Postprint of Research Progress on Small Data in the Domestic Library Field

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Abstract

[Purpose/Significance] To systematically review and summarize the research progress in the field of small data within Chinese library science, propose issues worthy of attention in future research on small data in Chinese libraries, and provide references for the expansion of this research domain. [Method/Process] Using CNKI as the sample source database, this study retrieved and compiled all academic literature published in China between January 2015 and September 2019, and employed content analysis to systematically review and analyze the literature, with a focus on conducting in-depth analysis across six dimensions: the connotation of small data, the connotation of library small data, opportunities and challenges that small data brings to libraries, service patterns based on small data, service models based on small data, and strategies for libraries to apply small data. [Results/Conclusion] Research on small data in the Chinese library community exhibits characteristics such as high sensitivity to small data and its application in libraries, growing emphasis, lack of established core authors and core research teams, concentrated research subjects, and emphasis on theory over practice. Future research on small data in the Chinese library community should emphasize the integration of theory and practice, strengthen evaluation of small data applications, and enhance exchange and cooperation with other disciplines.

Full Text

A Review of Small Data Research in Chinese Libraries

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Abstract:
[Purpose/Significance] This paper systematically reviews and summarizes research progress on small data in Chinese library science, identifies key issues

worthy of future attention, and provides references for expanding this research field. [**Method/Process**] Using CNKI as the data source, we retrieved and compiled all academic literature published between January 2015 and September 2019. Content analysis was employed to systematically review these documents, focusing on six aspects: the connotation of small data, the connotation of library small data, opportunities and challenges that small data brings to libraries, small data-based service models, small data-based service models, and strategies for library application of small data. [**Results/Conclusions**] Research on small data in Chinese libraries is characterized by high sensitivity to small data and its library applications, increasing attention, absence of core authors or teams, concentrated research subjects, and emphasis on theory over practice. Future research should emphasize integration of theory and practice, strengthen evaluation of small data applications, and enhance interdisciplinary exchange and cooperation.

Keywords: small data; big data; library; thematic analysis
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Introduction

Current library service systems, resource management and allocation strategies, service models, and service content based on big data face numerous challenges, including diverse data structures, massive and complex data processing, high application costs, operational difficulties, privacy leakage, and weak service specificity. These issues not only increase library management costs and application risks but also lead to declining service benefits [1-5]. Effectively addressing these problems has become a key concern for library scholars and experts both domestically and internationally. In 2013, Professor D. Estrin of Cornell University formally proposed the concept of "small data," pointing out that personalized data extracted from user data can effectively reveal patterns in user behavior [6]. Chinese scholars recognized that small data could not only effectively solve the aforementioned problems but also strengthen the people-oriented service philosophy in libraries [4], leading to in-depth discussions on small data applications in libraries. The earliest research outcome was Ma Xiaoting and Chen Chen's 2015 publication "Research on Library Personalized Services Based on Trusted Small Data" in *Library and Information Service*, which explored the connotations of small data and library small data and constructed a personalized service model based on trusted small data that could effectively reduce service data processing complexity and time while improving library personalized service quality [7]. Subsequently, Chinese library science has witnessed a research boom on small data applications, yielding numerous research achievements and practical experiences. Reviewing and summarizing the research status of small data applications in Chinese libraries over the past four years, identifying current research characteristics and shortcomings, and proposing future development strategies are of great significance for promoting

the transformation and innovation of Chinese library services in the big data era.

To ensure comprehensive retrieval results, we searched the CNKI database on October 8, 2019, using the search formula SU='library'*'small data'. After removing irrelevant literature (such as conference announcements and calls for papers), we obtained 39 papers related to small data application in libraries. Using content analysis, we systematically analyzed the research themes and content of these papers, attempting to clarify the progress, characteristics, and shortcomings of small data research in Chinese libraries from six aspects: small data connotation, library small data connotation, opportunities and challenges brought by small data to libraries, small data-based service models, small data-based service models, and strategies for library application of small data, thereby proposing future development recommendations to promote the deep application of small data in Chinese libraries and drive library service transformation and innovation.

