Paradigm Academic Press
Art and Society
ISSN 2709-9830
AUG. 2022 VOL.1 NO.1

Research on the Transformation of Smart Museums Under the Internet Thinking: A Case Study on the Palace Museum

Jingyi Peng[1]

[1] General Institute, Art Management, Gachon University, Seongnam, Korea

Correspondence: Jingyi Peng, General Institute, Art Management, Gachon University, Seongnam, Korea.

doi: 10.56397/AS.2022.08.05

Abstract

With the development of information and Internet technology, traditional museums have long followed the trend of integrating innovative technological elements into the changed museums. The museums must seize the opportunity of the trend transforming into smart museums, the key is to grasp the characteristics and laws of the Internet era, and use Internet thinking to explore the future development path. However, there are few studies on Internet thinking among the existing results. On the other hand, most of the relevant actual case studies still focus on the micro-level, which has obvious limitations. This paper will start from the current situation and trend, focus on the Palace Museum as a case study object, and discuss the problems and characteristics, to put forward the thinking about the development of smart museums in four aspects to explore the optimal path of transformation for smart museums.

Keywords: smart museum, internet thinking, transformation path, the place museum, case study

1. Introduction

Under the general trend of the Internet era, the shape of the museum has also changed. From the early traditional museum period, it gradually evolved into the digital museum stage, and then transformed into a new form - the “smart museum” which is now vigorously developing In China, the concept of a “smart museum” was first mentioned in the 8th by Beijing International Cultural and Creative Industry Expo held in 2013. Since then, it has attracted great attention in Chinese museum circles, academic circles, and even at the national level. In 2014, seven excellent museums were selected nationwide as “smart museums” pilots, thus beginning the road of exploration for smart museums (He & Yang, 2018).

The “smart museum” has been developing for nearly ten years in China. During this period, the relevant state and policy have continuously issued clear instructions for supporting the “smart museum”, constantly emphasizing its importance in the future. Whether it is the instructions from policies, the general trend of technological and social development, or the internal needs of museums, it all shows that “smart museums” are the future of the museum industry. Many scholars have also launched a research boom in this field. Chen (2013) believes that the four key intelligent technologies can clearly define the application in the smart museum, which has a wide range of influences. Also, Iv and Chen (2019) propose that the transformation of the smart museum management model can be a kind of business model, and switch the traditional passive browsing and publicity into active communication, which broadens the train of thought for the development of the smart museum. However, integrating emerging technologies into museums is not as simple as using technology to support them. Only grasping the characteristics and thinking of the times, and integrating them into the development of the museum industry is the inevitable choice for a traditional industry to carry out reform in the era, facing fierce competition and rapid iteration. The great “change” in the Internet age is taking place now. The widespread use of the Internet has escaped the original tool attributes and has been sublimated into a kind of thinking, which affects the development direction in various aspects. Also, the transformation of traditional industries requires

thinking about future development, under Internet thinking.

Therefore, this study will explore and optimize the smart museum industry in the new era under Internet thinking, by researching the Palace Museum as the case study object analyzes its process and achievements.

2. The Theory and Background

2.1 The Concept and Characteristics of the Smart Museum

2.1.1 The Concept of the Smart Museum

Representatives of scholars in Japan and the West, Eiji Mizushima (1989) and Ruotsalol (2013), have proposed the definition of a smart museum, arguing that a smart museum can automatically control the information transmission, exhibition and preservation environment, which can provide the various and personal experience for the audience. With the introduction of "smart museums" into China, Chinese scholars also put forward their unique insights. In the Chinese academic circles, Zhang and Wang (2012) introduced the "I-Museum System", and believed that the smart museum is a service museum based on modern technology where centred on the audience's needs. In 2017, the publication of "Smart Museum Cases (Volume 1)" provided a clear definition for the concept research of smart museums, expressing as "through the full use of information technology, such as the Internet of Things, cloud computing, big data, artificial intelligence, to calculate and analyze the information related to the operation of the museum, including people, objects, activities, to improve the service, protection and management capabilities." This is considered the general definition of the smart museum at present (Technical Innovation Alliance for Cultural Relics Protection, 2017). Based on the above overview, the study defines the smart museum as using information technologies, including the Internet of Things, cloud computing, big data, and artificial intelligence to make full use of digital resources to optimize education, research, conservation, collection and display functions in the museum.

