sources for the knowledge base of this field of the application of Digital Twin in Chinese library at present and in the future. They will continue to support the external publication and dissemination of academic achievements in this field of the application of Digital Twin in Chinese library, and help to enhance the academic influence of this research field of the application of Digital Twin in Chinese library. Therefore, in the future, relevant researchers in this field of the application of Digital Twin in Chinese library should pay more attention to these core journal groups in order to grasp the latest research hotspots and frontier trends in this field of the application of Digital Twin in Chinese library in time, so as to produce more latest research results in line with the research trends in this field of the application of Digital Twin in Chinese library, and quickly publish and disseminate them to the outside world, so as to promote the vertical development of this research field of the application of Digital Twin in Chinese library.



Fig. 2. The distribution cloud map of the top authors of the application of Digital Twin in Chinese library (Number of publications $\geq$ 2)

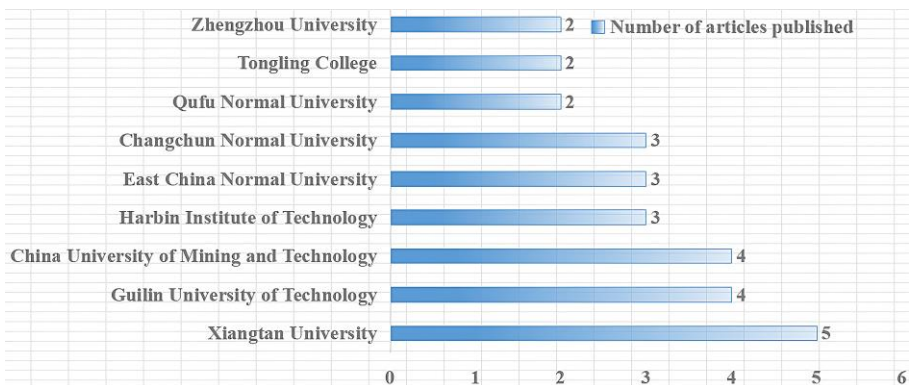


Fig. 3. The distribution map of the top institutions of the application of Digital Twin in Chinese library (Number of publications $\geq$ 2)

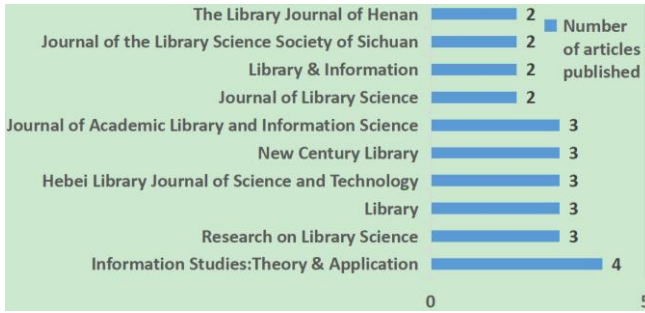


Fig. 4. The distribution map of the top publishing journal of the application of Digital Twin in Chinese library (Number of publications $\geq$ 2)

### 3.3 Research Hotspots and Main Subject

The analysis of research hotspots and main subject is mainly based on the text keywords of the academic achievements of Digital Twin in Chinese library. The construction, analysis and research of research hotspots and main subject visualization maps are carried out to reveal the hot topics and fewer topics of the current research on the application of Digital Twin in Chinese library, so as to provide some reference for the deepening and expansion of the research content of the application of Digital Twin in Chinese library in the future, so that researchers can pay more attention to the focus and difficulty of research on the basis of research hotspots. Fig. 5 is the distribution cloud map of research hotspots (Frequency of occurrence $\geq$ 2).

