Digital Innovation Management of Information Resources in the Context of Digital China: Element Analysis and Model Exploration—A Case Study of Scientific and Technological Archives Information Resources

Authors: Chen Hui, Liu Sainan, Chen Wenjing

Date: 2023-07-28T00:00:00+00:00

Abstract

[Purpose/Significance] In the context of Digital China construction, information resource management is undergoing increasingly extensive and profound transformations. Taking scientific and technological archives information resources as an example, this study introduces digital innovation management thinking into information resource management practices, explores a practically guiding element system for digital innovation management of information resources, better leverages the driving role of innovation, helps improve the overall effectiveness of China's digital innovation system, and develops information resource innovation management paths compatible with Digital China construction. [Method/Process] Based on digital innovation management concepts, the Kunliulong DC transmission project was selected as a typical case study. Nineteen qualitative data texts were obtained through semi-structured interviews, and thematic analysis was employed to code and analyze the data texts. [Results/Conclusions] Finally, with digital technology innovation as the foundational support, this study explores the integration and interaction among six dimensional elements: digital technology, institution, strategy, culture, organization, and knowledge innovation. This breaks through the innovation element dimensions proposed by existing theories, provides theoretical support for achieving comprehensive digital innovation in the field of scientific and technological archives management, and constructs a digital innovation management model for information resources based on this. This model effectively overcomes resource misallocation and ineffective innovation caused by "fragmented innovation" in the field of information resource innovation management.

Full Text

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CHEN Hui, LIU Sainan, CHEN Wenjing
School of Information Management, Central China Normal University, Wuhan 430079, China

Abstract

[**Purpose/Significance**] Against the backdrop of Digital China construction, information resource management is undergoing increasingly extensive and profound transformations. Taking scientific and technological archival information resources as an example, this study introduces digital innovation management thinking into information resource management practices, explores a practically guiding element system for digital innovation management of information resources, and seeks to better leverage innovation-driven development. This approach can enhance the overall effectiveness of China's digital innovation system and forge an innovation management path for information resources that aligns with Digital China construction.

[**Method/Process**] Grounded in digital innovation management theory, this research selects the Kunliulong DC Transmission Project as a typical case study. Through semi-structured interviews, 19 qualitative data texts were obtained and analyzed using thematic analysis.

[**Result/Conclusion**] With digital technology innovation as the foundational support, this study examines the integration and interaction among six dimensional elements: digital technology, digital institution, digital strategy, digital culture, digital organization, and digital knowledge innovation. This framework transcends the innovation element dimensions proposed by existing theories, providing theoretical support for achieving comprehensive digital innovation in scientific and technological archives management. Based on this analysis, the study constructs a digital innovation management model for information resources that effectively overcomes resource misallocation and ineffective innovation caused by "fragmented innovation" in the field of information resources innovation management.

Keywords: Digital China construction; information resource management; scientific and technological archival information resources; digital innovation management

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In his report to the 20th National Congress of the Communist Party of China,

General Secretary Xi Jinping emphasized the need to uphold innovation as the core of China's modernization drive, improve the new national system, strengthen national strategic scientific and technological capabilities, and enhance the overall effectiveness of the national innovation system. In February 2023, the Central Committee of the Communist Party of China and the State Council issued the "Overall Layout Plan for Digital China Construction" [1], which calls for promoting the deep integration of digital technology with the real economy, accelerating the innovative application of digital technology, and building a self-reliant digital technology innovation system. With the establishment of the national innovation system and the core position of innovation, a wave of innovative thinking is continuously and profoundly influencing all industries. Information resource management is similarly facing the impact of new economic norms such as the digital economy [2].

Information resource management takes information as its research object. As the digital environment evolves, its research scope continues to develop and expand, with research perspectives evolving from government document management to enterprise information resources, and further extending to library, information, and archival management [3]. Archival information resources constitute an important component of information resource management. With the rise of new-generation digital technologies, digital archival resources are increasingly becoming the mainstream form of future archival information resource management due to their convenience in information recording, transmission, and sharing [4]. As a crucial type of archival information resource, scientific and technological archival information resources are acquired through human participation and are useful to specific subjects, adapting to the development level of productive forces [5]. They reflect the historical achievements of national economic development and reform and opening up, possess significant scientific and evidentiary value, and represent important assets for national development and social transformation. Investigations reveal that scientific and technological archives management practices often adopt "fragmented innovation" during innovation processes—that is, innovating only those parts with urgent needs in isolation while ignoring the constraints imposed by technology, institutions, organization, and other factors on innovation effectiveness, resulting in suboptimal overall innovation outcomes [6]. This situation urgently needs to change. Therefore, against the new backdrop of Digital China construction, it is necessary to re-summarize and analyze the innovation management elements of scientific and technological archival information resources, accelerate the promotion of digital technology innovation in scientific and technological archives management, drive innovation in digital institutions, digital strategies, digital culture, and digital organization, and further explore a digital innovation management model for scientific and technological archival information resources. This will enable the transformation of scientific and technological archives innovation management from "single-element innovation" to "comprehensive innovation."