2. Literature Data Analysis

2.1 Temporal Distribution of Papers

The number of Chinese library science publications on small data is shown in Figure 1. As shown in Figure 1 [Figure 1: see original paper], research on small data in Chinese libraries originated in 2015, and the number of publications has shown an upward trend year by year since 2015 (with 2019 data collected up to October 8, 2019). The publication volume in 2018 was more than double that of 2015, reflecting increasing attention and emphasis from Chinese libraries, which have invested considerable resources in in-depth research and practice.

2.2 Journal Distribution of Papers

Analyzing the journal distribution of small data research literature in Chinese libraries helps identify core journal groups in this field. The top journals publishing such research are shown in Figure 2 [Figure 2: see original paper]. As shown in Figure 2, all top-ranking journals are library and information science journals, with cumulative publications accounting for 74.36% of the total relevant literature. Among them, six Chinese core journals (*Library Work and Study*, *Information Theory and Practice*, *Information and Documentation Services*, *Library*, *Library Theory and Practice*, and *Library and Information*) published 43.59% of the relevant literature, indicating that Chinese library science attaches great importance to small data research.

3. Key Research Content Analysis

3.1 On the Connotation of Small Data

As an emerging information technology originating abroad, the primary task for Chinese libraries to better utilize small data is to understand its definition,

connotation, and application areas. Domestic scholars have conducted extensive research on these aspects from different perspectives. Representative views include:

(1) Ma Xiaoting et al. believe that small data is individual-centered, comprehensive data covering individual digital characteristics related to thinking, behavior, emotion, traits, hobbies, and social connections, featuring personalization, precision, and concealment [7].

(2) Chen Chen believes that small data refers to data collection, processing, storage, analysis, judgment, and decision-making activities centered on users, characterized by small volume, high efficiency, controllability, easy processing, easy operation, personalization, reliability, and sustainability [8].

(3) Wang Hao believes that small data is comprehensive, individual-centered data, a new type of data based on individual digital information with the following features: individual-centered; low cost and high benefit; higher security that can avoid privacy data leakage; small data and big data complement each other [3].

(4) Niu Yong agrees with Ma Xiaoting et al.'s definition of small data [7], pointing out that small data has three characteristics: individual-centered, discovering individual characteristics or patterns from a micro perspective; aimed at discovering causal relationships of individuals in nodes; small data volume, single type, high value density, and strong specificity [9].

(5) Liu Qinglin believes that small data refers to the complete collection of data centered on individuals or team entities, encompassing complete characteristics, comprehensive, multi-level behavioral patterns, and contextual awareness, featuring limited data volume, single type, and high value density [4].

Based on comprehensive analysis of these definitions, we conclude that: small data is a new type of data based on individuals or single teams, representing selective, reliable, controllable, and value-added digital information; the analytical object of small data research is individuals or single teams; the purpose of small data research is to ensure data is usable and value-added both currently and in the future; small data includes basic characteristic data, behavioral pattern data, contextual awareness data, and social relationship data related to the analytical object; small data features include small volume, low cost, easy operation, single type, high value density, precision, reliability, concealment, controllability, high security, and sustainability; small data complements big data.

3.2 On the Connotation of Library Small Data

Building upon basic small data theories, library scholars have conducted in-depth discussions on library small data to promote better utilization of small

data to enhance overall library service capabilities and efficiency. For example, Ma Xiaoting et al. point out that library small data refers to comprehensive data related to readers' daily reading behaviors, habits, preferences, emotional changes, service purchasing ability, social relationships, physical condition, and financial status. Libraries conduct comprehensive collection, digital processing, computation, analysis, and application of these data. The main differences from library big data are: readers are the sole target and center, emphasizing personalized features, with librarians conducting data collection, mining, analysis, and utilization; characterized by limited data volume, single type, simple structure, and fast processing; focuses on constructing personalized reading demand systems and service methods for readers; provides support for identifying future reading needs and constructing personalized service systems based on reader groups or individual readers' historical behaviors [7].

Chen Chen believes that library small data refers to data information related to readers' reading behaviors, social relationships, historical records, movement paths, access records, comments, geographic locations, and configurations collected by video capture devices, sensor networks, wearable devices, servers, and network monitors during daily library management, operation, and service activities. It features high data value, low decision-making cost, strong controllability, and real-time decision-making services [8]. Chen Chen categorizes library small data into four types: reader individual characteristic data, reader behavior monitoring data, third-party shared data, and peripheral socialization data [2].

