Analysis of Open Data Service Practices in International Public Libraries and Implications for China: Postprint

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Abstract

[Purpose/Significance] How to leverage open data resources to develop novel public services, integrate public libraries into urban development, strengthen the nexus between libraries and society, and amplify libraries' societal impact are critical issues warranting in-depth consideration in the evolution of public libraries. [Method/Process] Through analyzing international practices of open data services in public libraries, this study identifies the following service characteristics: provision of richer data resources, utilization of open data to enhance service efficacy, development of innovative data service products, multi-stakeholder collaboration, construction of an ecosystem for open data utilization, and advancement of public data literacy. [Result/Conclusion] Public libraries in China should enhance open data resource construction, foster innovative service consciousness, deliver services aligned with public needs, strengthen cooperation with other institutions, and intensify data literacy education, thereby elevating the standard of open data services.

Full Text

An Analysis of Open Data Service Practices in Foreign Public Libraries and Their Implications for China

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Abstract

[**Purpose/Significance**] How to utilize open data resources to develop new public services, integrate public libraries into urban development, strengthen

the connection between libraries and society, and expand the influence of libraries on society are important issues that should be deeply considered in the development of public libraries. [**Method/Process**] Through analyzing open data service practices in foreign public libraries, we found their services have the following characteristics: providing more abundant data resources, using open data to improve service efficiency, developing new data service products, multi-party collaboration, building an open data utilization ecosystem, and promoting public data literacy. [**Result/Conclusion**] China' s public libraries should strengthen open data resource construction, establish innovative service awareness, provide services that meet public needs, strengthen cooperation with other institutions, and enhance data literacy education, thereby improving open data service levels.

Keywords: open data; public service; service innovation; makerspace; data literacy education
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Introduction

Data is the prerequisite for knowledge acquisition and service delivery, and its value and importance have attracted global attention. *The Economist* magazine featured "The world' s most valuable resource: Data and the new rules of competition" on its cover, pointing out that abundant data has changed the nature of competition [1]. Open data refers to data that can be freely used, reused, and redistributed by anyone [2], including open government data, research data, commercial data, library collection data, and user-generated data. The increasing demand for open data from stakeholders has promoted the continuous development of the open data movement. With the opening of large amounts of data, the quantity and types of open data continue to grow, and an open data environment is gradually taking shape.

The 83rd IFLA World Library and Information Congress had the theme "Libraries: Unity, Society," which indicated that better integration into social development is one of the future trends for libraries [4]. In an open data environment, libraries can collaborate with government departments, public institutions, nonprofit organizations, enterprises, and individuals to carry out data-driven innovative public services, promoting the integration of public libraries into smart city construction, strengthening the connection between libraries and society, and expanding the influence of libraries on society. Based on extensive case studies, this research analyzes the practices of foreign public libraries in developing open data services and proposes how Chinese public libraries should develop open data services according to China' s actual development conditions.

2 Literature Review

Extensive research on open data has been conducted both domestically and internationally. However, there are relatively few papers on how libraries can use open data to improve their services. Foreign research mainly focuses on open data processing, digital humanities, linked data technology, and data literacy. P. McDermott [5] points out that in the E-Government Act, the most critical part is how to acquire, utilize, and preserve government information, suggesting that libraries play an important role in the organization, description, and storage of government data. J. Shueh [6] believes that as digital platforms and data custodians, libraries should have the ability to reconstruct data, using their professional advantages to process open government data to make it more understandable and usable for users. The sharing and reuse of digital cultural heritage provides new opportunities for arts and humanities disciplines to access and analyze relevant resources. E. Ishita introduced how Japanese university libraries promote digital humanities open data through collection digitization [7]. Linked data is also a key focus of foreign open data research, including introductions to linked open data and related projects and their impact on libraries and information science [8], and how to use linked data technology to convert library catalog data into open data to help users access data more conveniently [9]. Data literacy is an essential competency for information professionals and citizens to adapt to the open environment. L.F.R. Simón et al. [10] analyzed the new roles of information professionals in metadata, interoperability, access licensing, information retrieval, and data query applications. J.C. Prado and M.A. Marzal [11] point out that open data initiatives and eScience development place higher demands on data literacy, but currently libraries have no specific standards, and they propose a set of core competencies and content to promote data literacy improvement. K. Okamoto [12] notes that libraries should remind users about privacy issues related to government open data; the "Data Privacy Project" has trained hundreds of library professionals to ensure they can protect user privacy when providing open data services. In addition, related research includes long-term preservation and reuse of open data, data visualization, etc.

