International Journal of Education and Humanities
ISSN: 2770-6702 | Vol. 17, No. 3, 2024

New Paths for the Development of Smart Museums from the Perspective of the Value Chain: The Integration and Presentation of AIGC Technology

Liyun Hu*

School of ZheJiang, Normal University, Zhejiang, China
* **Corresponding author email:** fox0cloud@gmail.com

Abstract: AIGC (Artificial Intelligence Generated Content) is emerging as a critical engine for knowledge production. Clarifying the applicability and application scenarios of AIGC in smart museum innovation will help to uncover the competitive advantages of museums and enhance their value. This paper, combining the technical characteristics of AIGC and the features of smart museums, elaborates on the applicability of AIGC in empowering the integrated innovation of smart museums. It also explores the application scenarios of AIGC in various value activities such as museum artifact research, collection protection, exhibition planning, promotional education, and audience services from the perspective of the value chain. The study finds that AIGC can efficiently promote the production and dissemination of museum knowledge, deepen the interactivity and richness of cultural experiences, and enhance the accessibility and inclusivity of museums.

Keywords: Smart Museum; AIGC; Value Chain.

1. Introduction

In the "Intelligent+" era, generative AI tools like ChatGPT, Sora, and Midjourney have gained global popularity, marking a shift from "weak artificial intelligence" to "strong artificial intelligence." AIGC has rapidly permeated cultural industries such as gaming, news, entertainment, and film, driving large-scale transformations in knowledge production, dissemination, and experience.

As the forefront laboratories of our shared cultural spirit, the core business logic of museums revolves around "knowledge" - its construction, accumulation, validation, and dissemination[1]. The realization of museum functions requires rebuilding the relationship between objects and people, stimulating the meaning of objects, and enriching human experiences. In this process, AIGC, as a vital branch of the new generation of artificial intelligence technology, can play a bridging role in establishing communication and dialogue mechanisms between museums and audiences. The 2023 annual trend report released by the American Alliance of Museums (AAM) predicts that the integration of AIGC technology will bring profound changes in collection protection, exhibitions, education, and audience services in museums[2]. In the museum field, leveraging the capabilities of generative AI can drive digital guides to support more timely and personalized audience navigation, create a hybrid space of virtual and real interactions to strengthen the interactive experience, and automate the analysis and extraction of textual information to assist in curatorial content creation, significantly improving planning efficiency. Based on the characteristics of smart museums, which are highly digital, interactive, and continuously evolving, AIGC simulates human intelligence in terms of perception, cognition, and content creation, promoting more efficient knowledge production and dissemination, deepening the interactivity and richness of cultural experiences, and enhancing the accessibility and inclusivity of museums.

Michael Porter's value chain theory has considerable applicability and methodological significance for systematically analyzing museum innovation. This paper explores the role of AIGC technology in reshaping museum business processes from the perspective of the value chain and, on this basis, examines how AIGC can empower the value creation of museums, aiming to provide reference and guidance for museum innovation.

2. Literature Review

Scholars at home and abroad have made multiple hypotheses regarding the application of AIGC in the fields of cultural heritage and museums, reflecting the museum community's high sensitivity and dynamic adaptability to technological changes. From a holistic perspective, academia has systematically analyzed the rationale for introducing AIGC technology into cultural memory institutions that support cultural heritage preservation and dissemination services (such as libraries, art galleries, museums, and archives - collectively referred to as GLAMS), and outlined and anticipated application scenarios. Scholars like Ma Lecun et al. have discussed the applicability of AIGC for the digital and intelligent development of GLAMS from the perspectives of policy, academia, industry, data, and users[3]. Wang Nuo, Bi Xuecheng, and Xu Xin believe that in the metaverse scenario, AIGC can efficiently construct virtual spaces for GLAMS, reconstruct organizational structures, promote knowledge production, reshape external interaction relationships, and bring opportunities for expanding public service functions[4].

