

DIGITIZATION OF INTANGIBLE CULTURAL HERITAGE AS A KEY FACTOR IN THE TRANSFORMATION OF CULTURAL TOURISM INTEGRATION: AN ANALYTICAL PERSPECTIVE OF THE DIGITALIZATION FRAMEWORK

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Abstract: With the rapid development of the global digital economy, there has been an increase in research on the digital transformation of the tertiary industry, including the culture and tourism industry. The digital transformation of culture and tourism industry is influenced by various factors including Intangible Cultural Heritage (ICH). However, existing research has not proposed a measurement tool for the digital transformation of culture and tourism from the perspective of the digital economy. Through a systematic literature review of 3082 manuscripts published in top-tier journals indexed in CNKI and Web of Science scholarly databases, this study combines the cross-validation results of statistical analysis and thematic analysis to comprehensively expound the measurement factors of digital transformation of culture and tourism industry and future research trends. The main measurement factors are summarized from four perspectives: digital industrialization, industry digitalization, digital governance, and data valorization, and the digitization of ICH is found to be a key factor in the digital transformation of cultural and tourism integration. And five research development trends are proposed accordingly: First, the green sustainable development trend of industry; Second, the digital transformation path of cultural tourism industry; Third, the development situation of digital co-governance of digital government; Fourth, the data utilization and information security construction in digital society; Fifth, the construction of general measurement standards for the digital transformation of cultural tourism industry.

Keywords: Digital economy, Digital transformation, Culture and tourism industry, Multi-method cross-validation

1 INTRODUCTION

Driven by the Internet, artificial intelligence, big data, blockchain and other digital technologies, the digital economy has stepped into a rapid development path, and various industries have begun internal transformation and upgrading under the influence of digitization, and the structure of the global economy, the matching of factors, and the pattern of competition have changed, and a number of countries have formulated a digital national strategy that adapts to the development of the digital economy. The "Overall Layout Plan for the Construction of Digital China" issued by the Central Committee of the Communist Party of China and the State Council focuses on planning the construction of China's digital economy and other work, and actively promotes and lays out the strategy of digital China. China Academy of Information and Communication Research should be "14th Five-Year Plan" requirements to continuously improve the digital economy, the construction of digital economy has gone through the digital development of "two aspects", "three aspects" and then "four aspects" [1]. In 2017, from the perspective of productivity, it proposed the two aspects of digital economy framework, which are digital industrialization and industrial digitization; in 2019, according to the "productivity and production relationship", it added digital governance. In 2019, digital governance was added based on productivity and production relations; in 2020, data-driven development of various industries and information and data have become one of the important factors of production in the social economy, and the framework was further improved to digital industrialization, industrial digitization, digital governance and data valorization.

As the cultural and tourism industry is an important part of the digital economy, the strategy of cultural and tourism digitalization has been put on the agenda. Domestic and international research on digital cultural tourism and digital industrialization of Intangible Cultural Heritage (ICH) has also increased year by year, but most of them focus on two dimensions, such as digital construction and integration of cultural tourism[2], and digitization and industrial transformation[3]. On the one hand, there are abundant research results on the integration of culture and tourism through digitalization, and the related research can be divided into three major dimensions. Dimension 1: systematic viewpoint to explore the development of cultural and tourism integration[4]; Dimension 2: quantitative measurement of cultural and tourism industry integration based on the coupling degree model[5]; and Dimension 3: focusing on the impact of cultural and tourism integration on industrial upgrading[6]. On the other hand, ICH has become a key concern of cultural tourism integration, and domestic and international research mainly focuses on interaction, protection and utilization, resource development[7], and countermeasure paths[8], etc. Nega (2018) pointed out that the management and value evaluation in cultural tourism and intangible cultural heritage are correlated, and the two are not only mutual support points but also mutually enhance the value[9]. In terms of the protection and utilization of intangible heritage and service scene innovation, Zhai et al. (2023) constructed a digital technology system of intangible heritage to provide intangible heritage intelligent data construction and intelligent service solutions for cultural tourism integration.

In summary, few articles have used a systematic framework to study the measurement factors and measurement mechanisms affecting the digital transformation of ICH cultural and tourism integration. Whereas the digital economy framework of four aspects is the main mechanism and model to promote the digital transformation of the industry, Jin (2022) explored the transformation and development path of the digital publishing industry from the four dimensions of digital industrialization, industrial digitization, digital governance and data valorization [10]. However, the study did not systematically measure the various factors affecting the digital transformation of the industry under the digital four aspects, or point out the path of digital transformation and upgrading of the cultural industry. Furthermore, the majority of research on the digital advancement of cultural and tourism integration relies on literature review, lacks a multidimensional perspective, and fails to incorporate quantitative analysis. Hence, this study places emphasis on the digitalization of Intangible Cultural Heritage (ICH) in the context of culture and tourism, an area of current concern for industry, academia, and governmental bodies. We will approach this from the perspective of "industry-university-research" synergistic innovation within the framework of the triple helix theory [11], identifying the key factors and pathways impacting the digital transformation of ICH culture and tourism fusion based on the digital quadrilateral model. To achieve this research objective, we will conduct a comprehensive review of domestic and international literature from 2020-2023 using Citespace bibliometric software and Nvivo qualitative analysis software. Additionally, we will employ a mixed-methods research approach, combining both quantitative and qualitative methodologies for cross-validation, with the findings serving as the basis for measuring the digital transformation of ICH cultural and tourism integration through the the digital economy framework of four aspects.

2 THEORETICAL FOUNDATION

This study adopts the four perspectives of digitalization as the four primary aspects of the digital transformation of cultural and tourism integration, namely digital industrialization, industrial digitization, digital governance and data valorization. The study clarifies the basic concepts of digitalization and cultural tourism integration, and explains the theoretical connotation and application reasons of the "technology-economy paradigm" to help us better understand the relationship between digital technology and digital economy, and the importance of digitalization for cultural tourism integration.

2.1 Four Perspectives of Digitalization

In the background of digital economy, the country attaches importance to the digital development of the whole industry, and the "2023 China Digital Economy Development Research Report" has sorted out the "four frameworks" of digital economy, defining four concepts of digital industrialization, industrial digitization, digital governance and data valorization[12], which provides a basic direction for the digital transformation and upgrading of cultural tourism integration. First, digital industrialization refers to the process of industrializing data elements, digital technology and other digital forms[13]. Its main body of development is the information and communication industry, including telecommunications industry, Internet industry, electronic information manufacturing industry, etc., which provide other industries with big data, cloud computing, artificial intelligence, block chain and other related technical products and services. Second, industry digitalization refers to the digital transformation and upgrading of traditional industries using digital technology to adapt to the development of social economy. Digitalization has improved the output efficiency and resource appropriateness of various industries, and the deep integration of digital technology and the real economy has given rise to new business models, with digital cultural tourism, digital finance, digital medical care, etc. These industries gradually develop towards networking, intelligence and platform. Third, data valorization means that data is given new value as a production factor. The characteristics of data storage, reusability and aggregation help real enterprises to realize digitalization and intelligent development. The process of data valorization includes data collection, data standardization, data circulation, data trading, data protection, etc. Fourth, digital governance refers to the use of digital technology by multiple subjects to improve the internal and external governance of the industries and provide important guarantees for the digital transformation of the industries. The content of digital governance includes governance subjects, governance methods, governance means, and service contents. Culture and tourism integration industry includes both traditional physical industry and covers the emerging digital virtual industry, and the use of digitalization means can stimulate the internal development potential of culture and tourism and promote the deep integration of culture industry and tourism industry.