Domestic research mainly focuses on four aspects: Research on the role and function of libraries in the open data environment. Du Yanjie and Gu Liping [13] analyzed the role of foreign libraries in open government data policy formulation. Liu Chunli and Xu Yuequan [14] analyzed the new roles of special libraries in the open science and open data environment. Gu Liping [15] analyzed the role of libraries in data governance regarding acquisition, sharing, reuse, and value-added services. Research on information resource construction. Sun Tan [16], based on analyzing the formation of the open information environment and new challenges and requirements for libraries, proposed the reconstruction of academic library resource environments, including restructuring business layouts, redefining business interaction models, and repositioning the roles of resource construction personnel. Yu Hong and Liu Juan [17] mainly analyzed the impact of open data on library information resource sharing and

issues that need attention. Research on services using open data. Zhang Zhengrong and Liu Yali [18] believe that in the big data era, libraries should provide open data services such as collection catalogs, data curation, open access, knowledge discovery, and semantic analysis to users. Xiao Min and Li Guipin [19] analyzed services that libraries can provide around open data in the big data environment, including data integration, storage and delivery, data analysis, data discovery and linking, and data literacy education. Research on open data platforms. Ma Xiaoting and Shang Qingsheng [20] studied library open data service platforms and service models in the big data era. Zhu Ling et al. [21] used the Peking University Open Research Data Platform as an example to introduce platform construction content and application effects. Zhai Xiaojuan and Nie Na [22] designed a library open platform that meets individual user needs based on the integration of OpenAPI, App, Mashup, and SOA.

3 Open Data Service Practices in Foreign Public Libraries

3.1 Providing Richer Data Resources

After years of digital library construction, libraries already possess large quantities and diverse types of data resources. Promoting library digital resources as open data resources according to open data principles is conducive to forming a new situation of openness and sharing. Many national libraries have formulated relevant open data plans and carried out data opening actions. For example, the National Library of New Zealand has formulated the "Open Data Plan" [23]; the Toronto Public Library has released open data policies and terms of use [24]; the National Library of Scotland has published its "Open Data Plan" on its official website [25]; the CERN Library released its bibliographic record data in "open data" form [26]; Library and Archives Canada (LAC) joined the Canadian government' s open data initiative in 2011 and provides all Canadians with access to GC datasets and public domain metadata [27]. In addition, the Deutsche Digitale Bibliothek (DDB) has provided digital collection resources to the public via API since November 2013, with its metadata using Creative Commons licenses, allowing any user to access and use them [28].

As single-building facilities, public libraries and other cultural institutions have an effective service radius of about 30 square kilometers, and actual service efficiency decreases with distance, making it difficult for remote areas to obtain basically equal services as central areas [29]. Opening library collection data can break the constraints of time and space on public access to data resources and data services. According to users' specific needs, libraries can use rich data resources to provide characteristic services. For example, the Dallas Office of Economic Development and the Dallas Public Library (DPL) carried out the Business Resource and Information Network (BRAIN) project. The Dallas Public Library uses various research resources, business reports, population data and other public data from libraries and governments to provide database resources for enterprises and grant and cooperation information resource navigation for government and non-profit organizations. Citizens can access a series

of information on finance, loans, policies, including how to obtain professional business resources and statistical data, how to master the latest information on funding opportunities and business planning, how to apply for policy support from relevant institutions, and how to protect intellectual property rights.

