

Innovation of Digital Management and Service Models for Library Resources

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Abstract: Digital technology has profoundly reshaped the form of library resources and service paradigms. The digital management of resources and the innovation of service models have become the core issues for the transformation and development of libraries. This study systematically explores these issues from three dimensions: theoretical logic, practical scenarios, and innovative paths. Based on the explanation of the evolution of the concept of digital resource management and the logic of service model transformation, it analyzes the typical practices and key issues of digital management and services in domestic libraries. It then constructs an innovative path framework from five dimensions: platform reconstruction, data empowerment, scene extension, collaborative creation, and capability reshaping. The study holds that libraries need to integrate their resource systems with a platform-based mindset, drive precise services with user profiling, build immersive ecosystems with full-time and space perception, gather collaborative forces through multi-party cooperation, and support sustainable development with compound talents. Ultimately, libraries should achieve a fundamental transformation from "knowledge repositories" to "knowledge ecosystems".

Keywords: Digitalization of resources; Service innovation; Data-driven; Smart library

1. Introduction

The rapid development of digital technology is profoundly reshaping the resource forms and service paradigms of libraries. From the perspective of the evolution of resource forms, the digitization of paper resources, the management of native digital resources, and data-driven knowledge services constitute three progressive levels of library resource management, corresponding respectively to the different management requirements of carrier transformation, resource integration, and knowledge mining [1]. Currently, the academic community has conducted multi-dimensional research on the digital management and service innovation of library resources. Some scholars, based on the perspective of new quality productivity, have proposed that the digital and intelligent construction of university libraries requires the three-dimensional synergy of the reconstruction of laborer capabilities, the technological iteration of labor means, and the expansion of the forms of labor objects to achieve the cultivation of new quality librarians and the construction of new quality libraries. However, existing research mostly focuses on the application of a single dimension of technology or the description of a model, and there is still a lack of systematic integration of platform reconstruction, data empowerment, scene extension, collaborative creation, and capability reshaping, which is insufficient to respond to the overall needs of library digital

transformation [2].

Based on this, this study, titled "Innovative Models of Digital Management and Services for Library Resources", follows the logical sequence of "theoretical logic - practical scenarios - innovative paths" to conduct a systematic study. The article starts with the concept evolution of digital resource management, explains the transformation logic of library service models in the digital age, and reveals the intrinsic connection between digital management and service innovation; it then systematically reviews typical domestic practices of library digital management and innovative cases of digital resource service models, diagnosing the key problems currently faced; and further designs innovative paths from five dimensions: platform reconstruction, data empowerment, scene extension, collaborative creation, and capability reshaping, aiming to provide theoretical basis and practical guidance for the digital transformation of libraries.

2. Theoretical Logic of Digital Management and Service Transformation of Library Resources

2.1 Conceptual Evolution and Theoretical Connotation of Digital Resource Management

From the perspective of information resource management theory, the conceptual evolution of digital resource management has undergone a profound leap from "technical operation" to "strategic management". In the early stage, digital resource management focused on technical aspects such as format conversion and storage management, with the core task being to solve the operational problem of "paper to digital". The management perspective was confined within the digital processing workshop. With the expansion of digital resource scale and the diversification of types, the management focus shifted to metadata standards, long-term preservation, and quality control, forming a resource ordering system centered on standardization. The management scope extended from "building up" to "managing". Based on the information lifecycle management theory, digital resource management can be decomposed into seven progressive links: creation, collection, organization, storage, retrieval, distribution, and preservation. Each link is interconnected and progressive, forming a complete management loop [3]. From the perspective of resource form evolution, the digitization of paper resources, the management of native digital resources, and data-driven knowledge services constitute the three levels of digital resource management, respectively corresponding to the different management requirements of carrier conversion, resource integration, and knowledge mining. The digitization of paper resources addresses the issue of regenerative protection of historical documents; the management of native digital resources responds to the new resource form of "born digital"; and data-driven knowledge services point to the in-depth development and intelligent utilization of resource content. The clarification of theoretical connotations indicates that digital resource management has risen from an auxiliary technical task to a core strategic capability of libraries, and its quality directly determines the survival foundation and development space of libraries in the digital age [4].

