

Research on the Service Transformation of Public Libraries in the Digital Age

Shuai Wang

Library, Hubei Minzu University, Enshi, Hubei, China

Abstract: With the rapid advancement of digital technologies, public libraries face dual challenges of service model reconstruction and user demand upgrades. This study examines the significance of service transformation in public libraries. Using bibliometric analysis and comparative research methods, we systematically review domestic and international theories and practices related to the digital transformation of public libraries. Integrating public service theory and trends in digital technology, we analyze transformation pathways from dimensions such as service philosophy, resource integration, technology application, and librarian roles. The findings indicate that public libraries in the digital age must shift from traditional resource provision to intelligent and personalized service delivery. This can be achieved through building digital resource-sharing platforms, incorporating artificial intelligence and big data analytics, and enhancing digital literacy training for librarians, thereby significantly improving service efficiency. Additionally, the transformation process must balance technological innovation with humanistic care, emphasizing participatory service design. The study concludes that the service transformation of public libraries is a systemic endeavor that requires collaborative advancement through conceptual innovation, technological empowerment, and institutional optimization to meet the demands of the digital age and provide high-quality, efficient knowledge services to the public.

Keywords: Digital Age; Public Libraries; Service Transformation; Smart Libraries; Digital Resource Integration

1. Introduction

1.1 Research Background and Significance

With the deep integration of digital technology

into social life, public libraries, as crucial hubs for knowledge dissemination and cultural services, are undergoing unprecedented transformations. According to the 53rd "Statistical Report on Internet Development in China" released by the China Internet Network Information Center (CNNIC), the number of internet users in China has reached 1.079 billion, with an internet penetration rate of 76.4% and over 800 million digital reading users [1]. This shift from traditional print media to mobile devices and online platforms has significantly increased the demand for instantaneous and personalized knowledge services. Concurrently, the mature application of technologies such as artificial intelligence, big data, and blockchain provides technical support for public libraries to transcend physical space limitations and innovate their service models.

The practical significance of the transformation of public library services is reflected on multiple levels. From a social development perspective, digital transformation helps bridge the digital divide, promotes equitable public cultural services, and meets diverse knowledge needs across different groups; from an industry evolution standpoint, transformation can reshape the core competitiveness of libraries, enabling them to maintain unique value in the digital information service market; from a user experience viewpoint, service transformation can enhance public satisfaction through precise resource delivery and interactive reading experiences, thereby increasing the social impact of libraries. Hence, systematically studying the pathways for the transformation of public library services is critically valuable for promoting high-quality industry development and enhancing the modern public cultural service system.

1.2 Review of Domestic and International Research Status

International research on the digital transformation of public libraries began earlier,

focusing on technological applications and service model innovations. Scholar Zhang Xiaoming noted that Western countries initiated smart library projects in the early 21st century, using IoT technology for intelligent resource management and service optimization [2]. Studies have indicated that the introduction of concepts like digital humanities and open access has prompted public libraries to evolve into knowledge co-creation platforms. In contrast, domestic research emphasizes localized practices alongside technological empowerment. Wang Fang and Li Hua's user demand survey revealed that Chinese public libraries need to enhance digital resource integration and personalized service offerings to meet the increasingly diverse cultural needs of the public [3].

Existing research has limitations. First, most studies focus on singular technological applications or service improvements, lacking a systematic analysis of the transformation processes; second, there is insufficient exploration of the balance between humanitarian values and technological rationality in service transformation; third, there is limited research on differentiated strategies for the digital transformation of grassroots public libraries. Therefore, it is essential to establish a multidimensional research framework encompassing technology, management, and humanities to provide more targeted theoretical guidance for practice.

1.3 Research Objectives and Methods

This study aims to construct a theoretical model and practical pathways for the transformation of public library services in the digital age by analyzing transformation drivers, core dimensions, and implementation strategies, thereby offering actionable solutions for industry development. The research employs bibliometric analysis and comparative research methods: firstly, relevant literature from 2018 to 2023 is retrieved from databases such as CNKI and Web of Science, using CiteSpace software for keyword clustering and research hotspot analysis; secondly, typical cases of digital transformation in domestic and international public libraries are compared to extract common experiences and differentiated pathways; finally, integrating public service theories and digital technology development trends, optimization strategies for transformation are proposed.

