

Digital transformation of museums: A new approach to cultural heritage conservation and inheritance

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Abstract. With the rapid development of information technology, digital transformation has become a key measure for museum industry to improve service quality and enhance cultural influence. However, in the actual process of progress, museum digital transformation still faces many challenges. This paper discusses the importance of museum digital transformation in the protection and inheritance of cultural heritage and the concrete implementation path. Through in-depth research on the application of digital technology in museum work, this paper proposes the necessity, implementation strategy and challenges of digital transformation. Research shows that digital transformation can not only improve the operational efficiency and visiting experience of museums, but also promote the wide dissemination and in-depth research of cultural heritage.

Keywords: Museum; Digital transformation; Protection of cultural heritage; Inheritance; Digital technology.

1. Introduction

With the rapid development of information technology, digital transformation has become an important trend in all walks of life. As an important institution for the protection and inheritance of cultural heritage, the urgency and importance of digital transformation of museums have become increasingly prominent. Cultural heritage is the witness of national history and spiritual sustenance, and museums are important places to protect and inherit these valuable assets. However, the traditional museum operation mode is powerless when facing the challenge of the information age. The diversification of audience needs, the acceleration of information dissemination and the increasing difficulty of cultural heritage protection all require museums to undertake digital transformation. The purpose of this study is to deeply analyze the necessity of digital transformation of museums, and explore the specific paths and strategies of digital transformation in improving the operational efficiency of museums, improving the visiting experience, and promoting the protection and inheritance of cultural heritage.^[1]

2. Current situation and characteristics of museum digital transformation

2.1. Current situation of museum digital transformation

(1) Digital transformation started early, but regional development is uneven

At present, Chinese museums have formed a museum system with state-owned museums as the main body and private museums as the supplement. In 2021, China's non-state-owned museums accounted for 32.2%, an increase from 2019 (Figure 1).

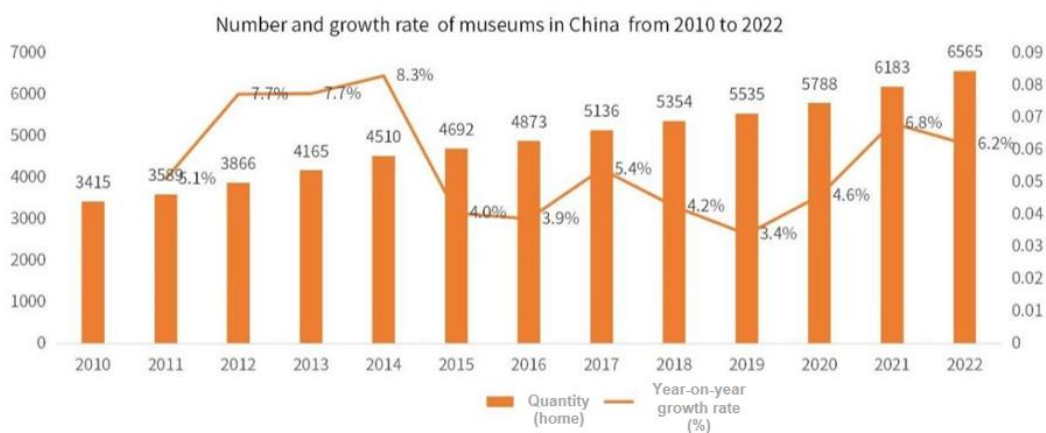


Figure 1: The number and year-on-year growth of museums in China
(Source: State Administration of Cultural Heritage)

On the whole, the digital transformation of China's museums has an early start, and many museums have tried to apply digital technology to exhibition, protection, management and other aspects. However, due to the differences of regions, levels, funds and other factors, the process of digital transformation of museums shows an obvious imbalance. Some large and well-known museums have sufficient funds and technical support, and the digital transformation is progressing rapidly, while some small and local museums are facing difficulties such as lack of funds and backward technology, and the digital transformation is progressing slowly.^[2]

(2) Lack of overall planning

In the process of digital transformation, many museums lack overall planning and strategic layout. Some museums see digital technology only as a tool or means and do not integrate it with the overall development strategy of the museum. This results in a lack of systematization, continuity, and sustainability in digital transformation, making it difficult to achieve long-term benefits.