2.1 Information Resources Innovation Management

The concept of "innovation" was first proposed by Austrian political economist Joseph Schumpeter in 1911, who argued that innovation plays a central role in economic and social transformation and defined it as "the recombination of production factors." Subsequently, the concept of innovation was introduced into the field of management, sparking extensive discussions among researchers and forming different research branches. Building on domestic and international research, the Innovation and Development Research Center at Zhejiang University, led by Professor Xu Qingrui, proposed Total Innovation Management (TIM), emphasizing comprehensive innovation covering various innovation elements such as technology, organization, market, strategy, culture, and institutions, as well as the organic coordination among these elements [7].

Under the trend of innovation-driven development, the interaction between information resource management and innovation continues to deepen. An increasing number of scholars in the information resource management field are exploring innovation and transformation in information resource management, focusing primarily on analyzing major information resource innovation management elements. Regarding technological elements, Chao Lemen [8] proposed applying artificial intelligence technology to information resource management in the new environment to achieve AI governance. Liu Yuenan and Wu Yunpeng [9] clarified the benefits of blockchain in solving data trust issues and promoting management automation, identifying seven key issues that need to be addressed when applying blockchain to digital archives. Regarding management elements, Yao Chen et al. [10] suggested strengthening collaborative participation of multiple management subjects in emergency management work to achieve innovative management of emergency information resources. Regarding institutional elements, Li Huaqiang et al. [11] took health code information resources as an example and proposed strengthening information resource sharing in public health emergencies to promote the construction of government digital resource sharing mechanisms. Analysis reveals that while these achievements mostly focus on the importance of a single archival innovation management element such as technology, management, or institutions, and conduct in-depth research on information resource innovation management, they also tend to emphasize research on single innovation management elements, neglecting the connections among various elements. They have not yet formed a coordinated information resource innovation management system, and still pay relatively little attention to information resource innovation management in the context of digital innovation.

2.2 Digital Innovation Management

The "Overall Layout Plan for Digital China Construction" [12] states that "building Digital China is an important engine for promoting Chinese-style modernization in the digital era and a powerful support for building new national competitive advantages." Since the 21st century, a new round of technological revolution centered on digital technology has been reshaping the innovation-

driven economic system, placing traditional innovation development theories in a new digital environment and giving rise to digital innovation management. Digital innovation management refers to the process by which enterprises or organizations adopt digital technology to change existing products, processes, or business models during innovation [13], including the creation and modification of new products, production process improvements, organizational model transformations, and business model changes [14].

Under the wave of digital transformation, some Chinese scholars have begun to pay attention to digital innovation management and conduct preliminary research. Liu Yang et al. [15] categorized digital innovation into digital product innovation, digital process innovation, digital organizational innovation, and digital business model innovation based on a review of domestic and international research status, while emphasizing the importance of formulating digital strategies and building a digital innovation-oriented culture. Yang Zhen, Xu Ruiqian, and Chen Jin [16] constructed a theoretical framework for knowledge ecosystems oriented toward digital innovation by deconstructing the core elements and characteristics of knowledge ecosystems in digital innovation environments. Currently, research on digital innovation management in the archival field is limited. Domestic scholars mostly explore "archival management innovation" and "archival resource development and utilization model innovation" from the perspective of digitalization and informatization transformation, but have not yet conducted in-depth understanding and analysis of the conceptual system of "digital innovation management of scientific and technological archives," nor have they integrated scientific and technological archives innovation management practices with digital innovation management concepts. Combining the meanings and research status of "scientific and technological archives innovation management" and "digital innovation management," this study posits that digital innovation management of scientific and technological archival information resources refers to the process by which scientific and technological archives managers or management departments, based on digital technology innovation, promote innovation in other aspects such as digital institutions, digital strategies, digital culture, digital organization, and digital knowledge in scientific and technological archives management work, change existing business processes and content, and ultimately promote the reconstruction and innovation of the scientific and technological archival information resources innovation management system.