2.2 Integration of Cultural Tourism

The integration of culture and tourism refers to a state of development in which the cultural industry and tourism industry intermingle and interpenetrate, and the two lend each other strength to achieve the effect of "shaping tourism with culture and highlighting culture with tourism". The deep integration of culture and tourism is not only an important means to promote cultural inheritance, cultural product innovation and cultural industry development, but also an important way to enhance the cultural taste of tourism and promote the synergistic high-quality development of culture and tourism[14], and the deep integration of culture and tourism has become an inevitable trend of industrial upgrading. In this dynamic development process of culture and tourism integration, the barriers between industries are lowered; resources, technologies, talents, products and other elements are shared, circulated and exchanged. Thus, new forms of cultural and tourism products and new industries of cultural tourism industry are gradually formed[15]. At the same

time, the rapid development of digital economy increasingly blurs the boundaries of various industries, prompting the tendency of integration and development within primary, secondary and tertiary industries, and digitalization gradually becomes a favorable means for each industry to carry out optimization and upgrading of industrial structure. Although Li and Xu (2020) put forward the motivation of the integration development of cultural and tourism industries, and considered human capital, innovation level, and openness level as the main driving factors affecting the integration development of culture and tourism [16], they did not specifically explore the impact of digital economy on the integration of culture and tourism. Huang (2020) argued that the digital cultural industry, based on digital industrialization and characterized by industrial digitization, is an integral part of the digital economy and a new driving force to promote industrial transformation and high-quality economic development [17]. Similarly, the digitalization of traditional cultural tourism industry and the emerging digital cultural tourism industry are also components of the digital economy with strong development potential, and how to stimulate the new vitality of cultural tourism has become a hot and difficult point of current research. And, no study has yet proposed the digital transformation path of cultural and tourism integration from four perspectives: digital industrialization, industrial digitization, data valorization and digital governance.

2.3 The "Techno-Economic Paradigm" Theory

The "techno-economic paradigm" was first proposed by the economist Perez in 1983, who argued that the emergence of key technologies would shape new patterns of development and that the impact of technology on various industries would follow a paradigm of production organization, in which the productivity growth of firms, industries and countries would shift under this paradigm [18]. The transition from an agricultural economy to an industrial economy and then to a digital economy is caused by major technological innovations that renew the content of productivity and production relations and dramatically change the nature and scope of people's production and life, forming a new "techno-economic paradigm". The current "techno-economic paradigm" experienced by human society is the digital economy [19], in which labor, capital, technology, and data are the main factors of production in the digital economy. The innovation and application of digital technology tools such as Internet, cloud computing, artificial intelligence, big data and so on make economic activities gradually informatized, networked and intelligent. Digital technology as a product or service not only contributes to the rapid development of the digital economy, but also gradually realizes the digitalization of multiple fields in the deep integration with other industries, and improves the production efficiency of industry, agriculture and commerce. As a result, the existing logic of industrial economy has become difficult to adapt to the development rules of digital economy, and the cyclical changes of economic structure driven by digital technology have occurred. The new "technology-economy paradigm" is reshaping the socio-economic infrastructure, leading industries and social organizations [20]. As a tertiary industry, how to grasp the laws of digital economy and use digital technology to realize digital transformation and upgrade and improve service quality has become an urgent problem. Therefore, this study is based on the "technology-economy" paradigm theory to find out the measurement elements of digital transformation of cultural and tourism integration under the four perspectives of digital economy, in order to present the relationship between digital industrialization, industrial digitization, digital governance and data valorization, and the factors influencing them.

3 METHODS

3.1 The Sample of Articles and Data Collection

In this study, the same criteria are used for the selection of Chinese and English literature, and core journals with authority are selected. Based on the four perspectives of the digital economy, search terms for measuring factors of digital transformation of cultural tourism integration were identified, and the time limit is "2020-2023" to ensure the frontier of the study.

3.1.1 Principles of Chinese literature screening

The Chinese sample literature of this study was obtained from the CNKI database, and four searches were conducted according to the four perspectives of the digital economy. Among them, digital industrialization search subject terms were set as "digital industrialization/ cultural tourism digital infrastructure/ digital technology manufacturing/ digital technology service industry/ digital technology application industry/ digital technology driven industry". The search terms for industry digitalization were set as "cultural tourism industry digitalization/ cultural industry digitalization/ tourism industry digitalization/ cultural tourism digitalization/ digital cultural tourism integration". The search terms for digital governance were set as "cultural and tourism digital governance/ cultural and tourism industry governance/ service industry governance/ digital governance/ public service digitalization". The search terms for data valorization were set as "data valorization/ data value of service industry/ data value of cultural and tourism industry". The above four searches were conducted by exact matching, the search library was selected as academic journals, the journal category was set as core journals, the time span was set as "2020-2023". And the other search terms were set as default options, and then 341, 291, 472, and 545 pieces of literature documents were obtained respectively, which were set as Chinese literature for this study.

3.1.2 Principles of English literature screening

The English language sample literature of this study was obtained from the Web of Science core collection database, and four searches were conducted according to the four perspectives of the digital economy. The search terms for digital

industrialization were set as “digital industrialization/ digital infrastructure/ digital technology industry/ cultural tourism*digital technology”. The search terms for industry digitalization were set as “cultural industrial digitization/ cultural industry digitalization/ tourism digitization/ tourism digitalization/ digital cultural industry/ digital tourism”. The search terms for digital governance were set as “cultural tourism digital regulation/ digital regulation”. The search terms for data valorization were set as “data value/ data trading/ data asset/ data productization/ data capitalization”. The time span of the above four searches was set to “2020-2023”, and the other search terms were set as default options. After de-duplication, 199, 364, 428, and 442 documents were obtained respectively, which were set as English literature samples for this study.

3.2 Research Methods

In this study, a combination of quantitative and qualitative research methods was used to specifically analyze the same literature sample through bibliometric and thematic analysis. We obtained the intersection content of the quantitative analysis results in China and abroad, and the intersection content of the qualitative analysis results in China and abroad, respectively. In the cross-validation stage, the quantitative analysis results under the four perspectives of digital economy were compared with the qualitative analysis results. Finally, the common contents and necessary key contents of both were selected as the cross-validation results, and then the measurement factor table of digital transformation of cultural tourism industry was generated.

3.2.1 Bibliometric

On the basis of scientific search and literature screening, Citespace bibliometric analysis software [21] was used to analyze Chinese and foreign research hotspots for four literature samples in digital industrialization, industrial digitization, data valorization and digital governance, respectively. First, the keywords of the literature samples were used to generate Chinese and foreign “keywords co-occurrence and clustering knowledge maps”, and then output Chinese and foreign “the summary table of clustering themes and high-frequency keywords”. Second, under the comparison of key clustering and high-frequency keyword contents in China and abroad, the common research hotspots and keywords in China and abroad were compiled as the quantitative analysis results of this study.

In this study, the Chinese sample literature and foreign language sample literature were imported into CiteSpace 6.2.R2 software according to four perspectives: digital industrialization, industrial digitization, digital governance, and data valorization, and a total of eight keywords co-occurrence and clustering analysis operations were performed. The same criteria were used for each operation: The “Time Slicing” interval was set from January 2020 to April 2023, which was the same as the acquisition time of the literature samples, and the “Keyword Node Types” in the Chinese sample literature or the foreign sample literature were retrieved and analyzed with a “Year Per Slice”. The “Pruning” algorithm selects “Pruning Sliced Networks” for each slice, and the others are set as default options to generate the co-occurring keywords of digital industrialization in China and abroad. We further clustered the keywords for each co-occurrence and used Log-Likelihood Ratio (LLR) Terms clustering to output a summary table of clustered topic information and counted the frequency of keywords within each cluster to analyze Chinese and foreign research hotspots under the four perspectives of digitalization.

3.2.2 Thematic analysis

Thematic analysis is a method used to identify, organize, and gain insight into information, which can deal with the textual surface of information or delve into the meaning behind it[22]. This study used Nvivo qualitative analysis software to conduct Chinese and foreign research thematic analysis for eight literature samples in digital industrialization, industrial digitization, data valorization, and digital governance, respectively. First, the contents of the three aspects of title, abstract, and keywords were coded thematically, and the specific Chinese and foreign thematic analysis tables were output. Second, under comparing the contents of Chinese and foreign themes and keywords, the common themes and keywords of Chinese and foreign studies were compiled as the results of this study's qualitative analysis.