3.2 Improving Service Efficiency

By using open data, libraries can effectively improve their service efficiency and quality. Libraries collect and analyze their internal data and integrate it with public data, which can improve work efficiency and provide evidence-based support for program development. Sharing library data, such as branch technology usage, anonymous circulation statistics, and catalog metadata, can improve organizational transparency and help citizens understand the value of libraries [31].

The Denver Public Library comprehensively uses library data, local data, and national statistical data to help libraries understand neighborhoods and provide personalized, precise, and intelligent services to the public. The Palo Alto City Library in the United States opens some of its statistical data to the public through the city' s open data platform (such as library fund usage overview, list of materials that have passed inspection, and annual library visitor volume). Its head, J. Reichental, expressed hope that this approach would increase participation from social users, thereby stimulating and guiding the public to participate more actively in library service innovation in the future and jointly contribute to library development [32]. The Queensland State Library in Australia [33] uses property location open data provided by the Department of Natural Resources and Mines to help users automatically fill in registration forms, which not only saves time for new member registration but also minimizes input errors. The data collected using open datasets is also released as open datasets to facilitate further development and utilization of open data.

3.3 Developing New Data Service Products

Open data refers to public data that anyone can access, use, and share. Whether it is population data from the government, public transportation data, or infrastructure location data, all are closely related to citizens' lives. If effectively utilized, they can help citizens better understand the city and enjoy smart, convenient public services. Libraries can use open data combined with library service content to provide citizens with various public service products. The Boston Public Library uses data provided by the Planning Bureau for various analyses, such as the contribution of immigration to the economy and employment promotion, and holds exhibitions to attract citizens' attention [34]. The Queensland Library digitized nearly 30,000 photos of soldiers taken before World War I and released them as an open dataset on the government website. At the same time, in cooperation with the National Archives of Australia, through the National Archives API, the library' s collection of soldier portraits can be matched with personal files in the National Archives [35]. The Chattanooga Public Library has

built an open data portal, citizen hacker labs, and creative spaces for community projects, and expanded online tutorials to help users master data development and utilization skills. The open data portal (Chattanooga Open Data) [36] aggregates city and community data, allowing citizens to obtain community data to solve practical problems and better interact with the community. Through the open data platform, citizens have developed analysis applications, such as visual geographic analysis of crime reports and bicycle parking location maps [37].

3.4 Multi-party Collaboration

As stakeholders in open data, governments, enterprises, relevant social organizations, and citizens need to jointly participate in the development and utilization of open data. Libraries must collaborate with them, fully integrating and utilizing data resources from different fields such as transportation, geography, climate, and the Internet of Things to solve public service issues of concern to the public. The Canadian Library and Archives, together with the University of Ottawa and other academic, public, and private sectors, held a conference on "Smart Cities: Imagining the Future National Capital Region" to discuss how to carry out smart city construction [38]. The Chattanooga Public Library' s open data portal was jointly implemented by the local government, the national non-profit organization Code for America, and local volunteers. In addition, the library helped organize the Open Chattanooga Citizens Brigade, a civic data team composed of creative thinkers, community advocates, data researchers, designers, developers, and entrepreneurs, which uses open government data to train citizens to create visualization applications and propose solutions to community information needs [39].

There are many forms of cooperation between libraries and stakeholders in jointly utilizing open data. In addition to themed conferences, building portals, and organizing civic data teams, open data competitions are also important forms. The UK' s Open Data Challenge, the US Challenge, and other famous open data competitions have seen numerous citizens and makers use open data to achieve many innovative projects in transportation, environment, safety, and other fields, generating a series of beneficial data products. Libraries are important partners in data opening competitions, providing essential resources and environmental support for citizen innovation. For example, the Brooklyn Public Library and Queens Library in New York are community partners of NYC BigApps.