2.1.2 The Characteristics of the Smart Museum

Adding a new generation of information technology allows museums to process data more freely, and the sensor automatically collected replaces manual input information, which greatly improves the efficiency and capacity. The interconnection of data and the ability of independent analysis systems also enrich the way of data application in museums, which constitute a new work system, and form different characteristics from the past.

Firstly, it makes full use of various resources to realize coordination and cooperation. The system in the smart museum, from data collection, data interconnection, and big data analysis to execution, has a clear division of labour at three levels to jointly build an interconnected working relationship. Therefore, the distinctive feature of the smart museum is the dynamic and diverse interconnection, which can coordinate and cooperate, and optimize and integrate resource allocation, to make the operation more efficient.

Secondly, it breaks the limitation of information collection. In the past, collecting information mainly relied on semi-automatic collection and manual, where the data collection cycle was usually long, and there were certain requirements for the space. Comparing, the data collection process in the smart museum relies on the full-automatic system including the collection, storage, management, and sharing, which turns into a real-time and dynamic method. It not only realizes real-time updating but also lowers the cost.

Thirdly, the smart museum also shows "people-oriented". In the smart museum, technology is only a means to assist "smart", and its ultimate purpose is still to serve and educate the public and promote cultural prosperity and development (Wang, 2019). The work of the Smart Museum revolves around the audience's needs, standing from their perspective, thinking about what they think, and doing what they need, which can provide the audience with comfortable and friendly services, stimulating the audience's enthusiasm, and guiding them to participate.

2.2 The Concept and Characteristics of the Internet Thinking

2.2.1 The Concept of Internet Thinking

The Internet, originally used as a tool, has realized information sharing and communication worldwide the world. With the prosperous development of technology, the Internet has gradually become closely linked with people's lives, completely changing human production and way of life, even infiltrating their cognitive style, interpersonal relationship, thinking style, worldview, and values, forming a kind of "Internet thinking". Its evolution from tools to thinking is an inevitable law of historical development as the American scholar Steve Lorre believes that technological changes affect not only behaviour but also human thinking (Steve, 2015). In 2011, Baidu whose founder called Li Yanhong first proposed the concept of "Internet thinking" in a speech "Three New Opportunities for Internet Entrepreneurship in China", and he stated that traditional industries have certain limitations in understanding, accepting and use to the Internet, and "Internet thinking" has not been applied to the industry. After that, the idea of "Internet Thinking" intensely aroused social repercussions, and several administrators in famous IT companies responded quickly, such as Baidu, Alibaba, Tencent, Xiaomi, Etc.

In addition, the expansion of Internet thinking has also attracted research from many experts and scholars. Shao (2015) believes that "Internet thinking for the industry is a new ecosystem, which is decentralized, heterogeneous, diverse and perceptual. It means that Internet thinking can be seen as a kind of cognition, and applied to various fields.

Therefore, combined with the research background and existing research, Internet thinking can be defined as cognitive thinking based on the functions and characteristics of the Internet. The transformation of the smart museum in China needs to re-examine the development of the industry through it and promotes a new pattern.