Chen Lianfang believes that library small data refers to all usable data that is comprehensive in space, full-process in time, and refined in depth for users, featuring operability, practicality, and humanistic care [10].

Li Zhifang believes that library small data refers to a series of data related to users' thinking and behaviors during library use, including physical behavior data, cognitive behavior data, and correlation data between behaviors, with five characteristics: individual-based, human-focused, easily overlooked, small volume, and strong operability, and three problems: randomness of user behavior, uncertainty of user cognition, and small data volume [11].

Liu Qinglin points out that library small data refers to all usable raw data related to readers themselves that is comprehensive in space and full-process in time when readers use library resources (including various resources in physical and virtual spaces) and services, including reader individual characteristic data, reader experience data, and socialization shared data, featuring personalization, small data volume, multi-level data sources, unstructured format, easy collection, strong practicality, and real-time dynamic prediction of the future [4].

Wang Xin et al. believe that research user small data refers to all usable data related to individuals generated by research users during scientific activities, including individual basic characteristic data, research activity data, and library

activity data [12].

Diao Yu et al. believe that maker small data refers to all behavior and state data related to maker groups during maker project research and development, including maker group characteristic data, maker behavior perception data, and social relationship data [13].

Wang Xin et al. believe that reader small data refers to relevant data generated around readers' lives and studies, mainly including reader basic characteristic data, social activity data, library activity data, and third-party open data [14].

Based on comprehensive analysis of these definitions, we conclude that: library small data is a new type of digital information based on reader groups or individual readers (including students, teachers, researchers, maker groups, etc.), and these data are selective, reliable, and value-added; the analytical object of library small data research is reader groups or individual readers; the purpose of library small data research is to utilize collected data to provide more personalized, precise, and intelligent services; library small data includes basic characteristic data, social activity data, library activity data, third-party open data, behavior perception data, and correlation data between these data related to the analytical object; library small data features include limited data volume, low decision-making cost, single data type, high data value, simple data structure, strong controllability, fast data processing, humanistic care, real-time dynamic future prediction, easy collection, reader instability, and unstructured format; library small data complements library big data.

3.3 Opportunities and Challenges of Small Data for Libraries

Based on discussions of basic theoretical issues such as the connotation and characteristics of small data and library small data, scholars have deeply analyzed the new challenges and development opportunities that small data brings to libraries from perspectives including data quality, personalized service, privacy protection, cost investment, decision support, research tracking, maker services, service models, user experience, promotion, service systems, competitiveness, technical support, and sustainable development.

Ma Xiaoting et al. point out that applying small data to libraries will bring development opportunities in four aspects: reducing data "noise" and improving data quality; improving personalized service levels and specificity; enhancing protection of readers' personal privacy; reducing investment in computer software and hardware [7].

Wang Min's research indicates that small data application in public libraries features obvious personalization, low cost with significant results, low information risk, and strong privacy protection capabilities. The opportunities and challenges for public libraries include: providing technical support for expanding information services; helping build more professional and precise new information service models; enhancing public library competitiveness and improving

service quality [1].

Chen Chen points out that small data brings major development opportunities to libraries: helping libraries improve the scientificity and usability of data decisions; achieving secure protection of readers' privacy in personalized services; providing safe, reliable, and real-time decision support for personalized intelligent services for readers [8].

Wang Hao points out that small data application in libraries will help optimize library personalized service systems, reduce data "noise" impact and improve data quality, help improve privacy data protection capabilities and reduce infringement risks, and reduce library investment in software and hardware [3].

Chen Lianfang believes that the advantages of small data application in libraries are reflected in five aspects: making users feel cared for and respected; enhancing promotion effects; optimizing embedded services; improving user experience; helping provide decision-making references [10].

Niu Yong points out that applying small data to library knowledge communities will help improve user stickiness and promote sustainable development [9].

Wang Xin et al. believe that small data brings four opportunities to library personalized research services: helping users develop innovative scientific thinking models; helping improve library personalized research service benefits; helping libraries provide more services meeting personalized research needs; helping libraries reduce data processing costs; achieving transformation from intuition-driven empirical decision-making to small data-driven reliable data decision-making; enhancing libraries' ability to protect readers' privacy [12, 14].