Focusing on the museum field, scholars like Zhao Zhuo, Tian Kan, and Wu Tao pointed out that AIGC will bring transformations to museum cultural research, promotional education, and audience services, addressing issues such as the scarcity of educational resources and the lack of personalization in museums[5]. Zhou Dingkai, Zhao Jing, and others have explored specific technologies, envisioning the role of natural language processing[6], large language models[7], and other technologies in driving smart museum

business innovations. Other scholars have focused on specific operations, discussing how AIGC technology can generate curatorial plans[8], enhance the interactive narrativity of exhibitions[9], or empower the intelligent processing and service of cultural heritage resources[10], intelligent information processing of ancient books[11], personalized recommendation systems[12], and digital guides[13]. Moreover, some scholars have also noted the risks and challenges brought by technology, such as Liu Jian pointing out that the application of AIGC in museums may lead to the replacement of traditional jobs, data privacy leaks, and the embedding of value biases[14].

In summary, the innovation in museums driven by AIGC and other next-generation artificial intelligence technologies has garnered academic attention. This interest spans both the theoretical framework and technical application levels, impacting various aspects of museum operations, including audience services, collection management, exhibition planning, and cultural heritage research. However, the research in this area is still in its early stages, with a relatively small body of work. The existing studies tend to focus on the impact of specific technologies, such as ChatGPT, natural language processing, and large language models, but lack a systematic approach. Furthermore, while some research analyzes the application scenarios of AIGC in GLAM (Galleries, Libraries, Archives, and Museums) institutions as a whole, there is a shortage of in-depth examination of museum-specific innovations. Additionally, there is a lack of collaborative research on the synergy between AIGC-enabled museum innovation and the applicability of these technologies. Therefore, this paper aims to clarify the rationale behind AIGC's reengineering of smart museum business processes. By employing Porter's value chain theory, it explores how AIGC empowers the integrated innovation of smart museums, considering how to maximize the inherent value of museums while enhancing their competitiveness, in addition to improving efficiency through technology.

3. The Applicability of AIGC in Empowering the Integrated Innovation of Smart Museums

The Fourth Technological Revolution, marked by the advent of mobile internet, artificial intelligence, and big data technologies, has profoundly influenced the evolution of museums. Following the phases of museum informatization and digitization, the development of smart museums has become a significant trend in the current museum landscape. In 2012, the Louvre in Paris, in collaboration with IBM, established Europe’s first smart museum, sparking a wave of smart museum development. Over the past decade, as an intelligent ecosystem, the smart museum has undergone continuous self-evolution and has consistently integrated new technologies and concepts, embodying three fundamental characteristics: resource integration, data reproduction, and a human-centered approach.

In the realm of integrated innovation within smart museums, the incorporation of AIGC technology is set to enhance intelligent collaboration, improve service efficiency, enrich user experience, and invigorate every link in the museum's value chain. IBM defines AIGC as a technology based on generative algorithm models that can create original content—such as text, images, videos, audio, or software code—based on user prompts or requests. It boasts advantages such as continuous availability, enhanced creativity, improved decision-making, and increased personalization, with the potential to accelerate or automate labor-intensive tasks and reduce costs[15].From the perspective of content creation, AIGC represents a method of content production distinct from PGC (Professionally Generated Content) and UGC (User-Generated Content). Technologically, AIGC is a collection of technologies used for the automated generation of content. Supported by large models, AIGC has evolved to include three cutting-edge capabilities: intelligent digital content twinning, intelligent digital content editing, and intelligent digital content creation[16].

This section will explore the applicability of AIGC in the integrated innovation of smart museums by considering the characteristics of smart museums and the technical features of AIGC.

3.1. Harnessing Cultural Productivity through Data-Driven AIGC

The operational model of a smart museum primarily revolves around the collection, transmission, integration, management, and utilization of data. Similarly, in the operational framework of AIGC, data serves as the fundamental "fuel." The "imagination" and creative capabilities of AIGC are generated by computers through learning and simulation based on vast amounts of data[17]. Given this dependency on data, AIGC shares the same production resources as smart museums, which fundamentally determines the potential for their integration.