In this study, Chinese sample literature and foreign sample literature of four perspectives: digital industrialization, industrial digitization, digital governance, and data valorization were imported into Nvivo12 software to create a total of eight items. Manual coding was performed for the titles, keywords, and abstracts of all sample documents, and the coding was to mark and analyze the salient concepts in the imported materials. In this process, the coders coded all the information in the software in order to avoid any omissions in coding. After the coding was completed, the similar or overlapping coding results were grouped into themes, which were able to closely follow the important information of the digitalization research questions. Then the similar and consistent codes (keywords) were initially categorized, and then the themes and keywords were revised and refined. And the naming of themes and keywords was finally determined to generate the content of the thematic analysis results for the Chinese and foreign digitalization research.

3.2.3 Multi-method cross-validation

Mixed methods might offer advantages over single methods due to their ability to provide deeper insights into research phenomena that cannot be fully comprehended using either qualitative or quantitative methods alone[23]. Vivek and Nanthagopan (2021) conducted a review and comparison of the feasibility of multiple methods and mixed methods in research, confirming that both mixed methods and multiple methods demonstrate reliability. They concluded that integrating quantitative and qualitative data through mixed or multi-method studies has the potential to significantly enhance the accuracy and quality of analysis and conclusions in any study [24]. Pillai and Sivathanu (2020) utilized a

mixed methods design, combining qualitative and quantitative techniques, to investigate the behavioral intentions of tourists and the actual use of chatbots in the Indian hotel and tourism industry context [25]. Therefore, this study employs a methodologically rigorous multi-crossover approach, whereby multiple research methods are utilized to explore a singular topic. Specifically, it employs a diverse set of methodologies within the same study [26]. In this regard, the current paper employs both quantitative and qualitative research methods to analyze the thematic characteristics of digitalization in both the domestic and international contexts. The study compares the results of bibliometric and thematic analyses and cross-validates to derive the content of each concept and keyword within the four constructs of digital industrialization, industrial digitization, data valorization, and digital governance, which serve as the measurement factors in the digital transformation of the cultural and tourism integration industries. The quantitative analysis supports the content elements of the digitalization framework through provision of data, while the qualitative findings supplement and improve the structural relationships between the elements. The cross-validation of both sets of findings provides a more rigorous and comprehensive research framework for investigating the digital transformation of cultural and tourism integration.

4 DIGITAL TRANSFORMATION OF CULTURAL TOURISM INDUSTRY FROM THE PERSPECTIVE OF DIGITAL INDUSTRIALIZATION

4.1 Bibliometric Analysis of Digital Industrialization in China and Abroad

A total of 341 Chinese literature samples and 199 foreign literature samples on the topic of digital industrialization were imported into CiteSpace 6.2.R2 software to generate a knowledge graph of the co-occurrence of Chinese and foreign keywords on digital industrialization. The co-occurring keywords were further clustered and analyzed, and a summary table of the clustering information and the frequency of the keywords in each cluster were output to analyze the research hotspots in the field.

4.1.1 Chinese keyword clustering and research hotspots

Keyword co-occurrence and clustering mapping of digital industrialization in China show the eight keyword clustering tags with the highest frequency of digital industrialization research in China, which are #0 digital technology, #1 digital economy, #2 manufacturing industry, #3 industrial structure, #4 real economy, #5 human capital, #6 new consumption, and #7 digitalization. The largest cluster is #0 digital technology, with high word frequency of digital economy, digital technology, and digital industrialization. Li and Qiu (2022) argue that digital industrialization collaboration, industrial digital synergy and digital technology innovation are important elements of digital economy industrial synergy development[27]. Second, the keywords frequency of digital technology, digital economy and total factor productivity are high in the #1 digital economy cluster, and digital technology is a new technological form of digitalization, networking and intellectualization, which largely promotes the improvement of socio-economic productivity and total factor productivity[28]. And the research of manufacturing industry in #2 clusters mainly focuses on digital trade and international division of labor[29], enterprise resource allocation[30], and digital-real economic integration[31]. Other clusters are smaller in scope, but #3 industrial structure and #5 human capital are more closely related to digital industrialization. Zhang et al. (2021) empirically tested that the digital economy is to promote high-quality economic development by improving the level of human capital and upgrading industrial structure through the construction of relevant index systems[32]. Therefore, the important research hotspots of digital industrialization in Chinese literature are digital technology, digital economy, manufacturing industry, industrial structure and human capital, respectively.

4.1.2 Foreign keyword clustering and research hotspots

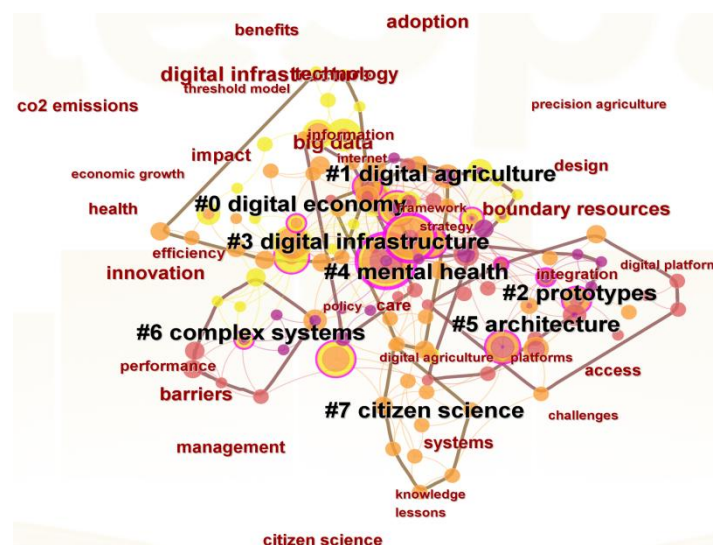


Figure 1 Foreign digital industrialization keyword co-occurrence and clustering mapping

Figure 1 presents the eight keyword clustering tags with the highest frequency of foreign digital industrialization research, which are #0 digital economy, #1 digital agriculture, #2 prototypes, #3 digital infrastructure, #4 mental health, #5 architecture, #6 complex systems, and #7 citizen science. The first major cluster #0 digital economy has a high keyword frequency of sustainability. Langley (2022) argues that industries should be aware of environmental damage while creating economic value and the rational use of digital technology can improve the transparency and efficiency of energy recycling[33]. #1 digital agriculture, as one of the digital convergence industries, has actively adopted digital technologies such as big data, cloud collection, artificial intelligence, and software applications[34]. The #2 prototypes clustering is related to the digital healthcare convergence industry, reflecting that digital technologies are applied to multiple industry sectors. Among the remaining clusters, digital infrastructure and complex systems are more important, including anti-debug, evasive strategy reengineering framework (EMRF), etc. They are vital risk security management components of digital infrastructure[35]. And the types of digital management systems are quite complex, such as digital ecosystem[36], digital financial system[37], and healthcare delivery system are very important. Therefore, based on the four perspectives of digitalization, the important research hotspots of digital industrialization in English literature are digital economy, digital convergence industry, digital infrastructure, and complex system.

4.1.3 Common research themes and keywords in China and abroad

Comparing the similarities and differences between Chinese and foreign research hotspots on digital industrialization, this study takes the intersection of Chinese and foreign research and related key contents to generate a summary table of digital industrialization themes and keywords. As shown in Table 1, the five subthemes under digital industrialization are digital economy, digital technology, industrial structure, digital infrastructure, and human capital.