3.5 Building an Open Data Utilization Ecosystem

According to the Pew Research Center' s "Libraries 2016" report, more than half of Americans believe that libraries can bring community members together to address local challenges, learn about new technologies, and learn how to identify trustworthy information [40]. Libraries have resources such as computers, databases, and spaces, and librarians possess professional abilities in data

retrieval and analysis, which can provide necessary help for entrepreneurs. Libraries can use their advantages in data, technology, space, and other resources to build a sustainable open data ecosystem that facilitates public participation, integrating resources, tools, and spaces to provide citizens with opportunities to learn innovative technologies, help citizens practice their ideas, and support citizens in achieving innovation and entrepreneurship.

"Hackathons" are an important form for users to utilize the library ecosystem for data development and utilization. They refer to library users spending a day or a week intensively using programming technology to complete a project together, which has become popular in many libraries in recent years. By holding related activities, libraries guide users to learn programming, develop data, solve problems, and achieve innovation. Hackathon activities can gather collective wisdom to solve urban development problems. For example, the Toronto Public Library hackathon addressed poverty issues in Toronto, inviting the director of the Toronto Open Data Institute, researchers from the Civic Hall Lab, and project leaders from the Toronto Council to jointly participate in the hackathon [41]. The Edmonton Public Library [42] held an International Open Data Day hackathon, inviting hackers, developers, designers, statisticians, and anyone interested in open data to spend a day creating open data.

3.6 Enhancing Public Data Literacy

Government data opening will release large amounts of data dividends. While citizens gain access to more needed data, they need higher data processing capabilities and need to continuously learn the use of new technologies and tools, including visualization, data analysis, and data mining. Libraries need to carry out relevant data literacy education according to the development of the times and public needs, such as database usage training and visualization tool usage courses. It should be noted that programming ability is a new hotspot in data literacy education. Programming ability is gradually becoming important in the open data environment, as much reuse and development of open data is achieved through programming. The American Public Library Association and the American Library Association, in cooperation with Google, launched the "Libraries Ready to Code" program [43]. Many libraries in the United States have carried out many coding-related activities. For example, the Denver Public Library provides a week-long web development summer camp; the Skokie (IL) Public Library holds an "Appathon" event where high school students spend an entire day designing applications; the Bowie Elementary School library in Texas, together with the school' s STEM teacher, hosted an "Angry Birds" coding course. The "Libraries Ready to Code" program will distill and share best practices to improve youth data literacy to better adapt to future society.

Open educational resources are an important component of open data resources. With the increase of open educational resources, libraries should adopt new forms and measures to promote the development and implementation of data literacy education. Public libraries can use institutional repositories, open access

repositories, OER repositories, and MOOC courses to help the public improve data literacy. ISKME launched the OER Commons project [44], which is a dynamic digital public library and collaboration platform that provides users with resource builders, course builders, and module builders. Users can set up their own resources and courses according to their actual learning and research needs, which can help users exert their creativity, gather various resources and ideas, and solve their own research and learning problems.

4 Implications for China

4.1 Strengthen Open Data Resource Construction and Establish Innovative Service Awareness

The 13th Five-Year Plan points out the need to promote equalization of basic public services, meet diverse public service needs, and innovate public service delivery methods. Subsequently, the "Public Cultural Service Guarantee Law" provides clear provisions for guaranteeing the development of public cultural services, among which enriching public cultural service supply and improving public cultural service efficiency are the focus of the Guarantee Law [45]. The opening and utilization of data from libraries, museums, art galleries, and other public cultural institutions can effectively enrich public cultural service supply and improve the utilization rate of public cultural service resources. Compared with foreign countries, China' s libraries are relatively backward in open data resource construction. Libraries need to change traditional resource construction thinking, change traditional collection resource construction models, and incorporate various open data resources such as already opened and usable data from other libraries, research data, government data, and commercial data into the library collection system to strengthen data resource integration and association, and deepen and innovate services based on this foundation.