(3) The scale of collection data is limited

Collections are the core resources of museums. In terms of the distribution of cultural relics collections in regional museums, the number of museum collections in Beijing far exceeds that in other regions, reaching 6.322 million pieces/sets, followed by Sichuan Province, Shanghai and Shaanxi Province, all of which exceed 3 million pieces/sets (see Figure 2). But in digital transformation, the scale and quality of collection data is often limited. On the one hand, due to historical reasons and technical limitations, many museum collection data is not complete or accurate; On the other hand, with the increasing number and diversification of collections, the difficulty of data collection, collation, storage and management is also increasing. This leaves museums facing the challenge of insufficient data and low quality in their digital transformation.^[3]

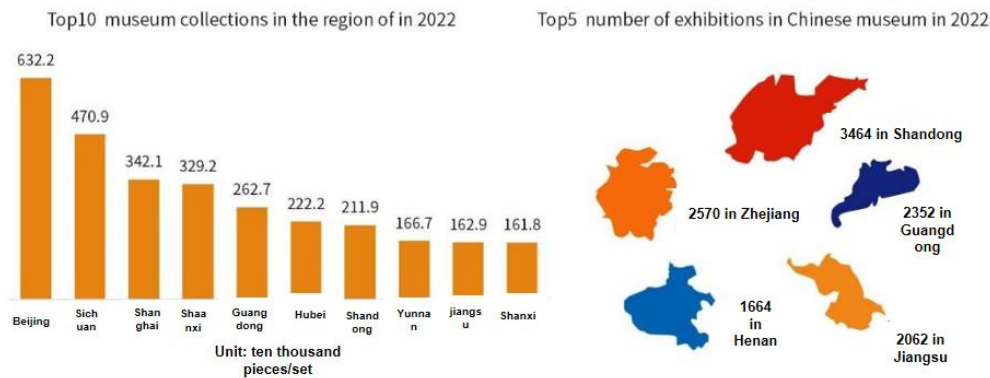


Figure 2: Distribution of museum collections and exhibitions in China (Source: National Bureau of Statistics)

(4) Lack of talent funds

The digital transformation of museums needs a lot of professional talents and financial support. However, many museums are currently facing a shortage of talent and funding. On the one hand, museums have difficulty recruiting and developing professionals in digital technology; On the other hand, museums have limited investments in digital transformation due to funding constraints, making it difficult to meet the growing demand.

2.2. Characteristics of museum digital transformation

(1) Personalized interactive experience

Digital transformation provides museums with more interactive experiences, enabling visitors to better understand and feel cultural heritage. Through virtual reality, augmented reality and other technologies, visitors can personally participate in the exhibition, experience the culture, and get a personalized interactive experience. This not only increases audience engagement and satisfaction, but also enhances the museum's appeal and influence.

(2) Display richness across time and space

Digital transformation enables museums to break through the limitations of time and space and present their collections to the audience in a richer form. Through digital technology, museums can scan, reconstruct and display their collections in three dimensions, allowing visitors to enjoy precious cultural heritage at any time and anywhere. This time-and-space display not only enriches the audience's visual experience, but also broadens the museum's communication channels and influence.

(3) Easy to expand within the exhibition

Digital transformation has made it easier to expand and update museum exhibits. The museum can add or update exhibit information and increase interactive links at any time according to needs, so as to make the exhibition content more colorful. At the same time, digital technology also provides museums with more creative space and design possibilities, making exhibitions more attractive and innovative.^[4]

(4) Comprehensive presentation of cultural information

Through digital transformation, museums can more comprehensively present the historical background, cultural connotation and value significance of cultural heritage. Digital technology can integrate text, pictures, video and other forms of information together to provide more comprehensive and vivid cultural information for the audience. This helps the audience to have a deeper

understanding of the cultural heritage and enhance their sense of identity and pride in traditional culture.

3. The positive effect of digital transformation on the protection and inheritance of cultural heritage

3.1. Improve protection efficiency and accuracy

On the one hand, digital transformation offers more innovative and diverse ways to display cultural heritage. Through virtual reality, augmented reality and other technologies, the audience can experience the charm and historical charm of cultural heritage. At the same time, digital technology can also combine cultural heritage with modern art forms to create more attractive and appealing display effects, and enhance public attention and recognition of cultural heritage. On the other hand, with the help of high-precision scanning, three-dimensional modeling and other technical means, digital transformation can accurately measure and record cultural heritage without contact, avoiding the damage that may be caused by traditional protection methods. At the same time, digital technology can quickly process and analyze a large amount of data, improve the efficiency and accuracy of protection work, and provide a strong guarantee for the long-term preservation of cultural heritage.