Table 1 Summary table of digital industrialization themes and keywords

	themes	keywords
1	digital economy	total factor productivity; sustainable development
2	digital technology	AI; blockchain; cloud collection
3	industrial structure	green development; sports industry; science and technology finance; manufacturing; digital agriculture; medical services
4	digital infrastructure	new infrastructure; digital platform; complex system; software library
5	human capital	technology introduction; innovation cost; trade in services; innovation ability; digital literacy

Source: Compiled by this study

4.2 Thematic Analysis of Digital Industrialization in China and Abroad

The 137 Chinese sample literature and 199 English sample literature with the theme of digital industrialization were imported into Nvivo12 software. The title, keywords and abstracts of all Chinese and English sample papers were analyzed thematically to generate a table of the results of the thematic analysis of digital industrialization in China and abroad.

Table 2 Results of the thematic analysis of digital industrialization in China and abroad

	Topics	Keywords
1	digital infrastructure	telecom infrastructure; digital platform; software and services; internet infrastructure; hardware industry; data center; digital currency; computational infrastructures; automation infrastructure
2	digital technology innovation	cloud computing technology; artificial intelligence; technological capability; 5G; automation technology innovation; universal technology; digital twin technology; soft technology; blockchain technology; low carbon technology innovation; IOT; cloud adoption
3	digital technology industry	digital technology-based manufacturing industry; digital technology applications industry; digital technology services industry; digital technology-driven industry
4	digital integration industry	digital cultural tourism industry; Industry 4.0; digital culture industry; digital sports industry; digital content industry; digital finance industry; digital specialty industry; digital creative industry; e-commerce industry
5	digital industrial development	collaborative networks' role; digital products; technological capability; national digital strategy; total factor productivity (TFP); technological capability; digital industrial organization; digital industrial resource allocation; industrial division of labor; digital industrial value chain; industrial integration; industrial linkage; industrial structural upgrading; industrial scale; industrial workforce; continuous development

Source: Compiled by this study

Comparing the results of the analysis of digital industrialization themes in China and abroad, this study adopts the intersection of the two and related key contents as the themes and keywords under digital industrialization. As shown in Table 2, the five sub-themes under digital industrialization are digital infrastructure, digital technology innovation, digital technology industry, digital integration industry, and digital industry development. First, among digital infrastructure, the same keywords include telecom infrastructure, digital platform, software and services, and internet infrastructure. While among different keywords, hardware industry, data center, computational infrastructures, and automation infrastructure all belong to "new infrastructure". Digital currency is considered as one of the important

applications of blockchain technology in the technology field, providing the function of "payment + settlement" for social transactions[38]. Secondly, in digital technology innovation, the keywords intersect with cloud computing, artificial intelligence technology, and digital innovation capability. Different keywords such as 5G, blockchain, and artificial intelligence are also emerging digital technology contents. Third, among digital technology industries, digital technology manufacturing industry, digital technology application industry, and digital technology service industry are the common focus of research. Digital technology driven industry with these three together illustrates the functional classification of digital technology industries. Therefore, the five sub-themes under digital industrialization and their necessary keywords are used as the qualitative analysis results of this perspective.

5 DIGITAL TRANSFORMATION OF TOURISM INDUSTRY FROM THE PERSPECTIVE OF INDUSTRY DIGITALIZATION

5.1 Bibliometric Analysis of Industry Digitalization in China and Abroad

The 137 Chinese sample literature and 199 foreign sample literature with the theme of industry digitalization were imported into CiteSpace 6.2.R2 software, and the co-occurrence knowledge map of Chinese and foreign industry digitalization keywords was generated according to the settings, and then the co-occurrence keywords were further clustered and analyzed. The summary table of topic information was output and the frequency of keywords in each cluster was counted to analyze the research hotspots in the field.

5.1.1 Chinese keyword clustering and research hotspots

Keyword co-occurrence and clustering mapping of industry digitalization in China show the nine keyword clustering tags with the highest frequency of industry digitalization research in China, which are #0 cultural and tourism integration, #1 cultural industry, #2 cultural and tourism industry, #3 digitalization, #4 library, #5 digital economy, #6 rural revitalization, #7 big data, and #8 value co-creation. In the first major cluster #0 cultural tourism integration, cultural industry, public library, public culture and digital cultural industry have high word frequency, and public library[39], public digital culture [40] and digital media [41] are important research directions of cultural tourism integration. In #1 cultural industry cluster, the word frequency of cultural industry, digital technology, and new infrastructure are high. Liu et al. (2023) focused on analyzing the impact of digital technology application on the digital transformation of cultural industry and the living heritage of non-foreign heritage[42], reflecting the importance of digital technology in industrial development. The #2 cultural tourism industry cluster has a high word frequency of industrial integration, and the existing literature focuses on the study of the integration motives of cultural tourism industry[43], and the study of its integration path[44]. Therefore, the key research themes under the industry digitalization are cultural tourism integration, cultural industry, cultural tourism industry, digitalization, and rural revitalization, respectively.

5.1.2 Foreign keyword clustering and research hotspots

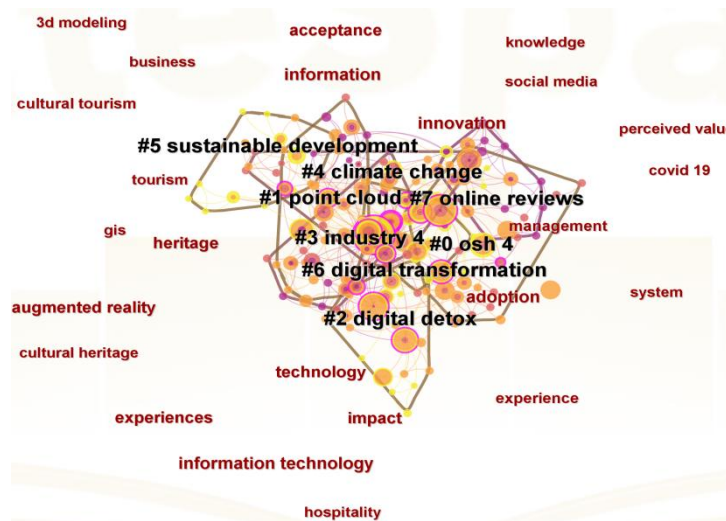


Figure 2 Foreign industry digitalization keyword co-occurrence and clustering mapping

Figure 2 shows the eight most frequently occurring keyword clusters in Chinese industry digitalization research, namely #0 occupational safety and health (osh), #1 point cloud, #2 digital emissions, #3 industry 4.0, #4 climate change, #5 sustainable development, #6 digital transformation, and #7 online reviews. The #0 occupational safety and health (osh) cluster and #3 industry 4.0 cluster both explore the profound impact of digital technology on industrial change, where the keyword "osh" refers to a work ecosystem formed by new changes in occupational safety risks in an industry 4.0 environment [45]. The #1 point cloud clustering focuses on the impact of digital technology on the cultural tourism industry, intangible cultural heritage and 3D modeling are more frequent words. Hannewijk et al. (2020) proposed a design framework that helps capture the value of intangible cultural heritage and can be applied to mobile

applications[46]. And point clouds and 3D modeling are widely used in the field of cultural heritage, providing an enabling digital technology tool for heritage development and conservation[47]. Therefore, the key themes under the industry digitalization are digital technology, sustainability, digital transformation, and social media, respectively.

5.1.3 Common research themes and keywords in China and abroad

Comparing the similarities and differences between Chinese and foreign industry digitalization research hotspots, this study takes the intersection of Chinese and foreign research and related key contents to generate a summary table of industry digitalization themes and keywords (Table 3). The six sub-themes under industry digitalization are cultural tourism integration, cultural creativity, digital transformation, sustainable development, social media, and rural revitalization.