3 Research Design

This study takes typical scientific and technological archival information resources as examples, investigates their innovation management processes, analyzes and summarizes the element composition of scientific and technological archival information resources innovation management, and further explores the innovation management model for scientific and technological archival information resources under the background of Digital China construction. The analysis

results of this typical case can provide certain insights for research on digital innovation management of information resources.

3.1.1 Literature Research Method

The literature research method is primarily applied to define core concepts and explore relevant theories and research progress. By searching keywords such as "innovation," "innovation management," "digital innovation management," "scientific and technological archival information resources," and "information resources innovation management" in domestic and international databases, this study sorted out literature strongly related to the research theme. Based on rational analysis, it grasped the research status of digital innovation management of information resources, identified the entry point for this research, understood the basic elements of digital innovation management of information resources, formed a scientific understanding of these elements, and summarized and refined the basic dimensions of digital innovation management of information resources under digital innovation management theory, laying a foundation for the selection of element analysis themes and model construction in the next step.

3.1.2 Typical Case Study

Typical case study is a qualitative research method that forms a theoretical framework through inductive methods by studying a representative case [17], forming research conclusions supported by empirical research to inspire similar case studies. Given that the power industry is an exemplary industry for scientific and technological archives innovation management, having accumulated considerable experience and methods in scientific and technological archives innovation management during the construction of various major scientific and technological demonstration projects, this study selects the Wudongde Power Station Transmission to Guangdong and Guangxi Ultra-high Voltage Multi-terminal DC Demonstration Project (hereinafter referred to as the "Kunliulong DC Project") as a typical case for research.

The Kunliulong DC Project is the world's first 800 kV ultra-high voltage multi-terminal flexible DC transmission project invested and constructed by China Southern Power Grid EHV Power Transmission Company. It is also the DC transmission project with the largest transmission capacity, greatest technical difficulty, and largest engineering investment in Southern Power Grid, characterized by large spatial span, strict time coordination, and complex hierarchical division of labor. It reflects the diverse types and complex compilation features of scientific and technological archival information resources. Moreover, its entire construction process integrates digital innovation thinking, demonstrating universal and comprehensive innovation elements. It offers enlightening significance for solving problems such as the "emphasizing engineering over archives" phenomenon in some major scientific and technological project units, limited application of emerging technologies in archives resource management, and insufficient innovation management. It can provide rich empirical data for research

implementation. Therefore, taking the Kunliulong DC Project as the research object aligns with the research theme and can effectively provide reference for related research.

3.1.3 Qualitative Interview Method

The interview method is a commonly used qualitative research approach. This study employs both focus group interviews and individual in-depth interviews, conducting interviews with project participants from various construction units of the Kunliulong DC Project around the six elements of digital innovation management of information resources. Focus group interviews were conducted in the form of small symposiums using semi-structured access at the Xingyi branch and Nanning branch of the Kunliulong DC Project department. This study selected 17 project participants of the Kunliulong DC Project as individual in-depth interviewees, all of whom possess relatively rich work experience in scientific and technological archives management. Their daily work involves one or more of the scientific and technological archives management elements, including digital strategy, culture, institutions, organization, technology, and knowledge. The interview outline was designed based on the literature review, divided into three parts: basic questions, specific questions, and summary questions, covering elements related to six innovation dimensions: digital technology innovation, digital institution innovation, digital strategy innovation, digital culture innovation, digital organization innovation, and digital knowledge innovation. After drafting the interview outline, pilot interviews were conducted using the outline, which was then revised and supplemented based on interview effectiveness.

3.1.4 Thematic Analysis Method

Thematic analysis is a fundamental method of qualitative research that answers research questions or objectives by identifying, analyzing, and displaying themes within data [18]. Thematic analysis relies on a theoretical framework to develop themes, which ensures the feasibility and rationality of coding analysis while reducing coding difficulty. This study uses thematic analysis to code and analyze the collected interview data. For theme setting, coding variables were established according to the frameworks of digital innovation management theory and total innovation management theory. This paper constructs a coding framework from six innovation element dimensions: digital technology, digital institution, digital strategy, digital culture, digital organization, and digital knowledge, extracts innovation elements, and uses NVivo12 (plus) for theme identification, review, definition, and naming to determine the constituent elements, themes, and basic structure of the system.

3.2 Data Collection and Processing

As a highly distinctive type of archives, scientific and technological archives management is also facing the impact of the new normal of the digital econ-

omy. Exploring digital innovation management of scientific and technological archival information resources can greatly promote archives management work in scientific and technological construction units, better assist scientific and technological project construction, and strongly support the implementation of the overall layout plan for Digital China construction. To this end, this study's data collection primarily focuses on scientific and technological archives innovation management work.