2.2 Transformation Logic of Library Service Models in the Digital Age

From the dual perspectives of user demand and technological evolution, the transformation of library service models in the digital age has a profound internal logic. On the user side, digital natives have become the core user group of libraries, and their information acquisition habits exhibit distinct characteristics such as immediacy, fragmentation, and visualization. On the technological side, mobile internet has enabled services to break through physical and temporal limitations, allowing users to enjoy round-the-clock services without having to visit the library; artificial intelligence empowers

personalized recommendations and intelligent question answering, making large-scale precise services possible; big data analysis supports user behavior insight and demand prediction, transforming passive response into proactive service; virtual reality technology creates immersive knowledge experience spaces, expanding the boundaries of knowledge presentation and dissemination [5].

The dual forces of demand traction and technological drive have pushed library service models through three paradigm shifts. The first is from "book-centered" to "user-centered", with the service focus shifting from document management to user demand satisfaction, marking a fundamental shift in the value coordinates of libraries. The second is from "passive response" to "active push", achieving personalized knowledge services through user profiling, turning "thousands of faces, thousands of services" from an ideal into reality. The third is from "resource provision" to "knowledge creation", with libraries evolving from knowledge repositories to knowledge production and collaboration platforms, where users are no longer merely resource consumers but also participants in knowledge co-creation. The deep logic of service transformation lies in the fact that the value of libraries no longer depends on the scale of their collections but on the precision of knowledge services and the ability to solve user problems. This logical shift requires libraries to re-examine their positioning and lead digital transformation through service innovation.

2.3 Logical Correlation between Digital Management and Service Innovation

Constructing a theoretical framework of bidirectional interaction between digital management and service innovation to reveal the deep logic of their co-evolution is key to understanding the digital transformation of libraries. Digital management is the foundation for service innovation - high-quality metadata is the prerequisite for precise retrieval. If metadata description is rough and chaotic, even the most powerful retrieval technology will be ineffective; A sound long-term preservation mechanism is the guarantee for the continuous service of resources. If digital resources cannot be read due to outdated formats, the service will be like cooking without rice. The ability to process data is the technical support for knowledge mining services. Without standardized data, the application of artificial intelligence will be like water without a source. It can be said that without scientific management, service innovation will be like a castle in the air.

Service innovation is the realization of the value of digital management. Changes in service scenarios force the optimization of management processes. New forms such as mobile services and embedded services put forward new requirements for the organization of resources. User experience evaluation drives the improvement of management quality. User satisfaction is the fundamental criterion for testing management effectiveness [6]. Management divorced from service, no matter how standardized the digitalization is, is merely "refined inventory" and difficult to generate actual value. From the perspective of systems theory, this study proposes an integrated framework of "management-service-user" as a trinity: at the management level, standardized and systematic construction of digital resource management norms is the core; at the service level, the design of service product systems is guided by intelligence and personalization; at the user level, feedback mechanisms are established with the goals of demand insight and experience optimization. The positive interaction among the three forms a collaborative ecosystem of "management supporting service, service feeding back to management, and management and service jointly serving users", enabling the digital transformation of libraries to shift from technology-driven to value-driven and from linear evolution to spiral ascent.

3. Practical Scenarios of Digital Management and Services of Library Resources

3.1 Typical Practices and Experience Sharing of Digital Management in Domestic Libraries

A systematic investigation of the typical practices of domestic libraries in digital management reveals that each institution has formed its own development path based on its own positioning, providing rich experience for the industry. The library of Southern University of Science and Technology has adopted a dual-driven approach of "paper-electronic coordination and data empowerment" to systematically promote the high-quality development of its collection. Facing the dual challenges of tight budgets and low usage efficiency, the library has established an overall collection construction positioning of "electronic as the main and paper as the auxiliary", and has effectively enhanced the collection guarantee capacity and usage efficiency through measures such as clarifying the paper-electronic ratio, optimizing the procurement model, and formulating the principle of duplicate copies. At the technical support level, the library has built a full-process quality management system for electronic resources based on the Alma platform, completed systematic data governance of paper resources, established a data dashboard covering 19 disciplines, and compiled a 110,000-word "Subject Librarian Book Selection Strategy Guide", providing a scientific basis for book selection. This practice fully demonstrates the transformation trend of digital management from experience-driven to data-driven, and its results are directly reflected in reader satisfaction [7].