"People" and "objects" are the primary sources of data for smart museums. This includes data on collections, preservation, research, visitors, management, and social interactions, all of which can support AIGC's data training.

Data flows multidirectionally among "people ⇄ objects ⇄ space." In this process, AIGC possesses the capacity to handle vast amounts of data, efficiently collecting, processing, and analyzing various types of data. It can uncover complex relationships within multidimensional data, thereby endowing museums with the abilities to think, understand, reason, and interpret.

3.2. Cross-Modal Integration and Innovation: Enhancing Resource Integration Efficiency with AIGC

Transitioning from "extensive" management to "refined" operations, smart museums have overcome the limitations of digital museums, such as information silos, by structurally optimizing and re-integrating previously fragmented digital resources. This has enabled comprehensive and in-depth interconnectivity of information. However, the challenge of how to transform the vast digital resources of museums into knowledge and present it to the public continues to impede the development of smart museums. The introduction of AIGC can make resource integration more efficient, further promoting knowledge production and dissemination within museums.

Cross-modal integration is a distinctive feature that sets AIGC apart from UGC (User-Generated Content) and PGC (Professionally Generated Content). AIGC can process data and information from different modalities, sources, and tasks. Cross-modal integration innovation has two key capabilities:

First, it identifies the correspondences between different

modalities of data, such as linking a piece of text with its corresponding image. AIGC organically integrates text, images, audio, and video to form a unified knowledge graph, allowing for more in-depth and comprehensive research on collection information. It can also automatically recognize and integrate the attribute information of artifacts, which are interrelated and influence each other, thereby strengthening the research on the original context and the systematic connections between artifacts. This deepens the understanding of the multifaceted value of cultural relics. This capability not only enhances the depth and precision of researchers' understanding of collections but also enriches the coherence and richness of information display.

Second, it facilitates the mutual conversion and generation of different modalities of data. For example, it can generate dynamic videos or 3D models based on a textual description, significantly improving the efficiency of knowledge production and enriching the formats of collection exhibitions.

3.3. Emphasizing Human-Centeredness: AIGC Facilitating Interactive Dialogue

In the process of museum digitization, while the use of audiovisual technologies has enhanced the physical accessibility of exhibits, the unidirectional nature of information dissemination has often failed to achieve true cultural accessibility.

The "intelligence" of a smart museum is directly reflected in the audience's "experience," emphasizing the primacy of the human subject and the ultimate enjoyment. By establishing a mechanism for communication and dialogue between the audience and the exhibits, smart museums encourage visitors to actively explore historical, artistic, and social knowledge. AIGC, when combined with virtual reality (VR) and augmented reality (AR) technologies, can digitally replicate and twin museum resources, creating three-dimensional exhibition spaces. This provides an immersive experience for visitors to explore the past and gain knowledge, stimulating their memory, discovery, and imagination. Additionally, AIGC possesses a certain level of cognitive interaction capability, which can enhance the narrativity and readability of collections. Users can ask questions about the artifacts at any time, engaging in dialogue to further understand the historical context of the items, greatly enhancing their sense of immersion and participation.

Moreover, the human-machine collaboration brought about by AIGC can free humans from physical and mental labor in many situations, such as enabling digital avatars to provide consultation and guided tour services. With its advantages of high efficiency, quality, and scalability in content generation, AIGC expands the intrinsic meaning of human subjectivity.

4. Integration and Presentation of AIGC in the Museum Value Chain

Porter's value chain theory posits that the value creation of any business entity is not merely achieved through marketing but is accomplished through a series of activities, including design, production, sales, delivery, and service. These activities form a dynamic process of value creation, known as the "value chain"[18]. The value chain consists of primary activities and support activities[19]. At the 2006 American Alliance of Museums (AAM) conference, Porter analyzed the primary activities of the museum value chain, which include: acquisition and preservation, exhibition, reception, marketing, and visitor services, with support activities encompassing infrastructure, finance and funding, human resources management, project and content development, and educational activities[20]. Each of these activities contributes to the creation of museum value and forms links in the museum value chain, playing a crucial role in optimizing the museum's competitive advantage.