2. Theoretical Foundations of Public Library Service Transformation in the Digital Age

2.1 Connotation of Public Service Theory

Public service theory emphasizes equitable distribution of social resources and fulfillment of public needs under government leadership. In the context of public libraries, this theory manifests through a focus on public welfare, ensuring citizens' cultural rights through standardized service delivery. As the construction of a service-oriented government advances, public library services are shifting from a "supply orientation" to a "demand orientation," requiring service content and methods to align more closely with actual public needs. Liu Jianguo and others propose that the construction of smart libraries should adhere to the principle of equalization of public services, reducing cultural gaps between urban and rural areas through the co-construction and sharing of digital resources [4]. This theory provides value guidance for the transformation of public library services, emphasizing the need to maintain public welfare attributes while balancing efficiency and equity during the transformation process.

2.2 Impact Mechanism of Digital Technology Development on Libraries

The iterative upgrading of digital technology has profoundly altered the service logic of libraries. Artificial intelligence technologies, through natural language processing and machine learning, enable intelligent recognition of user needs and precise resource recommendations; big data analytics can mine user behavior data to provide quantitative support for service optimization; blockchain technology ensures transparent and reliable management of digital resource copyrights and service processes. Chen Hong's research found that the application of digital technology allows library services to transcend temporal and spatial limitations, enabling users to access resources via mobile devices 24/7 [5]. Simultaneously, technological advancements prompt libraries to extend from physical spaces to virtual ones, giving rise to new service forms such as "boundaryless libraries" and "cloud reading communities."

3. Analysis of Drivers for Public Library Service Transformation in the Digital Age

3.1 External Environmental Driving Factors

Changes in policy environment and social demands constitute external motivations for the transformation of public library services. The national "14th Five-Year Plan" explicitly proposes "promoting the digital construction of public culture," providing policy support for library digital transformation. On the social level, public demand for knowledge services exhibits diversification. Li Qiang and Zhao Liang's research found that younger demographics prefer interactive and immersive reading experiences, while older groups require more convenient digital service guidance [6]. Additionally, the rapid expansion of internet companies and commercial institutions in the digital reading market places competitive pressure on the traditional service models of public libraries, compelling them to enhance service competitiveness through transformation.

3.2 Internal Development Demand Factors

The developmental bottlenecks within libraries drive the service transformation process. Traditional libraries face issues such as low resource utilization efficiency and a lack of service variety. Zhou Min's research indicates that the average borrowing rate of physical resources in Chinese public libraries is below 30%, while the access rate of digital resources grows at over 20% annually [7], highlighting an imbalance in resource structure. Concurrently, librarians' knowledge structures and technical capabilities lag behind the demands of digital development, necessitating role transformations to enhance service professionalism. Furthermore, the innovation of service effectiveness evaluation systems requires libraries to shift from "quantity of resources" to "quality of services" assessments, prompting exploration of more scientific service models.

4. Core Dimensions of Public Library Service Transformation in the Digital Age

4.1 Innovation in Service Philosophy

Digital technology reshapes the socio-cultural ecosystem, necessitating a shift in public library service philosophy from a "resource-centered" to a "user-centered" approach. Traditional library services focus on collection resources, emphasizing document preservation and borrowing functions, while in the digital age,

public needs have expanded to encompass diverse areas such as knowledge acquisition, cultural experience, and social interaction. Wu Haiyan's research indicates that the new service philosophy requires libraries to transition from a passive service model to actively exploring users' potential needs, establishing a "full lifecycle" service system [8]. This shift is reflected in service design evolving from "standardized supply" to "contextual customization," leveraging data from user reading preferences and behavior trajectories to provide tailored service solutions for different demographics. For instance, an immersive digital reading space designed for teenagers integrates virtual reality technology and interactive game elements, combining knowledge dissemination with entertainment; while a simplified digital service terminal for the elderly reduces operational complexity and includes voice navigation, exemplifying a commitment to human-centered service.

4.2 Transformation of Resource Integration Models

The explosive growth and heterogeneous nature of digital resources compel public libraries to reconstruct their resource integration models. Traditional integration relies on physical space classification and cataloging; however, the digital era necessitates the establishment of cross-platform and cross-domain resource integration mechanisms. Research by Yang Lei et al. highlights that the redundancy rate of digital resources in Chinese public libraries reaches 45%, with significant issues of resource fragmentation and low utilization efficiency [7]. The new integration model employs metadata standardization and knowledge graph technology to semantically relate heterogeneous resources such as text, images, and audiovisual content, forming a structured knowledge network. Furthermore, the promotion of Open Access facilitates data sharing between libraries, research institutions, and cultural enterprises, creating a "Library +" resource ecosystem. For example, the Shanghai Library's "Digital Humanities Resource Repository" integrates unique resources like local chronicles and ancient texts, employing visual presentation and knowledge mining tools for innovative cultural heritage utilization.