In the construction of smart service platforms, the library of Tianjin University of Technology and Education has recently completed the construction of a new generation of domestic smart library service platform (LSP), completely replacing the original foreign brand system. This platform covers core modules such as basic services and unified management of paper and electronic resources, and is fully integrated with the school's unified identity authentication system, enabling "one account, one password" for all library services, and greatly simplifying the operation process for teachers and students. As a member of the Tianjin Higher Education Literature Information Center Alliance, the university actively responded to the alliance's call for the replacement and deployment of domestic systems, and was among the first to complete the system switch and data migration, laying a technical foundation for subsequent resource co-construction and sharing. The practices of libraries in Jiangsu Province are also worth noting. The library of Jiangsu Ocean University closely combines the construction of literature resources with the development of the school's ESI disciplines, and through exploring an innovative path of "precise resource allocation, data-driven decision-making, and open sharing empowerment", has significantly improved the school's ESI global ranking in the top 1%. These practices collectively indicate that digital management is moving from single-institution construction to alliance collaboration, from technology introduction to self-control, and from resource management to discipline empowerment.

3.2 Innovative Cases of Digital Resource Service Models in Libraries

In terms of service model innovation, a number of exemplary cases have emerged in domestic libraries, demonstrating the transformation trend of digital resource services from "counter service" to "immersive experience" and from "general service" to "precise embedding". Recently, the Hubei Provincial Library completed a pilot project of the "Smart Shelf Visual Inventory System" in the art book borrowing area on the third floor. This system uses an intelligent inventory robot equipped with AI visual analysis technology to achieve automated, high-precision inventory and near real-time management of the collection, effectively solving the borrowing pain point of readers who "find the

book but can't find its location". After readers query books through the WeChat mini-program or in-library search devices, the system can generate a "3D location map" and provide "one-click navigation" services, with an identification accuracy rate of 99%. This innovation not only enhances the convenience of borrowing but also provides scientific support for the optimal allocation of collection resources through the visualization analysis of book circulation data, promoting the transformation of library management from "experience-driven" to "data-driven".

In the field of university libraries, the "paper-electronic integration" service jointly created by Harbin Institute of Technology and Tongfang Digital Science is of benchmark significance. This service is based on the deep integration of the China National Knowledge Infrastructure (CNKI) total database platform and the local OPAC system of Harbin Institute of Technology's library, achieving unified retrieval of paper and electronic resources. Teachers and students can access local collections by logging into CNKI without the need to log in to the OPAC system again. After three months of operation, the number of bibliographic searches in the library has increased nearly fourfold compared to the same period last year, and the borrowing frequency and utilization rate of physical collection resources have significantly improved. The "Public Library Reader Service Work" seminar held by the Shanghai Library systematically showcased the cutting-edge explorations in the industry. Huang Chen, the executive director of the Future Library at Zhejiang University, pointed out profoundly that the role of libraries is shifting from the guardian of "knowledge repositories" to the builder of "knowledge ecosystems", and their core capabilities are gradually transitioning from resource possession to knowledge activation.

3.3 Diagnosis of Key Issues in Current Management and Services

A systematic review of the current practice of digital resource management and services in libraries reveals multiple intertwined challenges that impede the in-depth advancement of digital transformation. From a management perspective, the lack of unified standards and norms remains a core obstacle to digital resource sharing. Although the national level has initiated the construction of relevant standards, the phenomenon of each institution having its own metadata standards and diverse format norms is still widespread, leading to prominent "digital island" problems. Research shows that current university libraries face issues such as insufficient integration depth and poor standard compatibility in the construction of digital and intelligent resources. The lack of a sound long-term preservation mechanism constitutes another major risk. The risks of outdated formats, aging carriers, and technological iterations of digital resources have not been effectively addressed, leaving a large number of digital resources in a "built but endangered" situation.

From a service perspective, the problem of insufficient service depth is particularly prominent. Studies have pointed out that current library digital services still have many issues in terms of efficiency, user experience, and data management. Existing digital resource services mostly remain at the "resource provision" level, with weak capabilities in knowledge mining and data analysis; personalized services are still in their infancy, with a gap between the ideal of "thousands of faces for thousands of people" and the reality of "one size fits all". User experience needs improvement, with technical issues such as poor cross-platform search, poor mobile device compatibility, and slow response times affecting user satisfaction. From the perspective of technology application, the introduction of new technologies often remains at the "ornamental" level and has not been truly integrated into core business processes. Research from the perspective of new quality productivity indicates that the digital and intelligent construction of university libraries requires the

three-dimensional coordination of laborer capability reconstruction, technological iteration of labor materials, and expansion of labor object forms to achieve the cultivation of new quality librarians and the integration and mutual embedding of new quality libraries and cutting-edge technologies. From the perspective of talent, there is a relative shortage of compound talents with both library science professional qualities and digital technology application capabilities, which restricts the in-depth advancement of management and service innovation. These problems are interwoven and mutually causal, constituting key obstacles to the digital transformation of libraries, which urgently need to be addressed through systematic strategy design.