Due to the diversity of the application on the internet thinking, many kinds of ideas are extended. Chen (2014) divides Internet thinking into twelve categories, including traffic thinking, product thinking, simple thinking, integrated thinking and so on. In addition, Zhao (2014) thinks that Internet thinking includes nine aspects, big data, iteration, socialization, and extreme thinking. Based on the current results, this research divides Internet thinking into the following aspects:

Table 1. Main ideas of Internet Thinking

Main ideas	contents
User thinking	Everything is user-centred, and all services and work are based on the users' needs. User thinking requires operators to follow the principle of user supremacy, thinking about the users' needs from their perspective, and all production and operation work is constructed on the user's needs.
Cross-border thinking	A new type of thinking concept and thinking mode by grafting ideas and modes from different industries or fields, or by innovating or transforming them. The fields originally unrelated or even contradictory can penetrate and integrate, to create an entirely new system, structure or process.
Big data thinking	Big data thinking refers to the way of thinking to track, mine, and understand the value from industry-related data, and even create new value.
Socialize thinking	Socialize thinking means that producers should actively use social tools, such as social media, and social networks, to establish a good communication relationship with users, pay attention to humanistic care, and form emotional bonds with them.

Source: Compiled by researchers

2.2.2 The Characteristics of the Internet Thinking

Based on the above, there are certain understanding of the concept and main types. It is the internalization of social practice activities in the human brain, and the rational expression of people's way of life. However, as for mastering and using a kind of thinking, the study for its characteristics cannot be ignored. Therefore, the following will specifically explore the characteristics of Internet thinking.

Firstly, Internet thinking has the characteristics of decentralization. supposing the huge Internet is regarded as a platform for information exchange. In that case, every individual participating or involved in the network can send and receive information, thus becoming a node on the Internet. In this system, the operation of each node is not affected by the outside world, but can be connected to form a relationship that is both connected and independent. Therefore, each node on the Internet has the same role and ability, there is no priority between the centre and the edge, forming a non-linear, open, and equal structure, which can also be called "decentralization".

Secondly, the characteristic is the wide connection. The Internet breaks the limitations of time, space, and even industries and concepts. It seems that in the Internet era, anyone, anything, any time, and any place are connected, and can communicate, interact, and think from all directions. And this kind of extensive connection puts the channels and sources of contact information got into a state of diversification so that the thinking can be more in-depth, thorough, extensive and comprehensive.

Thirdly, Internet thinking has a recurring feature, which is formed based on extensive connections. As the Internet the dissemination and circulation of information prompted, the huge scale of information circulation enables each individual to access a variety of complex and uneven information sources. Therefore, it is not only necessary to understand local information connected between them, but also to understand the overall results and functions, which form the systematic nature.

2.3 The Necessity of Smart Museums Transformation Guided by Internet Thinking

Internet thinking is a way of thinking that reflects the characteristics and the requirements of the times. Applying

this thinking to guide the development of smart museums has become an inevitable choice in the current. The specific reasons are as follows:

2.3.1 The New Achievements in the Industry

With the continuous updating of Internet technology, the meaning of Internet thinking will continue to develop, change and deepen. Therefore, the meaning of Internet thinking is a dynamic process. The emerging new technologies and ideas have injected new blood into the museum industry one after another, making the process of transformation full of various fresh and unique designs and unprecedented changes. Whether it is the development of cultural products, service work, or research on the protection of cultural collections, they are in a dynamic process of constant change, and they need to be constantly adjusted according to the market and environment in which they are located. Therefore, in the transformation of smart museums, it is necessary to firmly grasp and use the updating Internet thinking, so that it can maintain the vitality and competitiveness of the industry, and always have keen insight into the changes in the general environment.

2.3.2 The New Value in the Industry

The extensive connection of Internet platforms has brought the capacity of information to an unprecedented height. However, the connection does not only refer to a wide range between network terminals, such as PCs, tablets, collections, and watches. It is also a cross-border connection between industries, which can create new values in the field. In the Internet age, the connection between museums and the outside has more convenient channels than ever before, and there are opportunities for mutual understanding with other industries. This allows the museum to have a more diversified and extensive development, which can break the original pattern, and get breakthroughs with help from other industries. On the other hand, the collision and fusion of different fields can also enhance the shortcomings of the museum industry, to continuously dig out new value through cooperation. Therefore, using the widely interconnected nature of Internet thinking, realizing cooperation in new fields, and expanding or mining new value is essential for future development.