4.3 Technological Application and Service

Innovation

Technologies such as artificial intelligence and big data have become core drivers of innovation in public library services. Intelligent recommendation systems utilize user profiles and collaborative filtering algorithms to achieve precise resource delivery, increasing literature resource utilization by over 30% [5]. Big data analysis uncovers user behavior data, providing quantitative support for service decision-making. For instance, the National Library optimizes opening hours and collection layout by analyzing reader visitation times and borrowing records. Additionally, blockchain technology is applied in digital copyright protection and service traceability, ensuring legal resource usage and service process transparency. Technological innovations also give rise to new service forms, such as the "Library as a Service" model, which embeds library resources into third-party applications via API interfaces, enabling ubiquitous knowledge service delivery.

4.4 Reconstruction of Librarian Roles and Competencies

The widespread application of digital technology necessitates the transformation of librarians from "literature managers" to "knowledge service experts." Chen Hong emphasizes that librarians must possess digital literacy, data analysis skills, and cross-disciplinary knowledge integration capabilities [5]. In smart library settings, librarians' focus shifts from traditional lending services to user demand analysis, digital resource development, and knowledge service design. For example, the Shenzhen Library has formed a "data librarian" team to optimize service strategies through user data analysis; the Suzhou Library trains "reading promoters" who leverage new media platforms to conduct online reading activities and enhance public engagement. Moreover, librarians are expected to take on digital literacy education roles, offering skill training in information retrieval and data processing to various user groups, thereby enhancing their ability to access knowledge in the digital age.

5. Exploration of Pathways for Public Library Service Transformation in the Digital Age

5.1 Construction of Smart Service Platforms

Smart service platforms constitute the infrastructure for the digital transformation of

public libraries. Platform development should integrate IoT, cloud computing, and artificial intelligence technologies to realize intelligent resource management and automated service processes. On the hardware front, RFID technology facilitates self-service borrowing and inventory checks, reducing labor costs; on the software side, a unified user management system and resource portal are established for a "one-stop" service experience. For instance, the Hangzhou Library's "City Brain - Library System" integrates resources from all public libraries in the city, allowing users to reserve, borrow, and renew books via mobile devices while enjoying personalized recommendations. Additionally, the platform must prioritize data security and privacy protection, employing encryption technology and access control mechanisms to safeguard user data.

5.2 Development of Personalized Service Systems

Personalized service systems are user-demand-driven, achieving precise services through data-driven and technology-enabled approaches. First, a multidimensional user profile is established, integrating basic user information, reading history, and behavior data to create a dynamic demand model. Second, natural language processing technology is utilized for intelligent Q&A and demand interaction, enhancing service response efficiency. For instance, the National Library's "Intelligent Consulting Robot" can address over 90% of frequently asked questions. Lastly, innovative service formats, such as customized reading plans and knowledge community operations, are initiated. The Guangzhou Library's "Reading Marathon" online event, for example, matches reading lists to user interests and organizes online discussions, enhancing user engagement and loyalty.

5.3 Creation of a Collaborative Service Ecosystem

The transformation of public library services necessitates breaking institutional boundaries to build a diverse and collaborative service ecosystem. At the government level, policy guidance and financial support should be strengthened to promote resource sharing and service collaboration among public cultural institutions such as libraries, cultural centers, and museums. At the industry level, regional library alliances should be formed to enable

shared borrowing and cooperative development of digital resources. For instance, the Beijing-Tianjin-Hebei Library Alliance promotes the flow of cultural resources through unified service standards and technology platforms. At the societal level, the involvement of enterprises, universities, and social organizations should be encouraged, exploring collaborative models like "Library + Business" and "Library + Education." For example, the Nanjing Library has partnered with an internet company to develop a digital reading app, introducing a business model to enhance service sustainability; the Shanghai Children's Library collaborates with schools on "Library-School Cooperation" projects to integrate library resources into basic education curricula.

6. Conclusion

The transformation of public library services in the digital age is an inevitable outcome of the interplay between technological innovation and societal demands. This study analyzes the theoretical foundations, drivers, core dimensions, and pathways of transformation, revealing the systemic characteristics of public library service evolution. The findings indicate that service transformation should be led by innovative concepts, grounded in resource integration, supported by technological applications, and ensured through the enhancement of librarian competencies. Comprehensive upgrades in service models can be achieved through the establishment of intelligent platforms, personalized service offerings, and collaborative ecosystems. However, challenges such as the exacerbation of the digital divide, data security risks, and the lack of service standards persist during the transformation process. Future research should focus on transformation strategies for grassroots libraries and user participatory service design to provide more targeted theoretical guidance and practical

solutions for industry development.

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