4. Digital Management and Service Innovation Paths for Library Resources

4.1 Building an Integrated Smart Management Platform of "Resources - Data - Knowledge"

Reconstructing the digital resource management framework of libraries with a platform-based mindset and creating a three-layer integrated smart management platform of "resource layer - data layer - knowledge layer" is the fundamental project of digital transformation. The resource layer focuses on the unified collection and standardized storage of multi-source heterogeneous digital resources, establishing a unified resource pool covering digitized collection resources, native digital resources, purchased databases, and web-crawled resources. Drawing on the standard construction experience of the National Library of China, the data format and metadata standards are unified in the resource collection process to lay the foundation for subsequent integration and utilization. The practice of Southern University of Science and Technology Library in building a full-process quality management system for electronic resources based on the Alma platform shows that a unified resource platform can effectively improve management efficiency and service quality. The data layer processes the scattered and heterogeneous raw resources through data cleaning, deduplication, association, and annotation technologies, converting them into structured and standardized data assets. By introducing knowledge graph technology, semantic associations between resources are established, transforming isolated documents into interconnected knowledge networks. The knowledge layer conducts in-depth mining and intelligent analysis based on data, extracting knowledge insights from massive resources through text mining, topic modeling, and trend prediction technologies. In terms of technical architecture, the "microservices + middle platform" model is adopted to enhance the flexibility and scalability of the platform, modularizing functions such as resource collection, metadata management, full-text search, and user authentication, and establishing a data middle platform to integrate the library's data resources. In terms of deployment mode, it supports local deployment, cloud deployment, and hybrid deployment. Large libraries can adopt local deployment to ensure data security, while small and medium-sized libraries can leverage cloud services to reduce construction costs.

4.2 Building a Precise Service System Driven by User Portraits

Taking user data as the core resource, a precise service system driven by user portraits is constructed to achieve a fundamental transformation from "standardized services" to "personalized services". At the data collection level, multi-source data such as user basic information, behavior data, and social data are integrated to build a comprehensive user data pool. Under the strict compliance with privacy protection policies, user data is collected through legal and compliant means to ensure the transparency of data collection and the user's right to know. The data dashboard covering 19 disciplines established by the Southern University of Science and Technology Library provides a

practical example for data collection and analysis. At the data analysis level, machine learning algorithms are used to deeply mine user data, identifying user interests, research fields, and information needs, and building dynamic user portraits. The portrait model should cover multiple dimensions such as basic attributes, interest tags, demand features, and behavior patterns, and support dynamic adjustments over time. At the service application level, multi-level precise services are realized based on user portraits. In the resource recommendation aspect, a combination of collaborative filtering and content recommendation is adopted to push personalized reading lists to users; in the retrieval optimization aspect, the retrieval results are reordered based on user historical behaviors, prioritizing the most relevant content to the user's interests; in the knowledge consultation aspect, differentiated answers are provided based on user identities - basic guidance for undergraduates, research support for postgraduates, and discipline frontiers for teachers; in the literacy education aspect, personalized training resources are pushed based on user ability deficiencies. After the launch of the "paper-electronic integration" service jointly developed by Harbin Institute of Technology and Tongfang Digital Science, the volume of bibliographic searches increased nearly fourfold, fully demonstrating that data-driven precise services can significantly improve resource utilization and user satisfaction. Through data empowerment, a closed-loop iteration of "demand insight - service matching - experience optimization" is achieved, transforming library services from "one size fits all" to "tailored to individual needs".

4.3 Building an Immersive Service Ecosystem with Full-Space and Time Perception

Break through the boundaries between physical and virtual spaces to build an immersive service ecosystem featuring all-time and multi-scenario integration. At the level of intelligent transformation of physical spaces, draw on the experience of the digital reading experience zone of Yancheng City Library, and use Internet of Things (IoT), AR/VR, and digital twin technologies to upgrade the physical space of libraries. Deploy intelligent sensing devices to collect real-time data on space usage and dynamically adjust environmental parameters such as lighting, temperature, and humidity; create immersive reading spaces where readers can "enter" ancient book scenarios through virtual reality technology; and build interactive experience zones that support multi-modal interactions such as touch and voice between readers and digital resources. The successful pilot of the "Smart Shelf Visual Inventory System" at Hubei Provincial Library has achieved automated inventory and near real-time management of the library's collection. Readers can generate "3D location maps" and receive "one-click navigation" services through the system, with an accuracy rate of 99%. This technology can be further extended to immersive navigation experiences. At the level of extending virtual space services, build a ubiquitous service system accessible at any time, any place, and on any device. Mobile adaptation is the foundation of virtual space services. On this basis, further explore multi-terminal service forms such as WeChat mini-programs, social media robots, and smart speaker skills to integrate library services into users' daily life scenarios. At the level of scene integration and innovation, embed library digital resources into diverse scenarios such as teaching, research, learning, and life.