4.2 Provide Services that Meet Public Needs

As institutions that collect, organize, store, and disseminate data, information, and knowledge, libraries have rich experience in providing services to the public. Libraries should adhere to a "user-centered" approach, pay attention to issues of concern to users, and provide services that meet user needs. For example, innovation and entrepreneurship are hot issues in China' s current social development. The State Council' s "Opinions on Several Policy Measures to Vigorously Promote Mass Entrepreneurship and Innovation" clearly states the need to strengthen the opening and sharing of public service resources for entrepreneurship and innovation, and promote innovative business models in various industries relying on "Internet +" and big data [46]. Innovation and entrepreneurship cannot be separated from strong support from data, information, and knowledge. China' s public libraries can learn from foreign public libraries' service forms in using open data to promote citizen innovation and entrepreneurship, helping citizens access innovation and entrepreneurship resources and assisting citizens in formulating business plans and achieving en-

trepreneurial goals. In addition, libraries can also provide health information services and open education services according to user needs and hot issues of concern.

4.3 Strengthen Cooperation with Other Institutions

In the open data environment, libraries should adopt an open attitude and actively carry out beneficial cooperation with other social organizations, institutions, or individuals, such as jointly participating in open data competitions, holding hackathon activities, and inviting "data makers" to the library to interact with other users. Currently, the open data movement in China is continuously developing in depth, and various open data activities are gradually being carried out, such as the Shanghai Open Data Innovation Apps (SODA) data competition and the Shenzhen City Data Innovation Competition. However, the participation of China' s library community in open data activities is relatively low. In fact, libraries have the ability to help the public utilize open data, excavate data value, and promote the realization of data value. For example, the data application development competition held by the Shanghai Library has received widespread social attention. Libraries should cooperate with governments, enterprises, and other social organizations to actively promote and guide citizens to participate in the opening and development of data, realize data utilization and development, continuously launch innovative applications, accelerate project incubation and implementation, and promote social innovation and development. The maker spaces built by China' s libraries are excellent spaces and platforms for libraries to cooperate with other institutions and citizens to develop and utilize data. Libraries should better use data resources and space resources to strengthen cooperation with other institutions and provide services to users [47].

4.4 Strengthen Data Literacy Education

Libraries have always been an important force in cultivating citizen data literacy and encouraging and helping citizens to innovate and develop. According to ACRL' s "Documented Library Contributions to Student Learning and Success" [48] survey, libraries can effectively help students improve information literacy and thus succeed academically and scholastically. China' s library community has carried out many practices in citizen data literacy education. In the open data environment, libraries need to assume the responsibility of public data literacy education, enhance citizens' basic awareness of open data, cultivate citizens' data processing capabilities, and adopt new data literacy education methods.

The open government data movement is gaining momentum in China, and it is necessary for libraries to carry out relevant education and publicity, including basic concepts and principles of open government data, sources of government open data, what data cannot be opened, and how citizens can develop and utilize data resources. Libraries should popularize basic concepts of open data to

users through various means (such as lectures, seminars, and training sessions), and help users improve data literacy in practice through open data activities (such as data competitions and hackathons), deepening users' understanding and awareness of open data and enabling them to master relevant technologies and tools more proficiently. In various activities, libraries should pay attention to interacting with users and providing more effective guidance and help to users in specific practices.

With the continuous development of society and the advent of the data era, libraries are no longer just places for storing books. Libraries are in a new period of development and transformation. The development of the open data movement provides new opportunities for libraries to carry out data services and achieve innovative development. Foreign public libraries have already carried out many practices, while there are relatively few related practices in China. Public libraries should give full play to their functions, be user-centered, use more extensive, diverse, and complex data to achieve services that are more in line with the development of the times and user needs, thereby strengthening the relationship between public libraries and society, improving the social status of libraries, promoting the development of library undertakings, and achieving library transformation and leapfrog development.

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Author Contributions

Huang Ruhua: Provided ideas, guided writing and revised the paper;
Wang Chunying: Collected materials and wrote the paper;
Zhou Lihong: Guided writing and revised the paper.

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