Li Zhifang believes that small data application in libraries will promote the construction of small data-related user behavior databases and help libraries build new personalized recommendation service models based on small data [11].

Diao Yu et al. believe that applying maker small data to library precision maker services not only creates basic conditions for libraries to provide precise services for makers but also creates causal conditions for providing precise services for maker groups, while providing scientific guarantees for library precision maker services [13].

Diao Yu et al. also believe that small data application in libraries will help reduce hardware and software investment related to data, improve precision marketing benefits, enable real-time tracking of research users' attitudes and motivations, provide more accurate references for data service decision-making, construct privacy monitoring and protection mechanisms for research users, and promote interactive communication between libraries and research users [15].

3.4 Research on Service Models Based on Small Data

With the deepening of theoretical research and practical application of small data in libraries, scholars have recognized that libraries will change traditional service models and have proposed targeted solutions according to different service models.

Ma Xiaoting et al. proposed a library personalized service model based on trusted small data that can effectively solve problems such as rising service costs, declining benefits, and poor real-time performance in personalized intelligent services. They pointed out that the construction should focus on four key issues: enhancing the value density and data usability of small data; readers should have control over the entire series of activities from small data collection to application; providing personalized reading services based on small data for readers; building a small data-based CRM system [7].

Wang Min believes that constructing public library information service models based on small data should start from three aspects: service principles (including emphasizing the central position of service subjects, precision of service objectives, and diversity of service means); service processes; service measures (including emphasizing small data-based personalized reading services, valuing small data-based information resource construction, standardizing small data-based information service management, and ensuring user information security based on small data). During construction, special attention should be paid to two major issues: small data standards and user control [1].

Chen Chen proposed a library personalized service model based on linked data that can effectively solve problems such as high decision-making costs, poor personalized service levels, and low reader satisfaction in library personalized services. This model can effectively enhance the value attributes and decision-making usability of small data, improve data resource utilization, service investment returns, and reader reading satisfaction, ensure the CRM system is reader-centered, achieve secure protection of reader privacy through small data analysis, and provide strong support for personalized service quality [8].

Wang Hao pointed out that library personalized service application strategies based on small data include: applying small data to electronic document selection; applying small data to reader group analysis; applying small data to information services [3].

Niu Yong's research suggests that library knowledge community construction strategies based on small data include: clarifying the collection sources, scope, authorization, and tools of small data in library knowledge communities; building a library knowledge community architecture based on small data consisting of semantic analysis layer, matching layer, and value-added layer; building a high-level data protection system to provide strong guarantees for small data privacy and security [9].

Liu Qinglin pointed out that library precision service construction strategies

based on small data include: using intelligent sensor IoT technology to build a comprehensive automatic control and identification system for knowledge resources; optimizing resources to achieve library space re-creation; subdividing audiences and focusing on high-end readers; building reader self-discovery and self-management platforms [4].

Diao Yu et al. pointed out that library precision maker service construction strategies based on small data include: establishing awareness of library precision maker services oriented toward small data; building knowledge resource libraries based on maker small data; creating self-service knowledge and autonomous management platforms for makers oriented toward small data; subdividing classifications and focusing on high-end maker groups [13].

Diao Yu et al. also pointed out that subject micro-knowledge integration service construction strategies based on small data include: establishing relevant service awareness; ensuring unified management of research user small data; constructing relevant mechanisms for protecting subject micro-knowledge property rights; building micro-knowledge resource systems adapted to personalized subject service requirements [15].

Li Zhifang pointed out that small data application strategies in libraries include: constructing user small data-related behavior databases; building personalized recommendation service models [11].

Chen Chen pointed out that strategies for applying small data to reader interest discovery, dynamic updating, and effective management should include: constructing a model for reader interest discovery, dynamic updating, and effective management based on small data; the reader interest discovery process should highlight user relevance of small data; adopting dynamic reader interest discovery and updating strategies; constructing strategies for dynamically adjusting personalized service content according to changes in reader reading interests; establishing a user privacy security protection mechanism during the reader interest discovery process [19].