As the social environment evolves, the value activities of museums continue to change. In August 2022, the International Council of Museums (ICOM) established a new definition of museums, stating: “A museum is a not-for-profit, permanent institution in the service of society that researches, collects, conserves, interprets, and exhibits tangible and intangible heritage. Open to the public, accessible and inclusive, museums foster diversity and sustainability. They operate and communicate ethically, professionally, and with the participation of communities, offering varied experiences for education, enjoyment, reflection, and knowledge sharing”[21]. According to this definition, the core business of contemporary museums revolves around "knowledge," encompassing activities such as the research, collection, conservation, interpretation, and exhibition of both tangible and intangible cultural heritage, thereby achieving the construction, dissemination, and experience of knowledge.

In light of this new definition, this paper re-examines the composition of the museum value chain by combining museum operations with the value chain model.

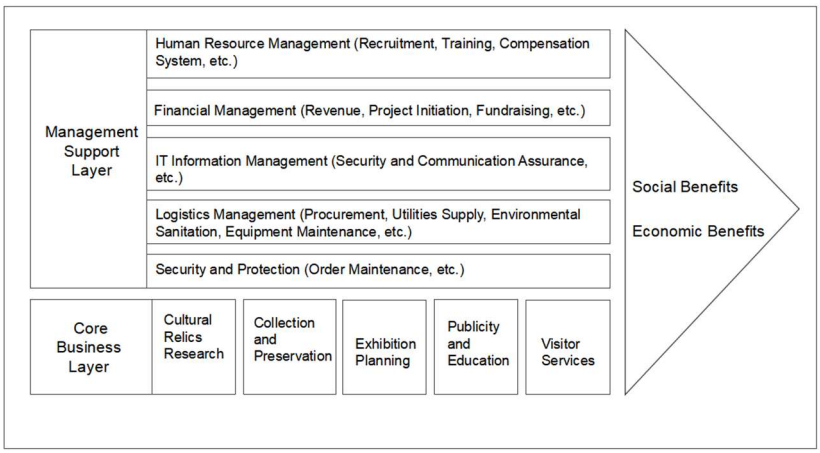

Fig.1 Schematic Diagram of the Museum Value Chain Model

As shown in Fig. 1, the management support layer (support activities) indirectly creates value by carrying out a series of tasks surrounding the museum's fundamental operations, providing a comfortable, convenient, and safe environment for the museum's daily operations. This includes activities such as human resources management, financial management, and IT information management. At the core business layer (primary activities), the five fundamental functions-artifact research, collection preservation, exhibition planning, public education, and visitor services-are the key activities that directly create social and economic benefits by constructing, managing, and experiencing knowledge within the museum. A crucial question is how to present the museum's historical, artistic, scientific, and sociocultural knowledge to the audience in an engaging manner. As a productivity engine, AIGC possesses powerful capabilities for knowledge acquisition, analysis, and application, offering significant potential and promising applications in the core business areas of museums.

4.1. Cultural Relics Reasearch

"Research" is universally recognized as the most critical function of museums worldwide. The activation and release of other museum functions are inseparable from meticulous research into the museum's own positioning, needs, and knowledge production[22]. Museum research delves into the content of collections, revealing their meanings through multidisciplinary interpretation of information and value.

AIGC has the capability to comprehend and perceive vast amounts of data, handling multimodal information such as text, images, and video, thereby enhancing the understandability and interpretability of this information. By employing related technologies such as machine learning, natural language processing, and knowledge graphs, AIGC can not only assist researchers in discovering the intrinsic connections and patterns among different attributes of information but also perform intelligent analysis, synthesis, and visualization.