2.3.3 The New Ecology in the Industry

The dissemination of information is no longer in the hands of the mainstream media, resulting in decentralization. It is necessary to respect the law of the Internet and use Internet thinking to guide, How new features and methods can play a role in the museum industry. Whether it is big data thinking or user thinking, it reflects the emphasis on each individual. Only by respecting the voice of users, fully understanding their needs, and actively interacting with them, the audience can feel transformed from an experience to a participant, to form a co-construction relationship between the museum and the audience, which promote the museum industry to form a new ecology pattern.

3. The Status Quo and Case Study: Transformation of Smart Museums in China

3.1 The Status Quo: Transformation of Smart Museums in China

Traditional Chinese museums revolve around the five major functions, education, research, appreciation, collection, and protection, and divide their business categories according to them, including exhibition, research, and collection preservation. However, the division or execution of work is relatively scattered, and each part of the work performs its duties. After the museum has entered the stage of intelligent transformation, due to the integration and interconnection of information resources, the previous business has begun to blend, forming a new business division, covering its original functions and missions, and further expanding the play of functions, namely smart services, Smart Protection, and Smart Management.

First of all, it is the transformation to smart services, and its business composition is mainly evolved from the original work in exhibition and education aspects. It is aimed at public service needs, using digital technology and information technology to dynamize museum resources, restore historical and cultural resources, display interactive forms in multi-dimensional, multi-channel information real-time push, cultural and creative product manufacturing and sharing, to achieve a high degree of interaction between the public and the collection (Technical Innovation Alliance for Cultural Relics Protection, 2017).

Secondly, it transforms into smart protection, which mainly integrates the functions of research and storage. Based on intelligent perception technology and non-destructive testing technology, it conducts a comprehensive quantitative analysis of collections. Data mining and analysis help scholars explore the quality of collections that are difficult to study manually. In addition, it can grasp the collection’s characteristics before it is damaged, and then use the data to build a model to form a three-dimensional visualization result, forming a smart protection system that integrates the diagnosis, analysis, processing and evaluation.

Thirdly, the smart museum can automatically collect data, so the workload of information collected is far greater than the previous. And due to the diversification of data collection channels, also increases the burden for backstage supporters and audience data management, which together constitute the new business focus of smart

services. As for smart management, all basic information of collections is contained, including recording, management status, research, protection progress, exhibition loan, Etc. The real-time mastery of the collection can finally realize dynamic management, and reduce the risks in management. On the other hand, by optimizing the information platform, the various business links, human resources, collections, financial resources and other resources can be checked on the intranet, and the risk of unclear responsibilities between internal departments can be further solved.

3.2 The Case Study: Transformation of Smart Museums in China

The transformation of smart museums in China is still in the exploratory stage, and there are relatively few forming theories. However, many museums have begun to try to use emerging information technology to move toward the road of transformation, which provide cases worthy of reference. Therefore, putting forward the suggestion on the transformation of smart museums under Internet thinking, this research will select the Palace Museum as the object of the case study, analyze its transformation achievements and process in-depth, and discuss its strengths and problems.

3.2.1 The Transformation Process of the Palace Museum

The object of this case study is the Palace Museum (Beijing), which has the largest collection and scale in China. In the early 1990s, it pioneered the informatization museum in China. After more than 30 years of continuously integrating new technologies and innovations, it has maintained a leading role in the modernization of museums. Seen from its development path, it can be divided into three main stages, the period of informatization and digitalization, the period of initial smart museums, and the period of advanced smart museums.