Liu Yang et al. deeply analyzed how library alliances can use small data for personalized services, believing that the following issues should be addressed: utilization and protection of personal data in library alliances; multi-source fusion of personal small data in library alliances [22].

3.5 Research on Service Models Based on Small Data

Liu Qinglin proposed a real-time reader reading interest discovery model based on small data that can express readers' reading interests and their degree of interest in real time, integrating a standard tag-based user interest model with the Ebbinghaus forgetting curve [4].

Chen Chen et al. constructed a reader reading interest discovery and prediction model based on small data decisions that can enhance libraries' prediction

accuracy of reader service needs and improve readers' knowledge acquisition efficiency and satisfaction in reading activities. They pointed out that key points include: small data selection should ensure strong correlation with reader reading activities; small data should accurately depict readers' reading activities and needs; small data system decisions should focus on protecting reader privacy security; enhancing the accuracy of small data in predicting reader interest discovery trends [18].

Diao Yu et al. constructed a library precision maker service discovery model consisting of four layers: maker small data collection layer, maker small data processing and analysis layer, maker innovation discovery layer, and maker precision service decision layer, which can provide the most valuable data support for personalized service decision-making for maker groups [13].

Chen Chen proposed a library reader reading interest discovery and dynamic updating model that can provide scientific reference for customizing and intelligently pushing personalized reader services, consisting of small data analysis and decision modules and reader reading interest discovery modules [20].

Zhang Sifeng constructed a personalized recommendation user model based on small data fusion that can build user preferences through feature association, feature mining, and situation estimation [20].

Zhao Ying constructed a library user service model based on library small data that can effectively compensate for big data's shortcomings such as weak personalization specificity and high privacy leakage risk, while improving service intelligence, security, and three-dimensionality [21].

3.6 Research on Library Application Strategies of Small Data

Scholars have deeply analyzed issues that should be addressed in library application of small data from perspectives of strategy construction and application.

Chen Chen pointed out that strategies for constructing library user personalized service systems based on small data include: formulating scientific small data collection and filtering standards; having the ability to provide personalized reading services based on small data for readers; achieving small data-based library CRM precision management; using small data analysis to achieve secure protection of reader privacy [2].

Wang Xin et al. constructed a library personalized research service model based on research user small data that can accurately discover research user needs and predict their development trends. This service model consists of two layers: research user small data decision support layer (including research user small data collection, cleaning, fusion, analysis, and decision-making) and library personalized research service push layer (including personalized research service recommendation mechanism and push services). They pointed out that during construction, issues such as control rights, standardization, and privacy security of research user small data should be addressed [12].

Li Zhifang constructed a library personalized recommendation service model based on small data that can meet users' common and individual needs and provide data services in visual form, consisting of four layers: infrastructure layer, data resource layer, data management layer, and application service layer. She pointed out that three issues should be noted when applying small data in libraries: be fact-based and focus on users' real thinking and behaviors in real environments; pay attention to user feedback to promote service effectiveness; construct an effective hierarchical trust mechanism to provide strong support for user privacy protection [11].

Wang Xin et al. constructed a library personalized intelligent service model based on university reader small data, consisting of five layers: intelligent collection and preprocessing layer of university reader small data, discovery and prediction layer of personalized reading needs, personalized intelligent decision recommendation layer, personalized intelligent service push layer, and personalized intelligent service evaluation layer. They pointed out that when developing this service, attention should be paid to: university reader relationship management; standardization of university reader small data; control of university reader small data [14].

Sun Danxia et al. constructed a precision and embedded subject service model based on user small data that can effectively enhance the depth and precision of embedded subject services and distinguish core users, loyal users, general users, and potential users [16].

Diao Yu constructed a university library think tank-type information consultation service model based on small data that can effectively solve big data's shortcomings such as difficulty in highlighting personalized data and precise data matching. He proposed the following safeguard measures: standardize small data collection principles to improve data value density; establish effective regulations to promote small data utilization and sharing; provide technical support for meeting user needs based on small data composition analysis; establish think tank-type information consultation service awareness to provide intellectual support for meeting user needs; construct think tank-type information consultation service resource systems to achieve value-added information data services [17].