Table 3 Summary table of industry digitalization themes and keywords

	themes	keywords
1	cultural and tourism integration	cultural industry; cultural and tourism industry; industrial integration; public library; tourism experience; creative industry
2	culture creativity	intangible cultural heritage; cultural confidence; rural culture; public culture; intangible cultural heritage; digital folk customs; national culture
3	digital transformation	innovation and development; intelligence; new business form; digital culture industry; tourism enterprise; digital tourism
4	sustainable development	sustainable tourism; cultural tourism; carbon emissions; market reforms; pandemic tourism recovery; business; sustainable development goals; value co-creation
5	social media	online review; digital marketing; ecotourism
6	rural revitalization	metaverse; digital countryside; digital culture industry and creative transformation

Source: Compiled by this study

5.2 Thematic Analysis of Digital Industrialization in China and Abroad

The 291 Chinese sample papers and 364 foreign sample papers with the theme of industry digitalization were imported into Nvivo12 software, and the title, keywords and abstracts of all Chinese and foreign sample papers were analyzed thematically to generate a table of the results of the analysis of industry digitalization in China and abroad.

Table 4 Results of the thematic analysis of industry digitalization in China and abroad

	Themes	Keywords
1	cultural resource development	intangible cultural heritage; industrial heritage; cultural heritage; national culture; public culture; digital folk custom; cultural creativity; red culture; cultural confidence; digital art
2	tourism resource development	tourism products; tourism activities; personalized tourism experience; mode of cultural tourism communication; cultural tourism brand; tourism market
3	cultural and tourism industry development	industrial boundary; industrial chain restructuring; industrial development policy; rural cultural tourism industry; characteristic cultural tourism industry; innovative development; sustainable development; attracting investment; and new marketing model
4	integrated development of culture and tourism	cultural and tourism market; cultural and tourism enterprises; creative industry; value co-creation; technology accumulation; human resources; cultural consumption; collaborative system development model; cultural and tourism industry reputation; cultural and tourism industry users
5	digital technology application	human-computer interaction technology; mobile application; digital twin; digital media; augmented reality technology; digital application industry
6	digital transformation	digital conditions; digital content (enterprise digitization; management concepts; production and delivery methods); digital results

Source: Compiled by this study

Comparing the analysis results of industry digitalization themes in China and abroad, this study adopts the intersection of the two and related key contents as the themes and keywords under industry digitalization. As shown in Table 4., the six sub-themes under industry digitalization are cultural resource development, tourism resource development, cultural tourism industry development, cultural tourism integration development, digital technology application, and digital transformation. First, in cultural resources development, the same keywords are intangible cultural heritage, industrial heritage, historical and cultural resources, and other ethnic cultures, cultural and cultural creation, digital art, public culture, etc. are also important developable resources. Second, in tourism resources development, tourism products and tourism activities are the intersection of Chinese and foreign studies, and tourism experiences, cultural tourism communication methods, cultural tourism brands and tourism markets are the multiple path choices in the development process. Third, in the development of cultural tourism industry, industrial boundary, industrial chain reorganization and industrial development policy are common concerns of research. Rural cultural tourism industry and special cultural tourism industry are two industrial development directions. Therefore, the common research themes of industry digitalization in China and abroad are cultural resources development, tourism resources development, cultural and tourism industry development, cultural and tourism integration development, digital technology application, and digital transformation.

6 DIGITAL TRANSFORMATION OF CULTURAL TOURISM INDUSTRY FROM THE PERSPECTIVE OF DIGITAL GOVERNANCE

6.1 Bibliometric Analysis of Digital Governance in China and Abroad

The 472 Chinese sample papers and 428 foreign sample papers with the theme of digital governance were imported into CiteSpace 6.2.R2 software to generate the co-occurrence knowledge graph of digital governance keywords in China and abroad. And then the co-occurrence keywords were further clustered and analyzed to output the clustered topic information. The clustering information was output and the frequency of keywords in each cluster was counted to analyze the research hotspots in the field.

6.1.1 Chinese keyword clustering and research hotspots

Keyword co-occurrence and clustering mapping of digital governance in China show the eight keyword clustering tags with the highest frequency of digital governance research in China, which are #0 digital technology, #1 digital government, #2 digitalization, #3 cultural tourism industry, #4 urban governance, #5 digital empowerment, #6 data governance, and #7 cultural industry. The first major cluster #0 digital technology has a high word frequency of digitalization, digital governance, and digital technology, and the digital governance content includes both data management and covers digital governance content of various industries, such as sports industry, library, tourism, etc. The #1 digital government cluster has high word frequency of digital government, digitalization, big data, and collaborative governance, and government data openness and authorized operation[48]. Innovative development of government data assetization[49] and collaborative governance of government data[50] are important governance contents of digital government. The #2 digital and #4 urban governance, both emphasize the correlation between digital economy and social governance and public cultural services. Xu et al. (2022) argued that public cultural services need to achieve intelligent, efficient and adapted service standards, and need to clarify the direction of digital development of public cultural services from the perspective of new infrastructure, digital humanities and user cognition[51]. Therefore, the research themes of digital governance in China are digital technology, digital government, digitalization, cultural and tourism industry, urban governance, and data governance.

6.1.2 Foreign keyword clustering and research hotspots

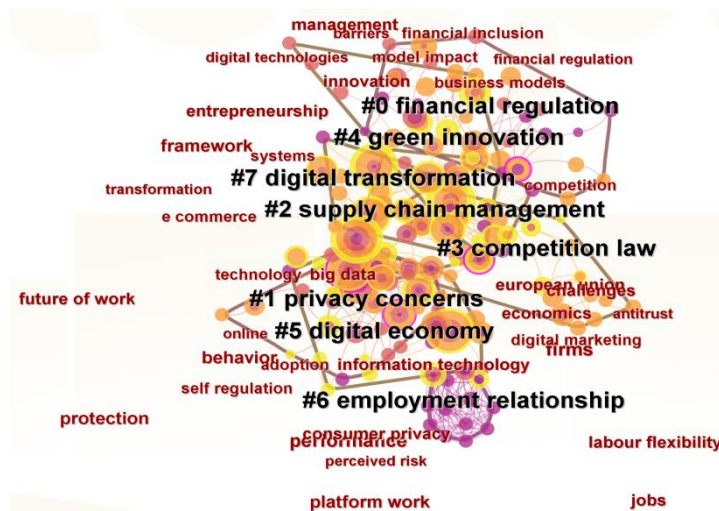


Figure 3 Foreign digital governance keyword co-occurrence and clustering mapping

Figure 3 presents the eight keyword clustering tags with the highest frequency of foreign digital governance research, which are #0 financial regulation, #1 privacy concerns, #2 supply chain management, #3 competition law, #4 green innovation, #5 digital economy, #6 employment relationship, and #7 digital transformation. The #0 financial regulation cluster has a high word frequency of social media, financial regulation, and digital technology, among which strengthening the legal regulation of social media is crucial because the spread of false information may cause damage to the public interest[52]. Financial regulation also includes the governance of digital currencies, which can be achieved through mechanisms that promote financial inclusion and regulate market access[53]. In #1 privacy clustering, information privacy and cryptographic digital currencies have high word frequency; digital tracking technology has intensified people's concern about privacy concerns. Privacy concerns can be moderated by government regulation to ease public trust issues[54]. In the #2 supply chain management cluster, digital technology, Industry 4.0, and circular economy are frequently discussed topics, and the fourth industrial revolution has prompted the exploration of blockchain technology in logistics and supply chain management[55]. Other themes include competition law, green innovation, digital economy, employment relationship, and digital transformation, with different keyword content explored in each theme.

6.1.3 Common research themes and keywords in China and abroad

Comparing the similarities and differences of digital governance research hotspots in China and abroad, this study took the intersection of Chinese and foreign studies and related key contents to generate a summary table of digital governance themes and keywords (Table 5). The seven sub-themes under digital governance are privacy concerns, legal regulation, digitalization, human resources, digital government, urban governance, and data governance.