① The period of informatization and digitalization

In 1998, the Palace Museum started its informatization construction. First, the informatization construction was locked in the collections, and a collection management information system was built. The system records the attributes and information of more than 1.8 million collections, so that can be easily displayed to the administrator, such as the specific name, size, basic identification information, Etc. Later, it continued to upgrade and innovate to form a comprehensive collection management system, which transformed the data collecting originally recorded by paper and pen into digital information. This meticulous and huge information input work was all done by hand typing word by word, and it took more than a year to complete this work in 1999. In addition, in the same year, the information network system and cables project were reconstructed. After five years with three phases of expansion and reconstruction, 12km of optical cables, 60km of twisted pair cables, and 24 network points were laid, which linked various businesses and departments together to prepare for digital museums.

② The period of initial smart museums

With the database established, the management businesses have been quite effective, and the managers also have preliminary confidence in using information technology to strengthen their daily work. During this period, based on the collection management system, the collection circulation system and the administrative management platform were established according to the work needs. The collection circulation system is upgraded and transformed based on the previous collection management system, which facilitates workers to extract, research and display. In addition, after the database is established, how to develop and utilize it to maximize the effect on the audience has become the biggest problem. The support from overseas has become the driving factor for the rapid development in this period. At the same time, the Palace Museum has also chosen to cooperate with local excellent technology companies and universities to jointly develop, and use advanced digital technology to create a series of outstanding and cutting-edge achievements.

Table 2. The main achievements in The period of initial smart museums

Number	Name	Time	Content
1	<“The Forbidden City Beyond Time and Space”>	2008.10.10	This project builds the Forbidden City with 3D virtual technology, which designs thematic tour routes, historical scene reproduction and recreational activities.
2	The series of APP produced by the Palace Museum	Since 2012	The Palace Museum develops APP applications based on smart mobile devices. These apps are beautiful screens and rich in content, providing the audience with interesting learning materials and cultural experiences, which make obscure historical knowledge interesting.
3	Digital exhibition hall	2015	The Palace Museum has selected one palace to transform into

			a “digital exhibition hall”. There are almost no physical collections in the entire exhibition hall, and all the collections are displayed through 3D models displayed on high-definition electronic screens, which break the distance between traditional culture and information technology, and provide viewers with an experience that is both visual and fun.
4	The Digital Palace Museum	2017	The Digital Palace Museum tries to create a museum that combines virtual and real, which exist apart from the physical museum, and realize the support to information service and interpersonal communication, to create a source aggregation platform that integrates online and offline. （Feng，2017）.

Source: Compiled by researchers

③ The period of advanced smart museums

Since 2018, with the rapid development of cloud computing, big data, artificial intelligence and mobile network technologies, the Palace Museum has entered a period of comprehensive intelligent transformation. During this period, information technology with intelligent characteristics became the main support, which makes the Palace Museum regain its vitality, and possess the ability to “think”. The local high-tech companies became the main partners of cooperation during this period, introducing intelligent information technology into traditional culture, restoration, public services, and so on. Furthermore, Smart games, voice chat robots, applets and other projects were invented, which were well received by the users. The Palace Museum as a whole has entered a comprehensive intelligent transformation, gradually transformed from a form dominated by digital technology to one dominated by intelligent information technology, and has built many achievements:

Table 3. The main achievements in the period of advanced smart museums

Number	Name	Time	achievements
1	Tencent Smart Game “Eyes·Dream”	2018	“Eyes·Dream” is a cutting-edge game with eye-tracking technology, which combines classic paintings and calligraphy collections, and triggers operations by recognizing human eye movements to achieve real-time synchronization with the screen. The graphics are all drawn from Chinese traditional painting and calligraphy works, and players can appreciate the charm in the interaction.
2	AI guide program	2019	The Palace Museum produced an AI intelligent chatbot “See the Minister”, which can chat with tourists at any time through the We Chat applet. The database of this AI intelligent chatbot contains 670 interesting questions and answers from documents, such as “The Collection of Living Notes in the Qing Dynasty” and “Records of Qing Dynasty”, which makes the chatbot imitate the communication habits to chat with the tourist humorously.
3	The “smart” palace museum in the future	2020	A blueprint for a future smart museum jointly conceived by the Palace Museum and Huawei. In the plan, the general structure of the Smart Museum is mainly based on “big data”, “cloud computing”, “Internet”, and “artificial intelligence”, through the collection, storage, calculation, management and application of data. “ to support all business work. Its core business is divided into four categories: management, service, administration, and maintenance.