For instance, the Shanghai Museum's Dong Qichang Digital Humanities Project utilized AIGC technology to map out humanistic networks. Based on high-resolution image data of Dong Qichang's calligraphy and painting collections, as well as other related data resources, AIGC extracted key information to systematically outline the various humanistic networks that influenced Dong Qichang's artistic career, including aspects of collection, social interactions, education, and legacy[23]. Moreover, AIGC technology performed associative data analysis on dispersed documents related to Dong Qichang, covering people, dates, places, events, and works. This analysis revealed Dong Qichang's distinctive creative characteristics at different times on a vertical timeline while also comparing the differing social, economic, and historical contexts between the East and West. The final chronicle not only encapsulated the creative journey of Dong Qichang's life but also provided a snapshot of the significant political and artistic events of the same period in both Eastern and Western societies, serving as a microcosm of the social changes and artistic developments of the late Ming dynasty.

4.2. Collection and Preservation

"Collection" involves gathering, authenticating, registering, and categorizing tangible or intangible cultural heritage, thereby incorporating these artifacts into the museum's knowledge research system. To facilitate preservation and display, digital collection methods have been widely adopted for recording and archiving information about cultural artifacts. AIGC's ability to produce cross-modal content, such as generating audio, images, and video from text or converting 2D images into 3D models, significantly enhances the efficiency of digitization. For example, when combined with 3D scanning technology, AIGC can capture high-precision data on an artifact's shape, texture, and color under non-contact conditions, rapidly and efficiently generating 3D models. This process creates digital archives of artifacts while also preventing any damage to the original objects[24].

Moreover, through the use of deep learning and other advanced technologies, AIGC can simulate human behavior, creativity, and styles, enabling the creative restoration of artifacts. This not only helps preserve the cultural significance embedded in the artifacts but also extends their lifespan. For instance, the famous Yuan Dynasty painting "Dwelling in the Fuchun Mountains" was partially damaged by fire, with the large and small sections of the painting now housed separately in the Zhejiang Provincial Museum and the National Palace Museum in Taipei. To ensure that the restored painting matched the existing authentic pieces, Baidu's Wenxin visual model undertook extensive study of Chinese landscape painting techniques, mastering elements such as composition, ink usage, and brushwork. It then applied this knowledge to a single-sample study of Huang Gongwang's "Dwelling in the Fuchun Mountains." The resulting restoration achieved a unified lighting style and harmonious landscape structure, successfully reuniting the separated painting sections across the Taiwan Strait. Similarly, the Rijksmuseum's "Operation Night Watch" restoration project utilized AIGC technology to learn and mimic Rembrandt's painting techniques, thereby restoring the masterpiece "The Night Watch," a highlight of the Dutch Golden Age of portraiture.

4.3. Exhibition Planning

Museum "exhibitions" serve as methods for presenting, communicating, and experiencing knowledge. AIGC's generative capabilities have broad applications in curatorial tasks, such as generating exhibition outlines, themes, display plans, exhibit labels, posters, and promotional copy[25]. Duke University's Nasher Museum of Art was the first to experiment with AIGC throughout the entire curatorial process, launching the exhibition "Pretend You're a Curator: An AI-Generated Exhibition"[26]. From the exhibition theme to the selection and description of exhibits and display design, everything was generated by ChatGPT, with the total cost of the technology amounting to $10.71. Although AIGC has shown some limitations in areas like aesthetic judgment, autonomy, and large-model hallucinations, as super artificial intelligence develops, AIGC will have vast potential applications in the museum exhibition field.

In terms of generating exhibit labels, the Harvard Art Museums have used various computer vision services, such as Google Vision and Azure OpenAI, to recognize visual features and text information in images. They applied AIGC technology to classify, label, describe, and annotate their art collection, covering 378,002 images of artworks[27]. The museum believes that without the specialized training of an art historian, AIGC's interpretive perspective is closer to reflecting the public's view.