4.4 Build an Open Service Ecosystem with Multi-Party Participation

Break through the limitations of resources and services of a single institution and build an open service ecosystem where government, libraries, enterprises, and users collaborate and co-create. At the inter-library collaboration level, draw on the experience of the Tianjin Higher Education

Document Information Center Alliance to promote the establishment of regional and industry-based digital resource co-construction and sharing alliances. Unify metadata standards, establish joint catalogs, conduct collaborative procurement to avoid duplicate construction; establish a joint digital resource preservation system to share the costs and risks of long-term preservation; and carry out inter-library loan and document delivery to achieve complementary and shared resources. Tianjin Vocational and Technical Normal University Library, as a member of the alliance, was among the first to complete the switch to domestic systems and data migration, laying a technical foundation for subsequent resource sharing. At the library-enterprise cooperation level, explore cooperation models with commercial institutions such as Superstar Group, China National Knowledge Infrastructure (CNKI), and Baidu Scholar. The deep cooperation between Harbin Institute of Technology and Tongfang Digital Science has proven that the combination of professional institutions' technical strength and libraries' business knowledge can produce significant synergy. At the user participation level, draw on the Web 2.0 concept to encourage users to transform from "consumers" to "co-creators". Encourage users to participate in resource construction, knowledge organization, content creation, and other diverse ways to enhance their sense of belonging and identity through participation. At the government-society collaboration level, strive for government policy and financial support, and collaborate with social organizations to promote culture, forming a development pattern where multiple forces participate together.

4.5 Build a Composite Talent Team with Data Literacy and Subject Service Capabilities

With talent team building as the core, build a composite talent team with both data literacy and subject service capabilities to provide talent support for management and service innovation. In terms of ability structure, future librarians need to possess three core ability clusters: data management capabilities, including technical skills such as metadata compilation, data cleaning, data analysis, and data visualization; subject service capabilities, including professional qualities such as understanding of subject knowledge, support for the research process, and judgment of academic trends; and technology application capabilities, including practical skills such as the use of AI tools, platform operation and maintenance, and user training and guidance. In terms of the training mechanism, establish a stratified and classified librarian development system. New librarians should focus on basic skills training to quickly master digital resource management norms and service processes; Core librarians focus on enhancing professional capabilities and are encouraged to participate in industry conferences, academic research, and project practices; senior librarians focus on expanding strategic vision and are cultivated to become leaders in subject services. In terms of the recruitment mechanism, the traditional limitation of library science is broken, and talents with backgrounds in computer science, data analysis, and subject specialties are actively recruited to optimize the team structure. In terms of the evaluation mechanism, a performance assessment system reflecting the requirements of compound capabilities is established, with data management capabilities, subject service effectiveness, and user satisfaction included in the evaluation indicators. Research from the perspective of new quality productivity shows that the digital and intelligent construction of university libraries needs to achieve the cultivation of new quality librarians and the integration and mutual embedding of new quality libraries and cutting-edge technologies through the three-dimensional coordination of the reconstruction of laborer capabilities, the technological iteration of labor materials, and the expansion of the forms of labor objects. Through systematic talent cultivation and team building, a compound talent team that "understands technology, excels in business, and is good at service" is created to

provide solid talent support for the digital transformation of libraries.

5. Conclusion

This study systematically constructed a path framework for the innovation of library resource digital management and service models. The research reveals that the core of library digital transformation lies in achieving three fundamental shifts: the management paradigm shifts from resource-oriented to data-driven, the service paradigm shifts from passive response to intelligent accompaniment, and the organizational paradigm shifts from single-library operation to ecological collaboration. Platform reconstruction is the foundational project, data empowerment is the core engine, scenario extension is the value space, collaborative creation is the driving mechanism, and capability reshaping is the fundamental guarantee. The five-dimensional paths support and advance each other in a coordinated manner. Future research can further explore the in-depth application of large-scale artificial intelligence models in knowledge services, as well as the technological iteration and ethical norms for the long-term preservation of digital resources.

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