3.2. Expand the scope and depth of inheritance

Through digital transformation, the transmission of cultural heritage is no longer limited to traditional word-of-mouth or limited written records. Digital platforms can break down geographical and temporal constraints and disseminate information about cultural heritage to a wider audience. In addition, digital technology can also integrate and display multiple dimensions of cultural heritage information, so that inheritors can better understand and comprehend the connotation and value of cultural heritage. At the same time, digital transformation can enhance public awareness and participation in cultural heritage. Through digital display and interactive experience, the public can more intuitively understand the historical background and value significance of cultural heritage, and enhance their sense of identity and responsibility for cultural heritage protection. At the same time, digital platforms can also provide opportunities and ways for the public to participate in the protection of cultural heritage, and encourage more people to actively participate in the practice of cultural heritage protection and inheritance.

3.3. Break through time and space restrictions and barriers

Digital transformation has broken through the time and space restrictions and barriers in the protection and inheritance of traditional cultural heritage. Through the digital platform, people can access and understand the information of cultural heritage anytime and anywhere, no longer limited by geographical location and time. This convenience enables more people to participate in the protection and inheritance of cultural heritage, forming a more extensive social participation and cultural sharing. In addition, digital transformation helps to promote communication and integration between different cultures. Through the digital platform, the cultural heritage of different regions can be displayed and exchanged with each other, enhancing the understanding and respect between different cultures. This kind of cross-cultural communication helps to promote the development of cultural diversity and form a more colorful cultural landscape.

3.4 Enhance the vitality and charm of cultural heritage

Digital transformation has brought new vitality and charm to cultural heritage. Through the use of digital technology, the presentation of cultural heritage is more vivid and vivid, and can attract the attention and interest of the public. At the same time, digital technology can also provide new possibilities for the creative development of cultural heritage, promote the integration of cultural heritage and modern society, and enhance its value and vitality. Moreover, digital transformation plays a positive role in promoting the innovation and development of cultural industry. Through the

introduction of digital technology, the protection and inheritance of cultural heritage can be combined with the cultural industry to form unique cultural products and services. This not only provides a new growth point for the development of the cultural industry, but also provides a more solid industrial support for the protection and inheritance of cultural heritage.

4. Problems encountered in the protection and inheritance of museum cultural heritage

4.1. Lack of protection awareness

Many museums have insufficient awareness of cultural heritage protection. Some museum staff do not have a deep understanding of the value and significance of cultural heritage, and lack of reverence for cultural heritage, resulting in negligence and improper operations in the protection work. At the same time, some audience members also lack the awareness of cultural heritage protection, and random touching, taking photos and other behaviors have brought potential threats to the protection of cultural heritage. In addition, in the protection of cultural heritage, excessive protection and restoration is also a problem that needs attention. In order to pursue short-term benefits or meet the audience's viewing needs, some museums overrepair or change the original appearance of cultural heritage, which not only violates the principle of cultural heritage protection, but also damages the historical value and authenticity of cultural relics.^[5]

4.2. The display method is not scientific

The way of museum display is directly related to the display effect and protection of cultural heritage. However, some museums lack science and professionalism in display design, resulting in poor display of cultural heritage, and even damage to cultural heritage. For example, the display environment does not meet the preservation requirements of cultural relics, and problems such as improper lighting and temperature control will cause damage to cultural relics.

4.3. Insufficient application of technology

With the development of science and technology, more and more new technologies can be applied to the protection and inheritance of cultural heritage. However, some museums have shortcomings in the application of science and technology, and fail to make full use of modern scientific and technological means to enhance the protection effect. For example, the application of digital technology in the protection of cultural heritage is not widely enough, and virtual reality, augmented reality and other technologies are not fully applied.

4.4. Inconsistent management systems

Museums lack a unified management system for the protection of cultural heritage. Museums in different regions and at different levels have different protection standards and management systems, which makes it difficult to form a joint force in the protection of cultural heritage. At the same time, due to the lack of a unified coordination mechanism, the cooperation and exchange between museums are also limited to some extent, and the system of museums in the protection and inheritance of cultural heritage is not perfect. Although there are some basic protection systems and regulations, there are still many loopholes and deficiencies in practice. For example, the process of identification, evaluation and registration of cultural heritage is not standardized enough, and the supervision and assessment mechanism of protection work is not perfect.

5. Strategic suggestions for optimizing museum digital transformation

5.1. Strengthen digital infrastructure construction

Museums should increase investment to improve the construction of digital infrastructure, including high-speed and stable network environment, efficient data processing and storage systems, and

advanced multimedia display equipment. These facilities will provide strong support for the museum's digital transformation, ensuring the stability and efficiency of digital services. For example, the Palace Museum has widely used information technology in the process of digital transformation. Through the establishment of a sound information management system, the museum has realized the digital management and inquiry of cultural relics, archives, research materials and other resources. At the same time, in the process of digital transformation, information security and privacy protection are crucial. The museum shall establish a sound information security management system and technical precautions to ensure the safe and stable operation of digital facilities and systems.