This study employs both focus group interviews and individual in-depth interviews for data collection. Focus group interviews were conducted in symposium form at the Xingyi and Nanning branches of the Kunliulong DC Project. Individual in-depth interviews selected 17 participants from the Kunliulong DC Project (2 chief infrastructure engineers, 6 full-time archivists, 2 part-time archivists, 2 safety managers, 1 construction worker, 1 quality supervisor, 1 supervisor engineer, 1 project manager, and 1 sales director). By the 15th interview, no new elements or themes emerged. To ensure research completeness and rigor, researchers continued interviewing the remaining 2 participants, with results still showing no new elements or themes, indicating that theoretical saturation had been basically achieved and interview data collection was terminated. Ultimately, the interview recordings totaled 751 minutes, generating 19 formal transcription texts totaling 274,979 characters. For easy identification and statistics, the transcription texts were organized according to the numbering rule of "data type (I-individual interview/G-focus group interview) + interview order + page number + line number" (detailed numbering and basic respondent information see Table 1). For example, "I-01-06-16" represents line 16 on page 6 of the first individual interview transcript.

3.3 Thematic Analysis of Interview Data

To facilitate text coding and in-depth analysis, this study uses NVivo12 (plus) qualitative analysis software, following the "six-stage procedure" of thematic analysis: "familiarizing with data," "generating initial codes," "searching for themes," "reviewing themes," "defining and naming themes," and "writing and analyzing." Based on interview data, this study extracts thematic elements of digital innovation management research for scientific and technological archival information resources, and gradually induces sub-themes, themes, and core themes.

First, by decomposing interview materials and inducting based on preliminary literature reading and personal understanding, initial thematic elements were extracted and the logic and relationships among them were analyzed to form sub-themes. Example processes are shown in Table 1. Ultimately, 41 thematic elements and 14 sub-themes were formed, where A, B, C, D, E, and F refer to the six constructed sub-theme classification identification numbers, and c represents code, i.e., element coding based on original materials.

Next, through reflection on interviews and coding results, combined with the ba-

sic framework of digital innovation management and the six dimensions of total innovation management, this study concludes that digital innovation management activities for scientific and technological archival information resources are most prominently constrained by six themes: digital technology, digital institution, digital strategy, digital culture, digital organization, and digital knowledge. Ultimately, this study constructs six themes for digital innovation of scientific and technological archival information resources, with the coding process shown in Table 2.

Finally, by integrating the six encompassing themes and combining the overall research background, this study highly condenses and deeply excavates the core category that can connect all themes, forming the core theme of "archives digital innovation management," and conducts in-depth analysis of each theme and the relationships among them.

4.1 Digital Technology Innovation

Digital technology refers to technology that uses certain equipment to convert various types of information (including graphics, text, sound, images, etc.) into binary digits "0" and "1" that electronic computers can recognize for operation, processing, storage, transmission, dissemination, and restoration [19], including big data, cloud computing, blockchain, Internet of Things, artificial intelligence, virtual reality technology, etc. [20]. Digital technology innovation refers to the development of new technologies or the application innovation of existing technologies under clear digital technology objectives. Based on interview data coding results, this study divides digital technology innovation for scientific and technological archival information resources into three levels: data resource layer technology innovation, functional application layer technology innovation, and infrastructure layer technology innovation (see Figure 1 [Figure 1: see original paper]).

Data resource layer technology innovation refers to the upgrading and replacement of technology applications at the data resource layer. In scientific and technological archives innovation management practice, data resource layer technology innovation primarily targets scientific and technological archives data resources, including innovations in the structure and format of various databases, as well as improvements and updates to archival big data platforms such as archival data sharing and exchange platforms and archival data open platforms. For example, improving the original stand-alone archives system and using emerging digital technologies such as big data and intelligent technology for personalized customization and development of scientific and technological archives data (I-17-03-26).

Functional application layer technology innovation refers to technical innovation centered around specific archival business functions. The applications of scientific and technological archives management mainly involve collection, management, storage, and utilization of archives, with corresponding technological

innovations in data application forming collection technology innovation, arrangement technology innovation, storage technology innovation, retrieval technology innovation, and publicity technology innovation. In collection technology, scientific and technological archives management uses intelligent technology to reduce the difficulty of archives collection and improve collection efficiency (G-02-02-03). In arrangement technology, it assists in extracting and entering archival template information and photo archives through intelligent entry and template recognition (I-16-04-28). In storage technology, it applies cutting-edge storage technologies such as cloud storage and blockchain to scientific and technological archives data storage to overcome the reality of continuous growth in archives data stock and increment. In retrieval technology, it introduces intelligent retrieval technology to improve the efficiency and level of scientific and technological archives retrieval (I-04-31-03). In publicity technology, it combines emerging multimedia technology and augmented reality technology to optimize the presentation effect of promotional videos for various scientific and technological project archives (G-01-09-10).