Source: Compiled by researchers

3.3 The Advantages and Disadvantages of Transformations

3.3.1 Advantages

Firstly, making the best use of the user’s thinking. After the Palace Museum established the hardware

information infrastructure, its digital cultural products began to blow out. From the early "Forbidden City beyond time and space" to the last series of APPs, applets, and "The Digital Palace Museum, which all rely on software platforms and forms familiar to the audience. Therefore, when the audience is touched it will not feel difficult to approach, which invisibly lowers the threshold for use. Not only games, animations, movies, and other display forms that audiences like, but also software platforms with high audience participation, such as WeChat and applets, have been incorporated into the intelligent construction. It is not hard to see that fully takes into account the life and usage habits of the audience, which reflects the concept of "audience first".

Secondly, optimizing museum services through data. The Palace Museum put forward the blueprint for establishing a "digital Palace Museum" at an early stage, which connects and gathers scattered audiences by creating a communication platform. Also, it is the main source to collect data and information from audiences. The value of audience data is far more than that. The reason why "AI" guides can communicate with the audience autonomously in the later guide applets precisely is that more than 70,000 pieces of audience information are collected to the audience database, which Can respond to a variety of questions. Huge and diverse databases have become an important support for smart museums to optimize their quality. Therefore, how to use, understand, process these data, and create value is the core of big data thinking.

Thirdly, actively cooperating with resources from all walks. The Palace Museum actively cooperates with other industries across borders, which can make up for its shortcomings, and create new values. On the one hand, it actively conducts cross-border cooperation with the communication industry. In the era of rapid Internet development, the application of 5G technology is the basis for realizing efficient and real-time data connections. On the other hand, the extension to games and social platforms has become another trend. With the increasing popularity of video and online games, the traditional model of information dissemination is gradually replaced by the mode that combines culture and game. With the development of technology, data resources can be circulated and reused. Under cross-border thinking actively seeking cooperation in fields that match museum resources, which can explore not only new values but also integrate inefficient work.

Fourth, the relationship with the audience is narrowed, through close social interaction. From the perspective of socialized thinking, there are mainly two ways to prompt the transformation of the museum. The Palace Museum used the concept of community in the early days, and while constantly exploring new forms, it also greatly emphasized building group connections between audiences. Social thinking is used in the game "Forbidden City Beyond Time and Space" in cooperation with IBM, and a virtual society is constructed in the game. Players from all over the world can communicate with each other in the virtual game. The "The Digital Palace Museum" project uses socialized thinking more thoroughly. It aims to separate from the real museum and build a virtual society, which brings together all people who pay attention to the Forbidden City.

3.3.2 Disadvantages

From the transformation process of the Palace Museum, it is found that its problems mainly appear in two aspects. On the one hand, the organizational structure is no longer suitable for the needs of smart museums. In the past, the main organizational structure of the museum was composed of three major parts: the management department, the exhibition department, and the preservation department. However, with new technologies, the previous organizational structure is no longer suitable for new needs. The new focus of work revolves around "data", which becomes the core, and its organizational structure should follow the new business centre. Therefore, museums must adjust their work pattern, workflow, and organizational structure accordingly.

On the other hand, the operation and maintenance are insufficient in the later. Compared with the previous forms of museums, the Smart Museum uses an endless stream of new technologies to help its work, achieve technological breakthroughs, and change the boring display method in traditional museums. However, during the field investigation, the researchers found that some projects invested a lot in the early stage, but they could not achieve sustainable development in the later stage, and even stopped using it. The researchers believe that this problem is mainly due to the high cost and the lack of high-level maintenance technicians in the museum. Therefore, how to break the deadlock, and opening up a new mode of operation and maintenance is a difficult problem for smart museums to face.

