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Opportunities and Challenges of Subject Services in the Era of Smart Libraries

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Abstract: The advent of digital and intelligent technologies has fueled the development of smart libraries, redefining their roles and functions while bringing subject services to a critical stage of transformation. This paper identifies the opportunities inherent in the smart library era, including the innovation of service models, the provision of precise and targeted services, enhanced inter-institutional collaboration, the redefinition of library spaces, and the professional transformation of librarians. At the same time, it highlights the challenges posed by this transition, such as the complexities of managing and mining massive datasets, the adoption and integration of emerging technologies, the growing diversity and personalization of reader demands, the increasing prominence of interdisciplinary and cross-disciplinary fields, and the shortcomings in service evaluation mechanisms. To address these challenges, several strategic approaches are proposed: reinforcing technological infrastructure, fostering the seamless integration of technology with library services, establishing personalized service frameworks, building collaborative service systems, and refining service evaluation models. These strategies aim to drive the transformation and enhancement of subject services in smart libraries.

Keywords: Smart Libraries; Subject Services; Digital and Intelligent Technologies; Service Innovation; Development Strategies

1. Introduction

As information technology matures, particularly with the rise of big data, cloud computing, the Internet of Things, blockchain, 5G, and artificial intelligence, smart libraries have gained new significance in our era [1-3]. Modern libraries, integrating intelligence, networking, functionality, and human-centered design, have redefined their roles. They have transformed from mere repositories of physical books into comprehensive service hubs, actively contributing to knowledge dissemination, academic exchange, and cultural innovation [4,5].

Subject services, as a core component of library offerings, are at a pivotal point of transformation in the era of smart libraries, shifting from mere resource provision to diverse information services. From the early prototypes of digital libraries to today's sophisticated smart ecosystems [6], subject services have undergone numerous iterations. They continuously align with the trajectory of library innovation, adopting more intelligent, open, and user-friendly approaches to resonate with the needs of education and research. This ongoing evolution seeks new positions and value anchors within the academic knowledge ecosystem [7-9].

2. Definition and Connotation of Subject Services

As one of the core service divisions within libraries [10], the subject services department is dedicated to designing customized support solutions for educational and research communities. Anchored in the knowledge framework of academic disciplines, its primary functions include the provision of information resources, in-depth knowledge mining, and technical application assistance. These services span the entire academic lifecycle, aiming to enhance the efficiency of knowledge acquisition and innovation, while facilitating the transformation and dissemination of academic achievements. The scope of subject services encompasses the construction and management of diverse types of literature and resources, such as e-books, journals, reports, and electronic databases; supporting teaching and research endeavors; conducting

information literacy training; and fostering academic communication and collaboration. In essence, subject services strive to meet the diverse needs of readers, promoting the creation, dissemination, and application of knowledge, thereby safeguarding education and research initiatives. Consequently, in the era of smart libraries, subject services face unprecedented opportunities and challenges.

3. Opportunities for Subject Services in the Era of Smart Libraries

3.1 Opportunities for Innovative Service Models

The development of smart libraries offers vast potential for transforming and upgrading subject service models. Leveraging technologies such as artificial intelligence and big data, these services can transcend traditional limitations, moving towards intelligent, diverse, precise, efficient, and proactive frameworks. This evolution creates new possibilities to meet the increasingly complex and changing needs of readers. For example, by deeply analyzing user behavior data, personalized knowledge recommendations become feasible. Readers can receive precisely tailored literature resources and academic information based on their interests. Intelligent customer service systems enable 7*24 online subject consultations, swiftly addressing readers' inquiries. The application of digital and intelligent technologies propels library subject services to new heights and realms.

3.2 Possibility of Precision and Targeted Services

Smart libraries operate by integrating vast, diverse datasets, and advanced data processing techniques provide robust support for precision in subject services. By comprehensively analyzing reader data such as borrowing records, search histories, and online resource usage, along with academic data like discipline trends, emerging fields, and high-impact literature, as well as research data including project information and outcomes, libraries can accurately identify readers' academic needs, research directions, and challenges. This enables them to develop targeted strategies for subject services, such as delivering highly relevant literature information, conducting precise academic intelligence analysis, and recommending academic exchange activities that meet readers' needs. Consequently, this enhances the specificity and effectiveness of subject services, maximally fulfilling readers' personalized requirements and significantly advancing the efficiency and precision of library services, offering robust support for academic research.