Infrastructure layer technology innovation refers to the research, development, and technical combination of new concepts for organizational infrastructure to improve the technical level of organizational infrastructure. The infrastructure layer technology innovation involved in digital innovation management of scientific and technological archives primarily targets the hardware systems of scientific and technological archives management. For example, based on the needs of intelligent warehouse construction and combined with digital technology, it develops and adopts hardware equipment such as intelligent archive compact shelves and intelligent environment regulators that are compatible with intelligent environments (I-14-30-15).

4.2 Digital Institution Innovation

Digital institution innovation refers to promoting institutional change and innovation under digital technology conditions to address real needs, introducing novel and feasible institutions that can solve practical problems and guide the orderly conduct of various management activities. Based on data coding, this study summarizes the elements of digital institution innovation in scientific and technological archival information resources innovation management into three categories: business management institution innovation, personnel management institution innovation, and general management institution innovation (see Figure 2 [Figure 2: see original paper]).

Business management institution innovation refers to the innovative construction of institutions around business development needs, achieving management innovation driven by institutional innovation. For scientific and technological archives management, business management institution innovation still revolves around basic business directions such as collection, management, storage, and utilization of scientific and technological archives, mainly including archives collection institution innovation, archives management institution innovation,

archives preservation institution innovation, and archives utilization institution innovation. For example, in scientific and technological archives collection institutions, it innovatively introduces archiving review forms to change the previous collection method of "collect first, check later," thereby enhancing the targeting of archives collection by implementation units from the source (I-13-47-10). In scientific and technological archives management institutions, it introduces the "first-volume system" as a new means of archives quality control, selecting the most outstanding archival volume as the reference standard for similar volumes throughout the project, making archives quality no longer dependent on repeated rectification (I-01-14-05). In scientific and technological archives preservation institutions, it proposes the "ten-prevention management" system for archives warehouses to guide physical archives preservation work (I-15-10-24). In scientific and technological archives utilization institutions, it proposes an electronic borrowing system to address the cross-regional utilization needs of scientific and technological archives, supporting online application, approval, and authorization of scientific and technological archives (I-07-29-22).

Personnel management institution innovation refers to the innovation of various management activities for staff members to achieve organizational goals. In the process of scientific and technological archives management, personnel management institution innovation mainly targets full-time and part-time personnel engaged in scientific and technological archives management, innovating in personnel management aspects such as training, evaluation, promotion, and motivation. For example, in scientific and technological archives personnel training, based on the requirement of synchronizing archives with engineering, it introduces the "frontline training method," requiring new archivists to go to frontline construction sites to familiarize themselves with basic engineering processes and receive hands-on field teaching (I-10-02-09). In scientific and technological archives personnel evaluation, combined with engineering project characteristics, it newly establishes mutual inspection and rating systems, linking scientific and technological archives mutual inspection results with performance rewards and punishments and final ratings (I-07-26-13). In scientific and technological archives personnel promotion, referring to the provisions of the new Archives Law on archival professional titles, it innovates the professional title evaluation system for scientific and technological archives personnel to solve the problem of difficult promotion (I-07-34-12). In scientific and technological archives personnel motivation, it establishes new incentive systems for innovative behaviors and innovates award settings according to the actual needs of scientific and technological archives personnel (I-12-16-17).

General management institution innovation refers to the formulation of relevant institutions for basic management affairs in management work that are non-business in nature. For scientific and technological archives innovation management, the innovation scope of general management institutions involves general management work beyond archival business, mainly including scientific and technological archives inspection and security institutions. For example, in security institutions, to ensure the confidentiality of scientific and technological

archives, it adds leadership approval procedures and solidifies them into security institutions (I-07-30-10). In inspection institutions, it introduces comprehensive inspection institutions to control archives quality and progress through quarterly mutual inspections (I-04-15-16).

4.3 Digital Strategy Innovation

Digital strategy innovation refers to decision-makers' use of digital resources to create differentiated value based on reality and oriented toward the future under the influence of digital technology, making strategic innovation plans for the organization's overall development direction and goals. For digital innovation management of scientific and technological archival information resources, digital strategy innovation means promoting the overall innovation of various archival management business activities and related governance activities from a strategic level (see Figure 3 [Figure 3: see original paper]), creating new opportunities and sustainable development space for scientific and technological archives in the digital economy era.