4. The Transformation of Smart Museum Under Internet Thinking

4.1 Building a Service-Oriented Smart Museum

Information technology has changed the one-way information transmission mode, and audience groups have channels to express their self-awareness. Whether the audience directly participates in the activities of the museum through the Internet, or the museum service provides rich, fast and personalized cultural products to the audience with different needs, it all reflects the user thinking of the smart museum. Firstly, from a long-term perspective, museums find the needs of target audiences, which are not only functional but also emotional appeals. Similarly, the humanistic value of the museum is reflected in the broadcast cultural value, and it is also

the carrier of human spiritual civilization. Therefore, only by adhering to the principle of being "people-oriented", respecting the needs of the service object, and building a service-oriented smart museum, which can put it on the right track, to exert the service function. The concept in the museum is that around "people" coincides with the user's thinking. In other words, the most important "user" in a museum is the audience it serves. Therefore, the new form of the smart museum should use "user thinking" to provide a channel for the audience to speak, and respect their humanized needs, to make the audience feel like owners in the museum.

4.2 Finding New Value through Cross-Border Cooperation

After the museum integrates the power of science and technology, the dissemination of information is fast and convenient. The smart museum has more extensive connections than ever before, gradually weakening the differences between information, lowering the communication threshold, and forming an existence without boundaries. The breaking of restrictions is manifested in all aspects, not only is the virtual museum breaking the limitations of space and time at the physical level, but also breaking the boundaries between the museum industry and others. In the new era, the development of smart museums should also take advantage of technology to use cross-border thinking integrating resources in multiple industries, fields and channels. It can create a comprehensive and borderless smart museum, subverting the barriers of traditional museums in terms of time, space, form, efficiency, and business scope. Therefore, smart museums based on cross-border thinking are mainly divided into two ways. One is based on vertical integration to improve efficiency. Another one is to seek horizontal expansion for new opportunities, to break the bottleneck of industry development, and break through the original pattern. However, no matter what kind of purpose cross-border, the cooperation between industries is not enough to only rely on the information of mutual penetration, and the key is to pay more attention to the target "audience".

4.3 Restructuring the Organizational Structure with "Data" as the Core

Information can be freely and widely disseminated in a museum in the internet age. All museum-related elements such as audiences, collections, staff, and artists can be regarded as nodes in the information circulation network, which are connected and influenced by each other, forming a decentralized communication mode. Diversified information carriers are digitally processed to form a unified communication language. In other words, information in different media such as pictures, audio, and video can be converted into a unified "data" language and spread through the network. Also, Data has become the core of the Smart Museum. From data collection to dissemination and reuse, the centre's businesses all revolve around "data", which is completely different from the traditional museum's operational characteristics and business work. Therefore, smart museums should fundamentally transform their ideological concepts, systems, business content and methods. Furthermore, it correspondingly changes or reshapes the mode, pattern and Processes. As well as, the organizational structures need to be adjusted according to their new characteristics to improve work efficiency.

4.4 Establishing a New Ecology with the Public

The core of the new ecology for the Smart Museum is "relationship". However, the relationship is a very broad concept, such as relatives, friends, and classmates, which are all different relationship layers, and information dissemination between different relationship layers also brings different effects (Zheng， 2019). Therefore, what kind of relationship should be established, and how to establish an ideal relationship are the central issues for building a new ecology of smart museums with its audience. First, museums and audiences should establish a "fan relationship". The two play the role of "consumption and service" to make the audience like to go to the museum, and even become loyal audience, so the museum needs to consider how to form a loyal fan relationship between the two. Second, museums can also serve as platforms to help audiences form community relationships. The contact point between museum visitors is that they visited, or are interested in the same museum. In other words, audiences are connected based on the same values and interests, and people with similar interests are united to form community relationships. The changes in connection methods with technology not only create new relationships between museums and audiences, but also increase the influence on museums from audiences. Therefore, only by managing the relationship between all parties can find the right direction for the development of smart museums.