Table 5 Summary of digital governance research hotspots in China and abroad

Themes	Keywords
1 privacy issues	crypto currency; information privacy; system quality; accounting tax
2 legal regulation	competition law; digital platform; platform supervision; digital service law
3 digitalization	public culture; public service; small and medium enterprises; inter-governmental cooperation; virtual banking
4 human resources	employment relationship; labor flexibility; platform work; future work; cost effectiveness
5 digital government	big data; collaborative governance; e-government
6 urban governance	urban governance; governance, common prosperity, rural construction and smart government
7 data governance	financial data; local government; personal information; and social governance

Source: Compiled by this study

6.2 Theme Analysis of Digital Governance in China and Abroad

The 472 Chinese sample documents and 428 foreign sample documents with the theme of digital governance were imported into Nvivo12 software, and the titles, keywords, and abstracts of all Chinese and foreign sample documents were manually coded to generate a table of the results of the thematic analysis of digital governance in China and abroad (Table 6).

Table 6 Results of the thematic analysis of digital governance in China and abroad

Themes	Keywords
1 multi-stakeholder governance	digital government; digital society; national governance; grassroots governance; corporate governance; digital citizenship; digital governance organization; digital leadership; technical competence
2 public services	Public database; collaborative creation of public value; equalization of public services between urban and rural areas; service inclusiveness; continuity of public service; service supply system
3 digital technology	big data; artificial intelligence; cloud computing; national online service platform; distributed storage technology; digital twin; intelligent culture and travel system; integrated data protection system; business observation tool; automated decision-making
4 digital governance methods	data protection legislation; digital policy; digital governance principles; agile governance; collaborative governance; collaborative governance; simplified governance; organized governance; scientific governance decision-making; e-government
5 digital governance content	personal data; public data; data sovereignty; data output; data ethics; data chain security; multiple industries

Source: Compiled by this study

Comparing the results of the analysis of digital governance themes in China and abroad, this study adopts the intersection of the two and the related key contents as the themes and keywords under digital governance. As shown in Table 8, the five sub-themes under digital governance are multi-stakeholder governance, public services, digital technology, digital governance methods, and digital governance content, and the keywords under each theme integrate the key discussion contents in China and abroad. First, under multi-stakeholder governance, multiple stakeholders such as government, companies, and society participate in collaborative governance, and each stakeholder also needs to have digital leadership and technology application capabilities. Second, under public services, collaborative creation, equalization, inclusiveness, and continuity are the prominent features of public services. Third, under digital technology, multiple emerging technologies and digital platform systems are important for digital governance. Fourth, digital governance approach includes three paths of law, policy and characteristics. Fifth, under digital governance content, multi-industry data, data sovereignty, data security, data ethics, etc. are the main governance directions.

7 DIGITAL TRANSFORMATION OF CULTURAL TOURISM INDUSTRY FROM THE PERSPECTIVE OF DATA VALORIZATION

7.1 Bibliometric Analysis of Data Valorization in China and Abroad

The 545 Chinese sample literature and 442 foreign sample literature with the theme of "data valorization" were imported into CiteSpace 6.2.R2 software to generate the co-occurrence knowledge graph of data valorization keywords in China and abroad, and then the co-occurrence keywords were further clustered and analyzed to output the clustered

4	value assessment	data assets; value chain; big data; data pricing
5	data elements	digital economy; construction of new think tank and construction of mapping discipline
6	artificial intelligence	scientific data; data privacy; influencing factors; value alienation

Source: Compiled by this study

7.2 Theme Analysis of Data Valorization in China and Abroad

The 545 Chinese sample papers and 442 foreign sample papers with the theme of "data valorization" were imported into Nvivo12 software, and the title, keywords, and abstracts of all Chinese and foreign sample papers were manually coded to generate a table of the results of the thematic analysis of data valorization in China and abroad (Table 8).

Table 8 Results of the thematic analysis of data valorization in China and abroad

Themes		Keywords
1	data elements	personal data; data providers; data availability; data service quality; scientific data; government data; public data; enterprise data; residual data; data literacy; open data platforms
2	data valorization	data pricing; data trading; data circulation; data standards; data collection; data validation; data commodities; data resourceization; data assetization; data capitalization; data value addition
3	digital technology	big data; blockchain; artificial intelligence; algorithms; machine learning; data storage technology; data mining technology; data platform
4	data management	protection of data privacy; distributed regulation; data transaction monitoring; data security issues; data misuse; data monopoly; data usage scope; risk management; digital government; smart data management

Source: Compiled by this study

Comparing the results of the analysis of data valorization themes in China and abroad, this study uses the intersection of the two and the necessary key contents as the themes and keywords under data valorization. As shown in Table 9, the four sub-themes under data valorization are data elements, data valorization, digital technology, and data management, and the important discussions in China and abroad are categorized under each theme. First, under the theme of data elements, the types of data elements include personal private data and open public data, and the provision and use of data require objective and subjective conditions such as development platforms and data literacy. Second, under the theme of data valorization, the keywords mainly present the process of data valorization, including dynamic processing contents such as data circulation, data collection, data validation and pricing, data trading, etc., as well as data use results such as data standards and data commodities. Third, under the digital technology theme, computational modeling and blockchain are used in establishing data transaction mechanisms and privacy protection efforts, and technologies such as data storage, mining, and algorithms can help process data effectively and quickly. Fourth, under the theme of data management, data privacy and security protection, data monopoly and misuse governance, enterprise risk management, and data usage scope are the key areas to be considered.

8 REVIEW AND OUTLOOK

8.1 Results

The cross-validation results of the four perspectives of digital industrialization, industry digitalization, data valorization and digital governance are collated to finally form a table of measurement factors for the digital transformation of cultural tourism integration. As shown in Table 9, four dimensions are categorized under each of the four perspectives of digital industrialization, and there are a total of 98 measurement factors under all dimensions. The table integrates the existing and new necessary considerations to provide the latest reference for the research of cultural tourism industry development.

Table 9 Measurement factors of digital transformation of cultural tourism industry

Perspectives	Dimensions	Measurement factors
digital industrialization	digital infrastructure	information network infrastructure; digital platforms; software and services; computing infrastructure; digital convergence infrastructure
	digital technology innovation	artificial intelligence; IoT; blockchain; cloud-based technology; soft technology; digital twin technology; low-carbon technology innovation
	digital technology industry	digital technology manufacturing; digital technology application industry; digital technology service industry; digital technology driven industry

	industrialization development	digital industry development mode; digital industry agglomeration; digital industry scale; digital industry structure upgrade; digital industry resource allocation; digital industry division of labor and cooperation; digital industry supply and demand
industry digitization	cultural tourism resource development	public culture; cultural heritage; cultural heritage; cultural confidence; tourism experience products
	cultural tourism industry development	cultural tourism integration; rural revitalization; innovation and sustainable development; industry chain restructuring; industrial reputation; value co-creation
	cultural and tourism enterprise development	technology accumulation; human resources; attracting investment; digital transformation; cultural tourism branding; cultural tourism marketing and marketing; cultural tourism consumption
	digital technology applications	digital platform construction; digital media and marketing; metaverse and human-computer interaction technology; virtual-real interaction and augmented reality technology; mobile applications; digital twin technology
digital governance	multi-entity governance	digital government; digital society; corporate governance; digital citizenship; digital governance organization; digital governance capacity
	digital technology	big data; digital platforms; artificial intelligence; cloud computing; crypto currency; digital Twins
	digital governance approach	related laws and regulations; digital policy; collaborative governance; e-government; digital governance Principles and Requirements
	digital governance content	public services; data governance; tax collection; employment relationship; cost effectiveness; digital currency; digital affirmative action
data valorization	data elements	cultural and tourism resource data; government data; public data; enterprise data; data attributes
	data valorization	data resourcefulness; data circulation and Standards; data commodity and value addition; data Pricing and trading; data assetization; data capitalization; value co-creation and alienation
	digital technology	data storage; data mining & analytics; blockchain; artificial intelligence; algorithms; digital platforms; internet of things
	data management	data literacy; data management subjects; data management methods; data use scope; data privacy and information security; data monopoly and data misuse; data transaction supervision; data risk management

Source: Compiled by this study

8.2 Evaluation of Previous Studies

By reviewing previous studies on the digital transformation of cultural and tourism integration in China and abroad, this study generated a table of measurement factors for the digital transformation of cultural and tourism integration under the four perspectives of digitalization. Based on the existing studies, the dimensions and measurement factors are summarized and inductively evaluated in terms of four perspectives: digital industrialization, industry digitization, data valorization, and digital governance.