Archives digital innovation systematization refers to promoting innovation in archives governance systems, archives career systems, archives theoretical systems, and archives technical systems from a strategic level under digital technology promotion, achieving systematization of innovation management. For example, in scientific and technological archives governance systems, it clarifies and strengthens the basic output, query, and utilization functions of archives, emphasizes the mining of knowledge elements in archives, and achieves effective transformation between archives management and knowledge management (I-17-05-25). In scientific and technological archives career systems, it changes the previous consciousness of "archiving for archiving's sake," emphasizing proactive and open awareness of archival services from a strategic level to better serve scientific and technological construction (I-15-08-22). In scientific and technological archives theoretical systems, it updates the theoretical system of scientific and technological archives innovation management by learning from advanced theoretical progress at home and abroad. In scientific and technological archives technical systems, it regularly solidifies quality common problem prevention in archival business operation technologies into the construction technical briefing system (I-14-10-04).

Archives governance modernization refers to using the modern development of archival business as the innovation starting point, utilizing digital resources to achieve scientific, standardized, procedural, and informatized archives management and modernized archives personnel management. For example, in scientific and technological archives management scientification, it proposes from a strategic level that technology development should be oriented toward business needs of scientific and technological archives, with improving business quality and efficiency as the primary goal (I-14-22-13). In scientific and technological archives management standardization, it introduces a single-track system plan, transforming the daily management objects of archives from physical archives to

electronic documents (G-01-05-22). In scientific and technological archives management informatization, it improves data backup by promoting the digitization strategy of physical archives and relying on the introduction of new technologies (I-11-06-16). In scientific and technological archives personnel management modernization, it proposes an innovative strategy of transforming archivists' role positioning through digital skills training and knowledge sharing against the background of archives digital transformation (I-07-34-10).

4.4 Digital Culture Innovation

Digital culture innovation refers to the process of modifying existing value concepts, behavioral patterns, and ideas to match the development of archives management practices with the environment under the influence of digital technology, endowing them with new cultural connotations. In digital innovation management practice of scientific and technological archival information resources, digital culture innovation is mainly manifested in two aspects (see Figure 4 [Figure 4: see original paper]).

Archives culture innovation refers to a series of innovative activities formed by organizations to effectively manage and utilize scientific and technological archives, including both discarding traditional archives culture and generating new scientific and technological archives culture in the digital environment. Specifically, it can be divided into spiritual culture innovation and behavioral culture innovation. Spiritual culture innovation emphasizes using new archival values, management thinking, and service concepts to guide management practices, insisting on integrating these spiritual orientations into all aspects of management practice, thereby changing the general management forms solidified by traditional concepts. For example, relying on digital technology support, it innovatively proposes process control thinking, strengthening process control of scientific and technological archives through intermediate inspections and pre-acceptance (I-14-18-05). Behavioral culture innovation refers to innovating cultural expressions at the behavioral level such as behavioral norms and behavioral patterns. The unique behavioral patterns and norms of scientific and technological archives are key content of behavioral culture innovation. For example, the behavioral patterns of scientific and technological archives managers are influenced by the sense of responsibility in "master-apprentice relationships" and "project team cooperative relationships," reflecting innovative archival management behavioral patterns (I-07-07-28).

Archives cultural innovation refers to innovation in cultural objects with physical material forms, including archives management-related cultural facilities and archives public service products. In terms of archives cultural facilities, it incorporates innovative ideas into cultural facilities such as scientific and technological archives cultural exhibitions and cultural corridors (I-14-23-02). In terms of archives cultural products, it promotes the development of scientific and technological archives cultural and creative products by cooperating with research institutions, government departments, and cultural technology enter-

prises, drawing on mature experience, and deeply mining the cultural connotations contained in archives, providing more cultural products for the digital era, giving play to the economic and historical value of archives, promoting historical inheritance and archival memory preservation, and enhancing the public service level of archives departments.

4.5 Digital Organization Innovation

Digital organization innovation refers to the fact that digital technology changes the internal functional system and external relationships of organizations [21], requiring innovative design and adjustment of organizational systems according to changes in the external environment and internal organizational conditions. Data coding result analysis reveals that organization innovation involved in digital innovation management of scientific and technological archival information resources mainly includes organizational function transformation and organizational relationship change (see Figure 5 [Figure 5: see original paper]).