3.3 Expansion of Cross-Institutional Collaboration and Resource Sharing

Smart libraries facilitate more extensive and diversified cooperation with other institutions. Internally, libraries can strengthen ties with departments like technology and academic affairs, merging the specialization of subject services with the efficiency of research management and the focus of teaching support to create a collaborative development ecosystem. Externally, libraries can establish broad collaborations with research institutions, enterprises, research institutes, and public libraries to achieve resource sharing and complementary strengths, fostering mutually beneficial outcomes. This broadens the resource channels for subject services, providing richer and more comprehensive offerings, enhancing the library’s influence in academic and societal contexts, and steering the library profession towards higher levels of innovation.

3.4 Redefinition of Subject Service Spaces

The spatial design of smart libraries has transcended the limitations of traditional physical layouts, creating opportunities for the redefinition of subject service spaces. Beyond the conventional reading and lending areas, smart libraries can develop a range of specialized service spaces, such as subject-specific seminar rooms and data visualization labs. These spaces are equipped with advanced information technology and offer a comfortable and inviting atmosphere, providing a platform for readers to engage in research, academic exchange, and collaborative activities.

3.5 Transformation of Librarian Roles and Skills Enhancement

In the smart library era, the roles, positioning, and skills of librarians have undergone significant transformation, outlining new

career development opportunities. Librarians are evolving into multifaceted professionals, embodying roles as subject knowledge navigators, information literacy educators, and research collaborators. This transformation drives librarians to continuously enhance their disciplinary expertise, information technology proficiency, data mining and analysis capabilities, research project management skills, and information literacy. Through ongoing knowledge and skill development, librarians solidify their professional foundations, accumulate career momentum, and broaden their career paths, laying a solid groundwork for becoming experts in subject services and innovation leaders. This elevates the status and impact of librarians in the advancement of the library profession.

4. Challenges for Subject Services in the Era of Smart Libraries

4.1 Challenges of Managing and Mining Massive Data

In the age of smart libraries, data is proliferating rapidly. The vast array of academic resources, reader behavior data, and research data presents significant challenges in storage and management. Traditional data management systems struggle to accommodate diverse and large-scale data, facing issues like storage capacity limitations and complex data structures that are difficult to integrate. Additionally, extracting valuable information from extensive datasets to support decision-making in subject services is fraught with challenges. The effectiveness of data mining algorithms, the accuracy and completeness of data, and the interpretability of mining results all require thorough exploration and optimization to avoid misleading biases from data noise and errors.

4.2 Pressure from Emerging Technologies

Emerging technologies such as artificial intelligence, big data analytics, the Internet of Things, and blockchain are increasingly being implemented in the development of smart libraries. Effectively integrating these technologies into subject services presents a significant challenge. For instance, while AI can be used for intelligent recommendations and smart queries, creating precise and efficient subject service models requires a deep understanding of the subject knowledge framework and the specific needs of readers, necessitating high technical proficiency and robust subject knowledge from librarians. Blockchain offers unique advantages in ensuring data security and trustworthiness, yet its application in subject services and seamless integration with existing library systems are still in the exploratory phase.

4.3 Challenges of Diverse and Personalized Reader Needs

As networks and emerging technologies evolve, readers' information literacy improves, leading to increasingly diverse and personalized demands for subject services. Readers expect more than simple document retrieval and delivery; they seek comprehensive support ranging from research topic selection and project applications to research processes and outcome dissemination. Different disciplines and research levels — undergraduates, postgraduates, teachers, research teams — exhibit distinct needs, requiring subject services to accurately identify and meet such personalized demands.

4.4 Complex Issues in Interdisciplinary and Cross-Disciplinary Services

The trend towards integration in academic development makes interdisciplinary research a mainstream direction. In smart libraries, there is an urgent need to efficiently integrate and provide precise guidance on interdisciplinary knowledge resources to support such research robustly. However, interdisciplinary studies involve multiple domains, research methodologies, and terminologies, complicating tasks like resource classification, search strategy formulation, and knowledge integration. Librarians, with their often single-disciplinary backgrounds, find it challenging to comprehensively serve interdisciplinary projects. Thus, forming specialized interdisciplinary service teams and enhancing their overall competence and collaboration skills is essential to address this complex situation.

4.5 Deficiencies in Service Evaluation Systems

Smart libraries have transformed the content and forms of subject services, rendering

traditional evaluation metrics inadequate for capturing service quality and effectiveness. For services involving emerging technologies, such as intelligent, personalized, or participative services, there is no comprehensive and systematic set of evaluation criteria. Current evaluations focus mainly on quantitative metrics, like the number of document deliveries or training attendees, lacking attention to qualitative aspects such as service depth, innovation, and actual contributions to research. Additionally, the methods for collecting and analyzing evaluation data are limited, falling short of acquiring genuine reader feedback and actual service impact data. This poses significant obstacles to service enhancement and hinders steady improvement and sustainable development.