4. Characteristics, Shortcomings, and Development Strategies

4.1 Characteristics

4.1.1 High Sensitivity to Small Data and Its Library Applications

Chinese library and information science has traditionally shown low sensitivity to foreign new theories, viewpoints, and technologies [23-24], but has been relatively sensitive to small data and its library applications. Small data research began in 2013 and was introduced to China and applied in libraries by 2015.

This indicates that Chinese library researchers are sensitive to this new concept and its library applications, and that big data era challenges facing libraries at home and abroad share many commonalities, creating similar urgency for library service transformation and innovation. Therefore, Chinese library science has paid close attention to the rise of small data and its library application research to seize development opportunities and reorient roles to enhance the people-oriented service philosophy and service benefits.

4.1.2 Increasing Attention Research on small data application in Chinese libraries started early and has developed rapidly, with research outcomes increasing year by year: 5 papers in 2015; 6 in 2016 (cumulative 11); 9 in 2017 (cumulative 20); 11 in 2018 (cumulative 31); and 8 in 2019 (cumulative 39, excluding collection lag). Twenty-one papers were published in core journals (accounting for 53.85% of total publications), indicating that small data research in Chinese libraries receives high attention and has produced abundant high-quality academic achievements.

4.1.3 Core Authors and Teams Not Yet Formed Although core authors such as Chen Chen, Diao Yu, Zhang Dongmei, Wang Xin, Chang Pei, and Ma Xiaoting, and core research institutions such as Lanzhou University of Finance and Economics Information Center, Lanzhou University of Commerce Information Engineering College, Sichuan University of Science and Engineering Library, Dalian University of Technology Technical College Library, and Qiqihar Medical College Library have conducted relatively continuous theoretical research and practical application of small data in libraries, the research is not comprehensive or deep enough, and a relatively stable research system has not yet been formed.

4.1.4 Concentrated Research Subjects Although relevant dissertations have emerged [20], all other academic outcomes are published in academic journals, and researchers mainly come from the library and information science field. This indicates that current research subjects on small data in Chinese libraries are relatively concentrated. However, since library application of small data faces issues such as privacy and technical implementation, overly single research subjects inevitably lead to limitations in research and practice.

4.1.5 Emphasis on Theory Over Practice Current research on small data application in Chinese libraries mainly focuses on theoretical discussions, such as what small data is, what library small data is, small data-based service models, small data-based service models, and small data-based strategies. However, there is a lack of in-depth discussion on the design and implementation of small data-based service systems and issues involved in practical application, with insufficient practical research.

4.2 Shortcomings and Development Strategies

Although Chinese libraries have conducted relatively in-depth discussions on small data application and achieved valuable academic research results, due to the relatively late start of this research field, there are still areas needing strengthening, such as more theoretical than practical research, few discussions on the role positioning of small data in libraries, few technical-level discussions on small data application in libraries, and few evaluation studies on small data application in libraries. We believe future research on small data application in Chinese libraries should strengthen exploration of the following issues:

4.2.1 Emphasize Integration of Theory and Practice to Promote Deep Application of Small Data in Libraries Research on small data application in libraries should not remain at the theoretical level but should strengthen practical exploration. Only in this way can theory guide practice and practice promote theoretical development. Moreover, small data application in libraries itself is a highly practical research area. Therefore, based on theoretical research, the question of "how to do it" must be addressed—that is, studying how to construct and implement practical, service-specific, and highly universal small data-based library application systems. What technical support is needed for small data application in libraries? How can valuable small data be better collected? What are the involved storage, analysis, and processing strategies and technologies? These practical issues require strong theoretical support and effective feedback from practical application. Therefore, future research should strengthen deep integration of theory and practice to promote deep application of small data in libraries.

4.2.2 Strengthen Evaluation Research on Small Data Application in Libraries Evaluating small data application in libraries helps objectively understand and assess the rationality and shortcomings of small data-based library service models, service models, service strategies, and service systems constructed and implemented by researchers, which is of great significance for further promoting and improving small data application in libraries. Future research should strengthen exploration of evaluation principles, standards, models, methods, and systems for small data application in libraries to form a series of achievements related to small data application evaluation in libraries and enrich and perfect Chinese research on small data application in libraries.