Regarding exhibition design, museums provide an

environment where visitors can construct specific meanings. Enhancing the interactivity of exhibitions can offer visitors immersive spaces for imagination, encouraging active engagement, empathy, and creativity. AIGC, with its digital content duplication capabilities, can more efficiently and economically create virtual spaces, simulating and reenacting historical and cultural scenes to enable dialogues between the past and present. Additionally, in virtual settings, embedding AIGC's interactive dialogue and cross-modal creation capabilities into interactive installations can enhance the connections and resonance between visitors and exhibits. At the end of 2022, the Dalí Museum in Florida used OpenAI's image generation technology, DALL·E, to launch the "Shapes of Dreams" exhibit. DALL·E created personalized images based on visitors' descriptions of their dreams, which were then collaged into unique Dalí-style artworks[28]. This immersive experience can guide visitors to reflect on personal growth and expansion, helping shift knowledge dissemination from museum-led education to visitor-driven exploratory learning.

4.4. Publicity and Education

The primary method for museum publicity involves using communication media to disseminate knowledge both inside and outside the museum, while encouraging public participation in the theoretical construction of museum knowledge through interactive communication. In the era of mobile internet, video imagery is more intuitive in showcasing cultural heritage and telling the stories of artifacts, which can attract a broader audience and effectively enhance the visibility and impact of cultural heritage. However, when museums and other institutions attempt to use internet platforms to distribute specialized content, such as creating videos that align with the intrinsic value of cultural heritage, they often face dual challenges in content creation and operational promotion[29].

AIGC's production capabilities can be involved in the entire video production process, including topic planning, scriptwriting, copywriting, and video production. Additionally, by using AIGC technology, large amounts of data can be analyzed to identify user characteristics, preferences, and needs, thereby generating content that aligns with user aesthetic preferences and optimizing the user's emotional experience and usage context. This approach not only enhances the dissemination of content from multiple dimensions, such as innovation, aesthetics, and emotion, but also fulfills user desires for knowledge, identity recognition, and leisure cultural experiences.

At the "2024 China·AI Festival," the 2,000-year-old Terracotta Warriors "performed" alongside singer Dong Baoshi in a cross-temporal duet of the song "Marching to War," using the Huayin Laoqiang style to showcase the "mighty spirit of the Qin Dynasty." The program, co-produced by Alibaba Cloud Tongyi Lab and the Qin Shihuang Mausoleum Museum, utilized a generative AI model, EMO, to bring the artifacts to life with realistic singing performances. This exhibition received high likes and shares on short video platforms like WeChat Video Channels and Douyin, winning widespread audience acclaim.

Museums experimenting with AIGC technology to produce creative short videos can significantly reduce production costs and technical barriers. However, it is essential to avoid issues like "overuse of technical effects," "sensory overload," and "formulaic approaches" while focusing on expressing the cultural depth and aesthetic significance.

4.5. Visitor Services

In the 21st century, museums have shifted from being "collection-centered" to "visitor-centered," emphasizing the human interpretation of cultural significance and the construction of meaning in life. The trend toward personalization, diversity, and quality in visitor needs has further encouraged museums to prioritize visitor research. Museum interpretation services play a crucial role in bridging the knowledge gap, establishing communication mechanisms with visitors, and promoting cultural dissemination. By making complex knowledge accessible and engaging, museums can immerse visitors in scenes that are understandable, interactive, and capable of awakening memories through associations.

Compared to human interpreters, AI-generated digital humans offer flexibility and personalization advantages. First, AI digital humans can provide 24-hour interpretation, guided tours, and consultation services, enabling a "non-stop service" and "never-ending exhibitions" museum experience. AIGC can simulate human communication styles, making interactions more lively and natural. Additionally, based on natural language processing technology, digital museum interpreters can continuously learn new knowledge and update their interpretation content according to changes in exhibition information. By integrating technologies such as virtual reality (VR) and augmented reality (AR), AI digital humans can vividly recreate the environment in which artifacts were used, explain their usage, and demonstrate their manufacturing processes during interpretation.

Second, AIGC-driven digital humans can quickly edit attributes such as appearance, tone, emotion, and expression to suit different contexts and environments[30]. When interacting with visitors, generative AI can shape personalized interpretation styles based on the specific needs and interests of users, recommending tour routes that align with visitor preferences. With the integration of speech synthesis technology and cross-modal content generation capabilities, it can also replicate voices, providing communication services in different dialects or multiple languages.