5. Strategies for Developing Subject Services in the Era of Smart Libraries

5.1 Comprehensive Enhancement of Data Management and Mining Capabilities

A comprehensive and rigorous data management framework is essential, encompassing detailed and practical guidelines for data collection processes, storage methods, integration techniques, cleaning standards, and security measures. The adoption of advanced data storage technologies, such as distributed storage architectures and cloud storage models, effectively alleviates the burden of massive data storage. Increased investment in the research of data mining applications, along with a focus on nurturing and attracting skilled professionals, is vital. Forming specialized data mining teams aligned with real-world needs or establishing strategic partnerships with established data companies would support the development of data mining algorithms and models tailored to subject service demands. Through data mining, insights into the usage patterns of subject resources and the unique characteristics of reader needs can be gained, providing a robust data foundation for informed decision-making in subject services, such as optimizing resource acquisition strategies and refining service process details.

5.2 Deep Integration of Emerging Technologies with Subject Services

Planning for the long-term application of emerging technologies in libraries should prioritize gradual, focused integration of cutting-edge technologies like artificial intelligence, big data, the Internet of Things, and blockchain into the subject service system. Enhancing technical training for librarians and expanding avenues for continued education are crucial to significantly improve their ability to manage and apply emerging technologies effectively. Practical exploration should be conducted in areas such as the construction of knowledge graphs and the development of intelligent recommendation systems using AI; similarly, innovative applications of blockchain technology in data sharing and security assurance should be actively pursued. Simultaneously, great attention must be given to feedback on user experiences and effectiveness evaluations in the technology application process. Adjustments and optimizations should be made based on actual user feedback to ensure that emerging technologies genuinely enhance the quality and efficiency of subject services.

5.3 Reader-Centered Personalized Service Ecosystems

In-depth research into reader needs can be conducted using surveys, interviews, and detailed analyses of reader behavior to accurately understand the specific demands and dynamic trends of various reader groups in subject services. Developing reader demand models and profiles helps in constructing personalized need characteristics based on personal information, academic background, research experience, and behavioral data. This approach allows for the creation of personalized service strategies and plans, such as customized resource recommendation lists, tailored subject information service packages, and unique academic exchange activities. Strengthening feedback mechanisms facilitates the timely collection of reader evaluations and suggestions, leading to the continuous optimization and enhancement of the personalized service ecosystem to increase reader satisfaction.

5.4 Cultivation of Interdisciplinary Service Teams and Collaborative Mechanisms

Reflecting the practical needs for interdisciplinary services, libraries might consider optimizing internal resources by selecting librarians from diverse academic

backgrounds to form a high-caliber team. Fostering cross-disciplinary knowledge and collaboration skills through regular academic discussions and project collaborations enhances the team's overall service competence. Establishing a collaborative service mechanism could involve forming close partnerships with campus technology departments and research teams, while also expanding cooperation with external interdisciplinary research institutions. This approach facilitates information sharing, resource pooling, and coordinated services, contributing to a shared development ecosystem that enhances the library's influence and service quality in the interdisciplinary domain.

5.5 Optimization and Refinement of the Subject Service Evaluation System

A scientifically sound evaluation metric system for subject services might include not only traditional quantity metrics but also qualitative indicators that assess precision, innovation, contributions to research, and improved reader satisfaction. Diversified evaluation methods could combine quantitative analysis with qualitative assessment, using statistical data to quantify services and case studies or expert reviews to evaluate quality and effectiveness. A dynamic data collection and analysis mechanism, supported by the smart library's information technology platform, enables real-time gathering and efficient processing of feedback and service data. Evaluative insights guide timely adjustments to subject service strategies, ensuring continuous improvement and adaptation to the evolving demands of the smart library era.

6. Conclusions

The evolution of smart libraries presents unprecedented opportunities and challenges for subject services. Innovatively enabled by digital and intelligent technologies, these services can achieve precision, facilitate cross-institutional cooperation, and redefine service spaces, while also transforming librarian roles and enhancing professional capabilities. However, significant challenges remain, such as the complexities of managing vast data volumes, pressures from new technology applications, the diverse and personalized demands of readers, interdisciplinary service difficulties, and deficiencies in evaluation systems. By enhancing data management and mining capabilities, integrating emerging technologies with subject services, building personalized service ecosystems, fostering interdisciplinary teams, and refining evaluation systems, subject services can overcome these bottlenecks. Continuous optimization in the smart library era will enable superior, efficient, and precise services for educational and research communities, propelling the library sector to new heights. This will further support the dissemination, innovation, and application of knowledge, reinforcing libraries' pivotal role in academic ecosystems. Ultimately, subject services must align with contemporary trends, seize opportunities, confront challenges, and pursue innovation to sustain momentum and invigorate educational and research efforts.

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