5.2. Collection digitization and data management

Digital processing and data management of collections are the core tasks of museum digital transformation. Museums should develop detailed collection digitization plans, adopt high-definition scanning, three-dimensional modeling and other technical means to convert collection information into digital form, and establish a perfect database for management and storage. At the same time, museums should also strengthen the quality control and security protection of data to ensure the accuracy and integrity of data. In addition, museums should pay attention to data analysis work, through the collection and analysis of the audience's behavioral data, visit feedback and other information, in-depth understanding of the needs and preferences of the audience. Based on the data analysis results, the museum can continuously optimize the exhibition content, improve the service quality, and better meet the expectations and needs of the audience. For example, the Palace Museum has made a comprehensive and detailed digital record of precious cultural relics through high-definition photography, three-dimensional scanning and other technical means. This not only provides an important basis for the preservation and restoration of cultural relics, but also provides a clearer and more vivid viewing experience for the audience. At the same time, digital technology can also be used to monitor the preservation status of cultural relics, timely detection of potential risks and problems, and ensure the safety of cultural relics.

5.3. Smart tour and interactive experience

Museums can enhance the visitor experience with smart tour systems and interactive experience technologies. Through the development of intelligent tour equipment and applications, visitors can be provided with personalized tour routes and detailed collection information. At the same time, the use of virtual reality, augmented reality and other technologies to create immersive interactive experience projects, so that the audience can more in-depth understanding of the connotation and value of cultural heritage.

5.4. Online exhibition and virtual exhibition hall

Online exhibitions and virtual exhibition halls are important directions for the digital transformation of museums. Museums should make full use of the Internet platform to move offline exhibitions online and provide more convenient ways for visitors to visit. The data shows that mobile users are highly active, and nearly half of them spend most of their time using Weibo, which creates opportunities for museum tourism to promote Weibo marketing (see Figure 3). At the same time, through the construction of virtual exhibition halls, the essence of the museum exhibits are presented to a wider audience in digital form, expanding the influence and dissemination of the museum. For example, the Palace Museum uses social media, official websites and other channels to strengthen interaction and communication with the public and enhance the effect of cultural communication.

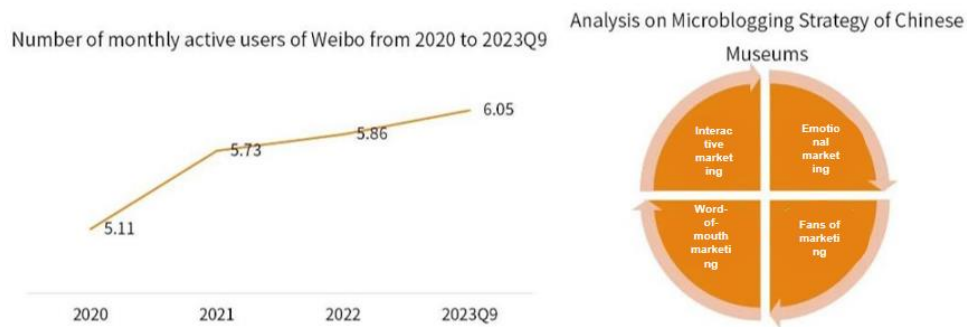


Figure 3: The museum internet operation analysis [6]

5.5. Education, training and cultural communication

Museums should strengthen the education and training of their staff to enhance their digital skills and cultural literacy. Organize training courses, seminars and other activities to enhance employees' awareness and understanding of digital transformation, and improve their professional quality and ability level in digital work. At the same time, museums should also actively carry out cultural communication activities, popularize cultural heritage knowledge to the public through lectures, workshops and other forms, and enhance the public's attention to cultural heritage and awareness of protection.

6. Conclusion

In summary, the strategic suggestions for optimizing the digital transformation of museums include strengthening the construction of digital infrastructure, collection digitization and data management, smart tour and interactive experience, online exhibition and virtual exhibition hall, cross-border cooperation and resource integration, education and training and cultural communication, data analysis and user feedback, information security and privacy protection, etc. Through integrated policies and coordinated promotion, museums will be able to better achieve the goal of digital transformation and provide better cultural services to the public. In the future, with the continuous progress of technology and the continuous expansion of application scenarios, the digital transformation of museums will present more possibilities and challenges. Museums should continue to strengthen technology research and development and application innovation, actively explore new models and new paths for digital transformation, and contribute more to the protection and inheritance of cultural heritage.

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