8.2.1 Evaluation of Chinese and foreign research on digital industrialization

Research on digital industrialization in China focuses on three aspects: digital technology innovation, digital infrastructure and industrialization development, among which frontier technologies are mainly applied to manufacturing industries, while less research is conducted on the combination of digital technology and other industries. With the deep integration of digital economy and real economy, the integration of digital technology with tertiary industries such as service industry has become the focus of development, but the cooperation between cultural tourism industry and digital industry still needs to be strengthened. In contrast, foreign research on digital industrialization focuses more on sustainable development approaches of digital economy, low-carbon technology innovation and industrial aspects of digital applications, and emphasizes the role of digital technology in industrial upgrading, energy utilization and ecological environment. Chinese and foreign studies agree that digital technologies have a wide range of applications, with more discussions on technologies such as 5G, artificial intelligence, Internet of Things and cloud computing. However, Chinese and foreign studies on digital industrialization still need to pay more attention to non-technological factors, such as cultural creativity, cultural tourism services and humanistic literacy, as well as cooperation and communication between the digital industry and the tertiary industry. Therefore, the digital industry needs to adjust the direction of industrial development, strengthen cooperation with the cultural tourism industry, and provide strong technical support to promote the reinvention and new growth of the digital industry.

8.2.2 Evaluation of Chinese and foreign research on industry digitalization

Research on the digitalization of Chinese industry focuses on three aspects: the development of cultural and tourism resources, the integrated development of cultural and tourism, and the application of digital technology. Among them, cultural heritage is currently the key content developed and utilized by the cultural tourism industry, and digital

technology plays an important role in realizing the protection and inheritance of non-heritage projects. However, the technical maturity and adaptability still limit the digital development of the industry, and the lack of data analysis ability of cultural tourism enterprises is also one of the bottlenecks limiting its development. Therefore, strengthening the training and introduction of talents and improving the digital literacy and data analysis ability of employees are important ways to promote the digital transformation of the cultural tourism industry. And foreign industry digitalization research focuses on three aspects: green sustainable development, cultural heritage digitization and digital media. The concept of green sustainable development includes the use of low-carbon technology, and the reasonable use of low-carbon technology can reduce the impact of industrial development on the ecological environment. The digitization of cultural heritage mainly uses 3D modeling technology to expand the online virtual tourism field of cultural tourism industry, and the use of digital media technology helps to improve the quality and efficiency of cultural tourism products and services. However, these studies have ignored the issue of cultural differences, and the cultural backgrounds and tourism markets of different countries and regions differ significantly, and subsequent studies need to pay more attention to the issues of cultural differences and localized applications. What Chinese and foreign studies have in common is that they both focus on the preservation and digital development of intangible cultural heritage (ICH), digital display and digital propaganda make more people understand ICH culture, and digital technology provides new opportunities for ICH preservation and development. Therefore, in the digital transformation of cultural tourism industry, the preservation and inheritance of ICH, sustainable development of the industry and digital talent training are the key research directions in the future.

8.2.3 Evaluation of Chinese and foreign research on digital governance

Research on digital governance in China covers three main areas: digital government, data governance, and public services. The construction of digital government requires solving the problems of information silos, digital divide, and information security, and formulating effective policies. Data governance includes various aspects such as open data sharing, security and privacy, intelligent decision making, and ethical social responsibility, among which blockchain technology can guarantee data and privacy security and can be flexibly applied by multiple subjects. And the digitization of public services can improve people's trust and satisfaction, and cultural and tourism enterprises can realize product refinement and personalized services through digital technology. Therefore, digital governance needs to pay attention to issues such as government credibility, data security and privacy protection, and strengthen cooperation between the government and multiple subjects such as the market and social organizations, so as to form a common pattern of digital governance. Meanwhile, foreign research on digital governance focuses on three aspects: financial regulation, data privacy, and policies and regulations. Research on financial regulation aims to improve the efficiency and accuracy of regulation, and promote the stability and development of financial markets. Research on data privacy includes legal frameworks, protection technologies, risk management, security education, etc., and aims to ensure the security and legality of data privacy to promote the sustainable development of industries and maximize social value. However, digital governance is still insufficient in terms of multi-actor linkage and cooperation, and needs to be strengthened to develop more scientific and effective policies. Both Chinese and foreign studies focus on privacy and security management, the impact of digital technologies on government governance, and the social impact of digital governance. Therefore, multiple social actors such as governments, enterprises, and citizens need to work together to raise awareness of privacy protection, contribute wisdom and strength to digital governance, and help governments develop effective management policies.

8.2.4 Evaluation of Chinese and foreign research on data valorization

Research on data valorization in China has focused on three aspects: data value assessment, data sharing, and data elements. There are studies that have thoroughly explored and proposed value assessment systems applicable to different types of data, but the standards and methods are not yet unified and standardized, especially in the cultural tourism industry, where data circulation standards have not yet been formed. The importance of monitoring data monopoly and data misuse issues is emphasized in data sharing, and data privacy and security protection remains one of the concerns in data valorization. In the cultural tourism industry, it is particularly important to classify and manage different data elements and explore the relationship and value between them. In contrast, foreign data valorization research focuses on three aspects: digital technology application, data resources, and data trading. Openness and sharing of data resources is a prerequisite for data valorization, but data security and privacy concerns are also necessary considerations. In terms of data trading, foreign studies focus on trading models, platforms and rules, and pay attention to policy and standard development, which requires cross-sector and cross-discipline coordination and cooperation. Both Chinese and foreign studies on data valorization focus on data collection and integration, processing and analysis, security and privacy protection, but lack standards for data development and utilization in the cultural tourism industry, and lack in-depth research on data assetization and capitalization. Therefore, research on data valorization and regulatory governance should be based on the direction of the cultural tourism industry with comprehensive consideration of data circulation standards, data use authority, data transaction scope and enterprise risk control, and provide data valorization guidelines for the cultural tourism industry.

8.3 Implications for Future Research

Based on the review of digitalization research in China and abroad, and according to the evaluation of the main contents and shortcomings of the existing research, five key trends are proposed for the future development of this research: First, the green sustainable development trend of the industry; Second, the digital transformation path of the cultural

tourism industry; Third, the development situation of digital co-governance of digital government; Fourth, the data utilization and information security construction in the digital society; Fifth, the construction of general measurement standards for the digital transformation of the cultural tourism industry.

8.3.1 Green sustainable development trend of industry

Future research should focus on the application of technological innovation, sustainable development and a green and low-carbon economy. Both the digital industry and the cultural tourism industry attach importance to the consideration of environmental factors and long-term interests.

On the one hand, innovative applications of emerging digital technologies have increased. China is committed to building an advanced green computing power center, and the digital industry continues to improve high-performance computing, big data processing, cloud computing and other areas to support the progress and wide application of digital technologies such as data analysis and artificial intelligence. Machine learning, deep learning and other technologies in artificial intelligence will be applied to intelligent analysis, intelligent manufacturing, transportation and other aspects, providing opportunities for various industries to develop towards automation and intelligence.

On the other hand, cultural tourism is a service-oriented industry mainly based on tourism, culture and entertainment, and it is a resource-consuming industry. Under the background of the "dual carbon" target, digitalization can better guide enterprises to reduce pollution and increase efficiency. The implementation of a green and low-carbon economy in the cultural tourism industry can not only better protect and utilize natural resources and the environment but also improve the competitiveness and long-term profitability of the cultural tourism industry. As people's awareness of environmental protection increases and consumption patterns change, more and more people are beginning to pay attention to sustainable development and environmental protection. Tourists hope to realize their own value and significance through tourism and cultural activities. Against this background, the cultural tourism industry must respond to market demand and provide more environmentally friendly, sustainable and high-quality cultural tourism services to improve customer satisfaction.