Currently, museums such as the Capital Museum, Henan Museum, and Shanghai Natural History Museum are experimenting with AI digital human interpreters. Additionally, the "Starlight Project," initiated by Tencent under the guidance of the National Cultural Heritage Administration, is helping small and medium-sized museums tell artifact stories through AI digital humans.

5. Conclusion and Reflection

From the transition to informationization and digitalization to the era of smart museums, technological revolutions have profoundly impacted the evolution of museum forms. AIGC (Artificial Intelligence-Generated Content) is a crucial knowledge production method in the "intelligent+" era. Its technical advantages in cognitive interaction, content creation, cross-modal integration, and large-scale data processing align with the museum's business logic, which centers around "knowledge." Under the value orientations of intelligence, efficiency, and immersion in smart museums, AIGC will invigorate various value activities such as artifact research, collection preservation, exhibition planning, publicity and education, and visitor services. This will promote knowledge

production and cultural dissemination, enhancing the public's knowledge experience and intellectual capabilities. Smart museums can leverage their positioning, from a value chain perspective, to explore their competitive advantages, thereby enhancing cultural, educational, social, and economic value.

Although AIGC has broad application prospects in the field of integration and innovation within smart museums, its development relies on three key factors: computing power, algorithms, and data. The deep integration and presentation of AIGC technology within smart museums require further exploration of cross-sector partnerships. Smart museums can build on the achievements of artifact digitization by opening their "digital resource libraries" and "digital material libraries" and collaborating extensively with tech companies in content and technology, thereby achieving value co-creation in knowledge.

References

[1] Song, Xiangguang. (2019). Analysis of the Significance and Logical Relationships of Basic Museum Operations. China Museum, (04), 35-40.

[2] Merritt, E. (2024). TrendsWatch: Navigating a volatile future. American Alliance of Museums.

[3] Ma, Lecun, Zhan, Xini, Zhu, Qiyu, et al. (2023). Research on AIGC-Driven GLAM Digital and Intelligent Integration Innovation Development. Journal of Agricultural Library and Information Science, 35(5), 4-15.

[4] Wang, Nuo, Bi, Xuecheng, Xu, Xin. (2023). First Sharpen the Tools: AIGC and Its Application Opportunities in GLAM Under the Metaverse Scenario. Library Tribune, 43(02), 117-124.

[5] Zhao, Zhuo, Tian, Kan, Wu, Tao. (2023). Reflections on the Implications of New Generation Artificial Intelligence Technology on Museum Work. The Museum Journal, (03), 37-42.

[6] Zhou, Dingkai, Zhang, Fenglin, Ding, Zhiguo, et al. (2023). Application Prospects of Natural Language Processing Technology in the Museum Field: Taking ChatGPT as an Example. Science Education and Museums, 9(03), 39-48. DOI:10.16703/j.cnki.31-2111/n.2023.03.008.

[7] Zhao, Jing, Zhang, Yijia, Yang, Xiying. (2024). Frontier Practices and Challenges of Artificial Intelligence Technologies Represented by Large Language Models in the Cultural Heritage Field. China Museum, (01), 119-126.

[8] Spennemann DHR. Exhibiting the Heritage of COVID-19—A Conversation with ChatGPT. Heritage. 2023; 6(8):5732-5749. https://doi.org/10.3390/heritage6080302

[9] Chai, Qiuxia, Deng, Youxi, Guo, Zhen. (2023). Interactive Narratives in Museum Exhibitions Under the Trend of Artificial Intelligence Applications. The Museum Journal, (03), 24-29.

[10] Xia, Cuijuan. (2023). AIGC and the Intelligent Processing and Service of Cultural Heritage Resources. Journal of Agricultural Library and Information Science, (01), 11-15.

[11] Wang, Dongbo. (2023). ChatGPT and the Intelligent Information Processing of Ancient Books: Opportunities and Challenges. Journal of Agricultural Library and Information Science, (01), 15-18.