Organizational function transformation refers to innovative activities carried out within a specific organization, primarily targeting the organization's own system structure, with innovation focus often concentrated on the function allocation, structure setting, and operation mode innovation of scientific and technological archives departments. For example, in scientific and technological archives department function allocation, it replaces "linear leadership structure" with "functional leadership structure," presenting complex cross-relationships between task executors and issuers within the department (I-04-46-09). In scientific and technological archives department organizational structure, it adjusts the "large centralized model" commonly used in scientific and technological archives management projects, which features centralized management and unified division of labor, and adopts a new structure of "branch sub-groups," delegating headquarters guidance authority to various branches, which then guide construction units according to planned schedules (I-13-36-10). In scientific and technological archives department operation mode, considering the current situation of few and scattered scientific and technological archives personnel within the department, it introduces a "gathering-style" communication operation mode for internal organizational exchange and sharing of problems and challenges, experience and methods for problem-solving, and future work planning and arrangements in scientific and technological archives management (I-07-24-28).

Organizational relationship change refers to innovation carried out in the process of coordinating with other external organizational entities. Due to the numerous participating units and wide-ranging departments involved in scientific and technological projects, scientific and technological archives management subjects are pluralistic, requiring close collaboration among various units and departments in management practice. The external organizational relationships involved in scientific and technological archives management mainly include cross-departmental and cross-unit organizational relationships. In cross-

departmental organizational relationship innovation, it mobilizes the enthusiasm of other departments for collaboration by adjusting the calculation method of organizational performance scores, linking contribution degree with performance bonus ratio (I-13-19-04). In cross-unit organizational relationship innovation, it updates cross-unit cooperation forms, with participating units dispatching relevant functional personnel to form cross-functional project teams to represent their units in inter-organizational exchange and sharing (I-04-45-26).

4.6 Digital Knowledge Innovation

Digital knowledge innovation refers to the proposal of new conceptual categories, theoretical doctrines, and methodological skills based on theoretical learning or practical experience accumulation under the influence of digital technology. For digital innovation management of scientific and technological archival information resources, digital knowledge innovation takes the explicit and implicit knowledge involved in the entire management activity as the innovation foundation, forms innovation points through knowledge element extraction and transformation, and is mainly manifested as theoretical innovation and practical innovation (see Figure 6 [Figure 6: see original paper]).

Theoretical knowledge refers to regular knowledge discovered and summarized in theoretical learning and practice. Theoretical innovation refers to the re-recognition, re-discovery, and re-application of theoretical knowledge driven by digital technology. Theoretical innovation in scientific and technological archives management mainly concentrates on scientific and technological archives business theory innovation, technical theory innovation, and management theory innovation. In scientific and technological archives business theory, it innovatively proposes whole-process control theory by combining the entire lifecycle of scientific and technological archives management (G-02-04-08). In scientific and technological archives technical theory, it develops the technical concept of "intelligent visa" by combining the unique visa business of scientific and technological archives with intelligent technology (I-17-05-20). In scientific and technological archives management theory, it introduces lean management, using the management concept of "continuous improvement and perfection" to lead and guide archives work, forming scientific methods and procedures for archives work through means such as perfecting institutions and optimizing processes with optimal effects and lowest costs (I-13-03-17).

Practical knowledge has high implicitness, referring to the technical knowledge obtained from practical experience and used to guide practice. Practical innovation refers to innovation with practical knowledge as the object. Innovation of practical knowledge in scientific and technological archives management mainly includes business operation skills, technology application skills, and work management skills required for archives management. In scientific and technological archives business operation skills, archivists are no longer limited to traditional links such as scientific and technological archives arrangement and archiving, but cultivate new skills in practice to sort out and summarize common problems

and form quality common problems (I-14-10-04). In scientific and technological archives technology application skills, archivists timely update their technology application skills, mastering cutting-edge digital technology application skills combined with informatization needs (I-14-05-07). In scientific and technological archives work management skills, archivists excavate new work skills based on the time characteristics of scientific and technological archives completion and handover, comprehensively considering archives handover time and rectification status to design archives work progress control tables (I-14-06-28).