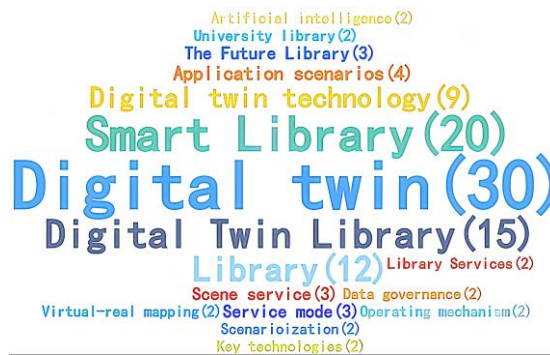


Fig. 5. Distribution cloud map of research hotspots of the application of Digital Twin in Chinese library (Frequency of occurrence $\geq$ 2)

Fig. 5 shows: The research hotspots (excluding ontology words: 'library' and 'Digital Twin') of the application of Digital Twin in Chinese library include 'Smart Library'(20 frequency), 'Digital Twin Library'(15 frequency),'Digital Twin technology'(9 frequency), 'Application scenarios'(4 frequency), 'Scene service'(3 frequency), 'Service mode'(3 frequency), 'The Future Library'(3 frequency), etc. and their related research topics. 'Smart Library ' mainly focuses on that how to uses Digital Twin to

achieve data governance, data fusion, scenario-based services, spatial reconstruction and business integration of smart libraries. 'Digital Twin Library' focuses on the discussion of the theoretical model, service scenarios, scenario-based service model, operation mechanism, service model and practical application of Digital Twin library. 'Digital Twin technology' mainly focuses on how Digital Twin technology can promote the construction of library scene service, the governance of digital resources, the construction of information resource sharing mode and the construction of learning cyberspace. 'Application scenarios' mainly focuses on the discussion of Digital Twin promoting the construction of scenario-based services and patterns and the construction of application scenarios. 'Scene service' mainly focuses on the construction of library scene service mode driven by Digital Twin. 'Service mode' mainly focuses on the discussion of Digital Twin promoting the operation mechanism of library and the construction of scenario-based services. 'The Future Library' mainly focuses on the new changes in the construction, operation and development of library promoted by Digital Twin.

## 4 Conclusion

Through the previous visual analysis, it shows: (1) The academic attention of the research on the application of Digital Twin in Chinese library has been on the rise, and the academic attention in this field will continue to rise in the future. (2) Although the research subjects of the application of Digital Twins in Chinese library are relatively concentrated, they have not formed a core research subject to conduct more in-depth research and practice. (3) The research hotspots and main subject of the application of Digital Twin in Chinese library mainly focus on keywords such as 'Smart Library', 'Digital Twin Library', 'Digital Twin technology', 'Application scenarios', 'Scene service', 'Service mode' and their related research topics.

Although the current research on the application of Digital Twin in Chinese library has made some research progress and achievements, the future can be further strengthened from the following aspects: (1) Enhance communication and cooperation among research subjects. At present, the research subjects of the application of Digital Twin in Chinese library are relatively concentrated, but there is a lack of communication and cooperation among these research subjects, which is not only not conducive to the communication and cooperation among the research subjects of related research topics, but also may lead to the same research topic being repeated research and practice, which leads to a large waste of human, material and financial resources, and also hinders the high-quality promotion of the application of Digital Twin in Chinese library. Therefore, in the future, we should further enhance the in-depth exchanges and cooperation among research subjects, so as to promote the in-depth promotion and practice of the application of Digital Twin in Chinese library. (2) Strengthen the information ethics research on the application of Digital Twin in Chinese library. Because the research on the application of Digital Twin in Chinese library will inevitably involve information ethical issues such as the acquisition, storage, utilization and sharing of user' personal information, the effective solution of these information ethical

issues will determine the depth and effectiveness of the application of Digital Twin in Chinese library. Therefore, in the future, we should strengthen the research on the information ethics of the application of Digital Twin in Chinese library, and construct a set of perfect information ethics management and service standards that meet the actual needs for the application of Digital Twin in Chinese library, so as to lay a solid information ethics foundation for the in-depth application of Digital Twin in Chinese library.

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