4.2.3 Enhance Interdisciplinary Exchange and Cooperation Applying small data in libraries also involves knowledge from computer science (such as small data processing, storage, and analysis technologies) and law (such as intellectual property rights). Therefore, relying solely on library and information scholars for theoretical research and practical application is insufficient. Exchange and cooperation with experts and scholars from other fields should be strengthened to more effectively solve technical and ethical issues involved in

small data application in libraries, thereby promoting deep application and sustainable development of small data in Chinese libraries and accelerating library service transformation and innovation.

References

[1] Wang Min. Research on public library information service models driven by small data thinking [J]. *Library Science Journal*, 2015, 37(12): 77-79.

[2] Chen Chen. Library personalized service based on small data decision support [J]. *Library and Information*, 2015(1): 82-86.

[3] Wang Hao. Research on library personalized services based on small data [J]. *Library Science Journal*, 2016, 38(6): 102-104.

[4] Liu Qinglin. Research on library precision services based on small data [J]. *Library Work and Study*, 2017(5): 45-50.

[5] Liu Lijie, Fan Fengxia. Strategies and implementation paths for reading promotion in university libraries under big data environment [J]. *Journal of Southwest Minzu University (Humanities and Social Sciences Edition)*, 2017(8): 225-228.

[6] ESTRIN D. Small, n=me, data [EB/OL]. [2019-09-15]. https://www.nsf.gov/events/event_{summ}.jsp?cntr

[7] Ma Xiaoting, Chen Chen. Research on library personalized services based on trusted small data [J]. *Library and Information Service*, 2015, 59(4): 70-75.

[8] Chen Chen. Research on QoS guarantee of library personalized services based on small data [J]. *Library and Information*, 2015(11): 32-35.

[9] Niu Yong. Research on library knowledge community construction based on small data [J]. *Library and Information*, 2016(2): 58-61.

[10] Chen Lianfang. Collection, analysis, and application of library user small data under big data environment [J]. *National Library Journal*, 2016, 25(3): 69-74.

[11] Li Zhifang. Research on library users' small data behavior driven by "Internet Plus" [J]. *Library Theory and Practice*, 2017(9): 108-112.

[12] Wang Xin, Zhang Dongmei, Yan Fengyun, et al. Research on library personalized research services based on research user small data under big data environment [J]. *Information Theory and Practice*, 2017, 40(10): 85-90.

[13] Diao Yu, Chang Pei. Research on library precision maker services oriented toward small data [J]. *Library Theory and Practice*, 2018(5): 109-112.

[14] Wang Xin, Zhang Dongmei. Research on library personalized intelligent services based on university reader small data under big data environment [J]. *Information Theory and Practice*, 2018, 41(2): 132-137.

[15] Diao Yu, Chang Pei. Research on subject micro-knowledge integration services based on small data [J]. *Library Work and Study*, 2018(5): 70-75.

[16] Sun Danxia, Wang Weijun, Jiang Yi. Research on embedded subject services based on user small data [J]. *Library Work and Study*, 2019(4): 84-90.

[17] Diao Yu. Research on university library think tank-type information consultation service model based on small data [J]. *Library Work and Study*, 2019(8): 82-86.

[18] Chen Chen, Li Qiang. Reader interest discovery and prediction based on small data decisions [J]. *Information Science*, 2017, 35(5): 75-80.

[19] Chen Chen. Reader interest discovery and dynamic updating based on small data [J]. *Library*, 2017(3): 23-27.

[20] Zhang Sifeng. Research on personalized recommendation of digital libraries based on small data fusion [D]. Wuhan: Central China Normal University, 2018.

[21] Zhao Ying. Research on user services based on library small data under modular concept [J]. *Library Work and Study*, 2019(8): 77-81.

[22] Liu Yang, Li Qingyang, Wei Wei. Research on personalized services for library alliance users based on personal small data [J]. *Information and Documentation Services*, 2019, 40(3): 73-79.

[23] Xiao Ximing, Shen Yan. Research progress of iSchools in China [J]. *Library Journal*, 2014, 33(5): 16-22.

[24] Yang Guangyuan. Research hotspots and progress of data curation in China [J]. *Library and Information Service*, 2016, 60(2): 129-136.

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