5 Model Exploration: Analysis of Element Relationships in Digital Innovation Management of Information Resources

Element relationship analysis refers to deeply mining the interdependent and collaborative relationships among various innovation dimensions based on the overall characteristics of the element system. The themes in the digital innovation management framework for scientific and technological archival information resources have significant internal correlations, indicating that multiple themes and sub-themes are interrelated and can be integrated to form a unified entity with specific functions, jointly promoting system function realization. Analyzing system constituent elements from the perspective of correlation facilitates effective conceptual integration based on element connections, forming specific functional unities, and thereby maximizing innovation effectiveness. Therefore, this study first horizontally integrates the digital innovation management element system for scientific and technological archives from the perspective of conceptual consistency, forming three levels: "business operation layer," "organization management layer," and "ideological culture layer" (see Figure 7 [Figure 7: see original paper]). From a micro perspective, digital innovation management of information resources integrates technology innovation and knowledge innovation dimensions, incorporating knowledge into technology innovation to strengthen the interaction between technology and knowledge, forming a "business operation functional unity" that solidifies the practical foundation of various innovation elements. From a meso perspective, digital innovation management of information resources integrates institution innovation and organization innovation dimensions to form an "organization management functional unity," solidifying the management foundation of various innovation elements and providing more coordinated and feasible management basis. From a macro perspective, digital innovation management of information resources integrates strategy innovation and culture innovation dimensions, using strategy innovation as direction and culture innovation as guidance to form an "ideological culture functional unity," where strategy and culture are closely integrated to jointly establish the ideological foundation of innovation activities.

Integration emphasizes the consistency of goals at each level. Element relationship analysis should also focus on interactions among various elements to grasp core themes, take into account other elements, and achieve positive interaction and collaborative matching among elements. Therefore, based on the analysis

of horizontal integration relationships among elements, this study further excavates the interdependent and collaborative relationships among digital technology, institution, strategy, culture, organization, and knowledge innovation, and inductively forms a digital innovation management system for information resources featuring "digital strategy innovation guiding innovation direction; digital organization innovation and digital institution innovation as innovation guarantees; digital knowledge innovation and digital culture innovation stimulating innovation vitality; digital technology innovation providing basic support" (see Figure 8 [Figure 8: see original paper]). The various themes interact and complement each other, with one change affecting the whole system. "Digital strategy innovation guiding innovation direction" means that strategy innovation directly influences the overall direction of institutional innovation, technology innovation, knowledge innovation, and other element dimensions, providing basic innovation direction for them. "Digital organization innovation and digital institution as innovation guarantees" means that organization innovation and institution innovation can optimize innovation conditions from the system and structure, have the functions of solidifying management structure and standardizing behavioral norms, and can provide innovation guarantees. "Digital knowledge innovation and digital culture innovation stimulating innovation vitality" means that culture innovation can create a favorable innovation environment, and knowledge innovation can transform experiential products in innovation element dimensions, opening up important innovation sources and stimulating the vitality of institution, organization, technology, and knowledge innovation. "Digital technology innovation providing basic support" means that technology innovation can lay the foundation for innovation in other dimensions and drive innovation in other dimensions. In the process of digital innovation management of information resources, digital strategy innovation has strong relationships with all other innovation elements, and the continuous advancement of all innovation activities requires directional guidance from strategy innovation. Formulating and implementing digital innovation strategies suitable for enterprise development is the primary step in digital innovation management. The relationships reflected by technology innovation are primarily weak relationships, i.e., influencing other innovation elements from the peripheral environment, running through the entire innovation management process.

6 Conclusion and Outlook

Based on the element dimensions of total innovation management theory and introducing digital innovation management concepts, this study uses qualitative analysis to sort through and excavate over 270,000 characters of interview data from 17 power industry practitioners. Through thematic analysis, it inductively identifies 41 initial system thematic elements and 14 sub-themes, reconstructing six themes of digital innovation management for scientific and technological archival information resources: digital technology innovation, digital institution innovation, digital strategy innovation, digital culture innovation, digital organization innovation, and digital knowledge innovation. Based on the constituent

element construction results, it explores the relationships among various themes and forms a digital innovation management model for information resources. By constructing a well-developed, reasonably structured, and scientifically rigorous digital innovation management model for scientific and technological archival information resources, this study keeps pace with the rapid development of the digital economy, thereby promoting the realization of "digital innovation management of information resources" and supporting the construction of Digital China and an innovative country.

This study divides digital innovation management of scientific and technological archival information resources into six themes using qualitative research methods and extracts sub-themes and thematic elements for each theme. However, it has not yet used quantitative research methods to estimate the specific indicator weights of the above innovation elements. Future research could consider using quantitative research methods to clarify the indicator weights of each element dimension, construct an evaluation index system for digital innovation management of scientific and technological archival information resources, and form an indicator system evaluation table that can be directly referenced by practice units, providing reference for standardized evaluation of digital innovation management activities.

Author Contributions

CHEN Hui: Research framework design, topic selection and research guidance, data collection, and paper revision;
LIU Sainan: Paper writing and revision;
CHEN Wenjing: Paper writing and revision.

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Note: Figure translations are in progress. See original paper for figures.