5. In Conclusion

This research is based on the related theories of smart museums and Internet thinking. It analyzes that Internet thinking can promote the transformation of smart museums, such as creating new achievements, new values, and new ecology in the industry, to form the necessity of the transformation of smart museums with Internet thinking.

In addition, to further analyze the advantages and disadvantages of smart museums under Internet thinking, the Palace Museum is selected as an example to be analyzed its achievements and transformation paths in three

different stages. On the one hand, the Palace Museum utilizes and fully displays user thinking, big data thinking, cross-border thinking, and social thinking, showing many advantages, such as taking the audience as the protagonist, using data to optimize museum services, actively cooperating with all walks of life, and promoting relations with the audience. On the other hand, its shortcomings show that the organizational structure is no longer suitable for the needs, and the maintenance is insufficient in the later stage. Finally, based on the above advantages and disadvantages, the thinking on the transformation of smart museums in china under the Internet thinking mainly comes from four aspects, respectively building a service-oriented smart museum, cross-border cooperation to find new value in the industry, and focusing on "data" as the core on organizational structure, and building a new ecology with the public.

This research explores the new appearance and form of smart museums to meet the new needs of the audience, and provides a reference for the transformation of smart museums in China on the current stage. However, the rapid iteration of technology will continue to produce more and newer technologies at a speed and scope beyond people's imagination. The use and impact of emerging technologies in the museum industry will certainly continue to revolutionize perceptions, far beyond the range of this research at this stage.

Therefore, this research still has the possibility of improvement, which explores back and forth in the constantly updated technology, theory and practice, keeps up with the characteristics of the times, and continues to supply, improve and study the development of the smart museum.

References

He, L. & Yang, X.F. (2018). An analysis of the current situation of Smart Museum construction in my country. *China Museum*, *11*, (3).

Chen, G. (2013). Smart Museum: A new trend of digital museum development. *China Museum*, *4*, (4).

Lv, T. & Chen, Y.F. (2019). Research on the smart management of museums in the "Internet +" Era. *Science and Technology Economics Guide*, *10*, (35).

Mizushima E. (1989). What Is an 'Intelligent Museum'? A Japanese View, *Museum International*, *41*, (4), pp. 241-243.

Tuukka, Ruotsalo, Krister, et al. (2013). Smart museum: A mobile recommender system for the web of data. *Journal of Web Semantics Science Services & Agents on the World Wide Web.*

Zhang, Y. & Wang, C. (2012) Wisdom Museum, my museum—A museum visitor experience system based on mobile application. *China Museum*, *6*, (1).

Wang, C.F. (2019). Opportunities and challenges in the construction of Smart Museums. *Journal of the National Museum of China*, *6*, (1).

Shao, X.L. (2015). Promoting the construction of smart museum with Internet Thinking. *China Museum*, *4*, (3).

Feng, N.E. (2017). A review of the concept and practice of digital museum construction: Taking the digital palace museum community as an example. *Journal of the Palace Museum. 16*, (1).

Technical Innovation Alliance for Cultural Relics Protection. (2017). *The Smart Museum cases (Volume 1)*. Beijing: Cultural Relics Publishing House, pp. 3-7.

Steve, L. (2015). *Big Dataism*. CITIC Press, pp. 41-63.

Chen, G.F. (2014). *Internet Thinking: Business subversion and reconstruction*. China Science and Technology Information, pp. 192.

Zhao, D.W. (2014). *Internet Thinking Dugu Nine Swords. China Science and Technology Information*, pp. 2-12.

Zhang, Y.Y. (2019). Resear*ch on college students' thought and behavior guidance based on Internet Thinking* (PhD Thesis). University of Electronic Science and Technology of China, China.

Copyrights