[12] Trichopoulos G, Konstantakis M, Alexandridis G, Caridakis G. Large Language Models as Recommendation Systems in Museums. Electronics. 2023; 12(18):3829. https://doi.org/10.3390/electronics12183829.

[13] Zhang, Zhijing. (2024). Exploration and Practice of AIGC-Driven Digital Guides Based on GLMs: A Case Study of the "Shanghai Natural History Museum Digital Guide." Information Systems Engineering, (06), 114-117.

[14] Liu, Jian. (2023). The Future Is Now: Reflections on Artificial Intelligence and Museum Digitalization. The Museum Journal, (03), 14-23.

[15] IBM.What is generative AI. [EB/OL]. (2024-03-22) [2024-07-23]. https://www.ibm.com/topics/generative-ai.

[16] China Academy of Information and Communications Technology, JD Exploration and Research Institute. (2022). White Paper on Artificial Intelligence-Generated Content (AIGC) [R/OL]. (2022-09-02) [2022-11-05], pp. 4-6. Retrieved from http://www.

[17] Li, Baiyang, Bai, Yun, Zhan, Xini, et al. (2023). Technical Characteristics and Evolution of Artificial Intelligence-Generated Content (AIGC). Library and Information Knowledge, 40(01), 66-74. DOI:10.13366/j.dik.2023.01.066.

[18] Michael E. Porter. Competitive Advantage: Creating and Sustaining Superior Performance. New York, The Free Press, 1985: 36.

[19] Michael E. Porter. Competitive Advantage: Creating and Sustaining Superior Performance. New York, The Free Press, 1985: 39.

[20] Michael E. Porter. Strategy for Museum.[DB/OL][2008-04-28][2022-05-21[https://www.hbs.edu/ris/Publication%20-Files/Strategy_for_Museuems_20060427_8d7858e780664cdb-a790-986f55e87ae4.pdf.

[21] China Museum Association. (2022). The Special General Assembly of ICOM Passed the New Museum Definition [EB/OL]. (2022-08-25) [2024-07-23]. Retrieved from https://www.chinamuseum.org.cn/cma/detail.html?id=12&contentId=12403.

[22] Du, Xinyu, Yang, Zhiru, Wei, Jun. (2022). Defining Museums: Some Discussions on the Museum Definition Proposal by ICOM. Cultural Heritage Journal, (03), 54-61.

[23] Tong, Yin. (2021). Design and Data Analysis of Dong Qichang Digital Humanities Map. Digital Humanities, (02), 142-157.

[24] Geng, Guohua, He, Xiaowei, Wang, Meili, et al. (2023). Research Progress on Smart Museums in the Metaverse. Journal of Image and Graphics, 28(06), 1567-1584.

[25] Zhang, Tiangang. (2024). The Concept and Future of AI Curatorship. Art, (06), 64-69. DOI:10.13864/j.cnki.cn11-1311/j.007422.

[26] American Alliance of Museums. (2023). Curatorial chatbot: An experiment with AI at the Nasher Museum of Art. Retrieved from https://www.aam-us.org/2023/11/28/curatorial-chatbot-an-experiment-with-ai-at-the-nasher-museum-of-art/

[27] Harvard Art Museums. (n.d.). About the Harvard Art Museums AI project. Retrieved from https://ai.harvardartmuseums.org/about.

[28] The Dalí Museum. (2022). The Dalí Museum's first-of-its-kind experience. Retrieved from https://thedali.org/press-room/the-dali-museums-first-of-its-kind-experience/.

[29] Wang, Wenbin, Zhu, Xia. (2023). Analysis of the Development Status of Museum Short Videos: Taking the Douyin Platform as an Example. China Museum, (02), 81-88.

[30] China Academy of Information and Communications Technology, JD Exploration and Research Institute. (2022). White Paper on Artificial Intelligence-Generated Content (AIGC) [R/OL]. (2022-09-02) [2022-11-05], p. 23. Retrieved from http://www.