Therefore, the digital transformation of the cultural tourism industry should include sustainable development aspects such as resource conservation, environmental auditing and social responsibility.

8.3.2 The digital transformation path of the cultural tourism industry

Although the digital transformation of the manufacturing industry is mature, other industries are still exploring the methods and ways of digital transformation. Among them, the culture and tourism industry is relatively weak in digital research, which is a research field that needs to be supplemented and improved in the future. The cultural tourism industry should grasp the three directions of digitalization, networking and intelligence, and use new Internet technologies to carry out an all-round and full-chain transformation of the traditional cultural tourism industry, so as to empower the transformation and upgrading of traditional industries.

First, strengthen the deep integration of new information technologies such as 5G, AI, and big data with the cultural and tourism industry, improve output efficiency and service quality, and fully play the driving role of technology. Second, the upgrading and transformation of the traditional cultural tourism industry should shift from single-point breakthroughs to comprehensive empowerment, and the empowerment of the whole industrial chain and the whole ecological chain should be comprehensively considered. Although the cultural tourism management system has shifted from offline to online, the problem of data islands still exists. For example, data such as enterprise user management, order management and product management are not integrated into the same system, which can easily lead to repeated construction and cost increases, which is not conducive to the precipitation of overall digital assets. Third, transform the real cultural tourism space into a digital twin space. The digital twin space is aimed at the entities in the physical world, and constructs a complete clone of the digital world through digital means, to realize the interactive connection between virtual and real spaces. Cultural tourism entities can analyze, predict and control the environment, traffic, tourists and other information about scenic spots with the help of historical data, real-time data and algorithmic models to help cultural tourism enterprises make scientific decisions and unify management.

Therefore, the cultural tourism industry can realize the digital transformation and upgrading of the industry through digital and real integration methods such as emerging information technology, comprehensive digital empowerment and digital twin space.

8.3.3 Development situation of digital co-governance of digital government

Digital government plays a fundamental and guiding role in the development of comprehensive digitalization, and promotes the development of the digital economy, the construction of a digital society, and the improvement of the digital ecosystem. In order to achieve a scientific, rational and efficient digital Co-governance situation, it is necessary to start with data resource sharing, government information transparency, improving public participation and promoting e-governance.

First, strengthen the sharing of data resources. The government should build an open and shared data resource system, and provide the public with efficient and convenient services through the joint construction of an information platform. At the same time, open public data to enhance the vitality of social innovation. Second, improve the transparency of government information disclosure. The government will strengthen the digitization of government information; promote the disclosure and sharing of government information through the Internet, and build channels for public opinion and feedback. Realize supervision visualization, and improve efficiency and credibility. Third, increase public participation. Use new media, apps and other means to realize government participation functions such as public suggestion collection and voting decision-making based on digital technology, and shorten the distance between the government and the public. Fourth, promote e-government. Improve the e-government service platform and establish e-

governance mechanisms such as signing and approving official documents, so as to shorten the government decision-making response cycle and improve the efficiency of document handling.

Therefore, digital Co-governance represents new trends in digital elements, digital thinking and digital cognition. The digital government aims to build a comprehensive and open governance system and a sound and scientific decision-making mechanism, allowing more social forces to participate in government management and public governance, and improving social governance through digital and networked co-governance.

8.3.4 Data utilization and information security construction in the digital society

As a new production factor, data elements have an important impact on the development of digital society. In the future, the scope of data use will be more extensive, and the management of data security use should be strengthened from awareness to behavior. The trend of data value is reflected in the following aspects:

First, encourage open data sharing and promote data circulation. Improve the legal system for data collection and utilization, guide the orderly flow of data, and provide legal support for data utilization. Second, data transactions and markets will continue to develop. The establishment of data exchanges and market platforms can promote data transactions and utilization, and data transaction rules and standards must be improved to ensure orderly and efficient data transaction venues. Third, the cross-border data flow will become a new trend. The state supports the establishment of international data ports and free trade zones to promote cross-border data transfer and exchange. Data exchanges should study cross-border data policies and technical standards to ensure safe and efficient cross-border data flow. Finally, great attention will be paid to data security and privacy protection. The government will continue to improve the data security legal system and policies, covering the entire process of data collection, storage and use. The digital industry must strengthen data security construction and technology research and development to prevent security risks.

Therefore, data elements will become an important resource for the development of a digital society. Promoting data utilization and security construction requires interdepartmental coordination, joint governance between government and enterprises, and mutual benefit and win-win.

8.3.5 Construction of general measurement standards for the digital transformation of the cultural tourism industry

Existing research on the cultural tourism industry lacks common measurement standards and implementation paths for digital strategies, and the cultural tourism industry needs a standardized measurement framework suitable for itself. Although some current studies involve proposing individual measurement factors, they have not proposed a general framework for the digital transformation of the cultural tourism industry. The measurement standards for the digital transformation of manufacturing and technology-based enterprises have been formed, but factors such as production efficiency, product quality, and cost-effectiveness cannot be fully applied to the cultural and tourism industry. Large differences, so it is difficult to find a common measure. In the future, it is necessary to formulate corresponding measurement factors according to the characteristics and needs of the cultural tourism industry, such as customer satisfaction, service quality, digital technology application degree, etc. And on the implementation path, the digital transformation of the cultural and tourism industry needs to be explored from various aspects such as information construction, intelligent application, digital marketing and big data analysis.

9 SUMMARY & CONCLUSION

Based on the previous research results of digital transformation, this study has made a comprehensive summary of the four perspectives of digitalization. However, with the in-depth development of the digital economy, the emergence of new technologies, new ideas and new environments requires us to discover and add new measurement factors. In terms of digital industrialization, the construction of digital infrastructure and the industrialization of digital technology have received attention. But the mastery of digital core technologies in the digital industry has become the focus, and digital enterprises have become the backbone of digital infrastructure construction. The innovation of technologies such as computing power, artificial intelligence and low-carbon technology will strengthen the innovative application of various industries. In terms of industry digitalization, the digitalization of the traditional cultural tourism industry is relatively slow, and it is necessary to enhance the core competitiveness of cultural tourism enterprises through the deep integration of digital technology and industry. The use of low-carbon technologies helps the cultural tourism industry to meet the needs of consumers, mainly by providing more environmentally friendly, sustainable and high-quality cultural tourism services to improve customer satisfaction.

In terms of digital governance, laws, policies, rules and other governance methods have been proposed for the normative use of data, but it is also necessary to harness social forces to improve the overall governance capability. In the future, the government, society, enterprises and other multi-subjects will be advocated for collaborative governance. In addition, the content of digital management based on the service of the cultural tourism industry is less, and the use of new technologies to improve the service of the cultural tourism industry and standardize data governance is also a future research trend. In terms of data valorization, data elements as new production factors are new development projects in various industries. Data storage, sharing, circulation, even standardization, availability and transaction are undefined areas in the cultural and tourism industry. In addition, data utilization and information security need to be further balanced, and how to bridge the digital divide is also an urgent problem to be solved.

In conclusion, none of the existing studies has proposed a general measurement table for the digital transformation of the cultural and tourism integration industry. At present, there are few specific and feasible measurement factors and indicators. With the development of technology and industry, some measurement methods are no longer fully applicable. The current cultural tourism industry needs to use digital means as a lever to carry out integration,

transformation and upgrading. In the future, it is necessary to propose a digital co-governance path of coordinated development of the "triple helix theory". Therefore, based on the adjustment of the existing and newly discovered measurement factors, this study finds out the feasible measurement factors for the digital transformation of the cultural tourism industry. In the future, it will be compiled and developed into an outline and item questionnaire for Delphi expert interviews. On this basis, we will create a measurement index system for the cultural tourism of digital transformation and upgrading, which can be used by the "triple helix theory" tripartite reference.

COMPETING INTERESTS

The authors have no relevant financial or non-financial interests to disclose.

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