Current Status, Hotspots, and Frontiers of Knowledge Service Model Research: A Postprint

Authors: Zhang Lu, Shen Jing

Date: 2023-08-26T00:00:00+00:00

Abstract

[Purpose/Significance] Grasping the current status, hotspots, and frontiers of knowledge service model research plays an important role in understanding knowledge service activities and effectively guiding knowledge service practice. [Method/Process] Based on the conceptual definitions of knowledge service and knowledge service models, this study systematically reviews the current status of knowledge service model research using keyword frequency statistics and co-occurrence network analysis methods, and explores the hotspots and frontiers of knowledge service model research from the four elements of knowledge service through content analysis. [Results/Conclusions] Research on knowledge service models both domestically and internationally shows an overall growth trend, while certain differences exist. The current research hotspots mainly focus on exploring innovation-oriented, user-oriented, technology-oriented, and domain-oriented knowledge service models. Future research frontiers will be knowledge service models under open innovation, knowledge service innovation models under design thinking, knowledge management models under big data environments, and applications of knowledge service models in the healthcare domain.

Full Text

The Current Status, Hotspots, and Frontiers of Research on Knowledge Service Models

Zhang Lu, Shen Jing
Department of Information Management, Peking University, Beijing 100871

Abstract

[Purpose/Significance] Grasping the current status, hotspots, and frontiers of knowledge service model research plays a crucial role in understanding

knowledge service activities and effectively guiding knowledge service practices. [**Method/Process**] Based on defining the concepts of knowledge service and knowledge service model, this paper systematically reviews the current state of knowledge service model research using keyword frequency statistics and co-occurrence network analysis. Through content analysis, it explores research hotspots and frontiers from the four elements of knowledge service. [**Result/Conclusion**] Research on knowledge service models both domestically and internationally shows an overall growth trend, though certain differences exist. Current research hotspots focus on innovation-oriented, user-oriented, technology-oriented, and domain-oriented knowledge service models. Future research frontiers will involve knowledge service models under open innovation, knowledge service innovation models under design thinking, knowledge management models in big data environments, and the application of knowledge service models in the healthcare domain.

Keywords: knowledge service; service model; knowledge management; open innovation; design thinking
Classification Number: G203

---

1. Conceptual Definitions of Knowledge Service and Knowledge Service Model

Different scholars have varying understandings of knowledge service and knowledge service model. This paper first clarifies these two concepts to establish a foundation for the literature review.

1.1 The Concept of Knowledge Service Since the 1990s, knowledge service has gradually been introduced into academia, receiving widespread attention particularly from economics and library and information science scholars. Current conceptual definitions mainly adopt two perspectives: the information service perspective and the industry perspective. From the information service perspective, Zhang Xiaolin proposed that knowledge service is based on the ability to search, organize, analyze, and reorganize information and knowledge, integrating into users' problem-solving processes according to their problems and contexts to provide services that effectively support knowledge application and innovation. Shen Jing, from the knowledge-intensive service industry perspective, defined knowledge service as a business service based on highly specialized knowledge, primarily providing knowledge- or skill-intensive products or services with high intellectual added value, and playing an important role in knowledge production and dissemination.

Comparatively, the information service perspective is more micro-level, emphasizing the important value of knowledge relative to information and focusing more on the generation process of knowledge content. The industry perspective is more macro-level, emphasizing real-world problems facing industries and

organizations, and focusing more on the value that knowledge services bring to society, with practical guiding significance. Since this paper aims to guide knowledge service practice through research on knowledge service models, the industry perspective is more appropriate. The knowledge service referred to in this paper relies on knowledge from different subjects, domains, and forms, employs advanced information technology as a means, and provides knowledge-based products or services to society in a problem-oriented and value-added manner. It can also be understood as knowledge-intensive service. It comprises four elements: knowledge service provider, knowledge service object, knowledge service means, and knowledge service content. It has four characteristics: (1) value-added nature, where continuous innovation by service providers increases knowledge value; (2) orientation, focusing on problem-solving for users' knowledge needs; (3) technicality, using advanced information technology to achieve knowledge internalization and externalization; and (4) knowledge intensity, with high dependence on various types of knowledge throughout the service process.

1.2 The Concept of Knowledge Service Model Regarding the connotation of "model," Chinese and English dictionaries provide similar explanations. Chinese dictionaries define it as "the standard pattern of things," while English dictionaries define "pattern" as "something that repeats in a predictable way, a general way of operating or behaving that can serve as a guide," and "mode" as "a way, method, or manner of behavior or action; a special type or form of something; a specified state for a particular task or problem." Thus, a model can be understood as a description, refinement, and abstraction of the ways, methods, and approaches of a subject' s behavior. For instance, L. M. Applegate defined a business model as a description of the structure of business activities, the relationships among constituent elements, and how they reflect the real world. Consequently, a service model describes the structure of service activities and the relationships among their constituent elements. The knowledge service model in this paper describes the constituent elements of knowledge service activities and their interrelationships, representing a refinement and generalization of the technical implementation, operation, management, and innovation activities of knowledge service. It is characterized by being intuitive, concise, and repeatable, and can serve as a standard form for guiding knowledge service practice.

---

2. Current Status of Knowledge Service Model Research

To comprehensively understand the current status of knowledge service model research, the authors collected literature data from Web of Science and CNKI, and analyzed keyword frequencies and co-occurrence networks.

2.1 Literature Data Collection For literature data collection and screening, since knowledge service can also be understood as knowledge-intensive service,

involving concepts such as knowledge-based service, knowledge-intensive service, and knowledge-intensive business service, and since knowledge service activities are both a service process and an innovation process, the authors used the search query: (knowledge service) AND ("service model" OR "service mode" OR "service pattern" OR "innovation model" OR "innovation mode" OR "innovation pattern" OR "model of innovation" OR "mode of innovation" OR "pattern of innovation" OR "model of service" OR "mode of service" OR "pattern of service") in the Web of Science database, with fuzzy matching for "knowledge service" to ensure coverage of related concepts like "knowledge-intensive service" and "knowledge-intensive business service." Similarly, CNKI's core journal database was searched with the condition: (Subject = knowledge service (fuzzy match)) AND (Subject = service model OR Subject = innovation model (exact match)). The final search date was May 10, 2017. After initial deduplication and screening, 503 English documents and 272 Chinese documents were obtained, each containing data on authors, titles, publication years, publications, keywords, and abstracts.

For data processing, Excel was used to count the number of publications by year and to group and count keyword frequencies. Excel functions were then used to generate an English keyword co-occurrence matrix of $1508\$ \times 1508 and a Chinese keyword co-occurrence matrix of $552 \times \$552$, which were analyzed using Ucinet & Netdraw software. These co-occurrence matrices are symmetric, with each element value representing the number of times two keywords co-occurred in the literature.

2.2 Literature Data Analysis Knowledge service model research began in the 1990s, with domestic research starting later than international research. Overall, research in this field is growing and attracting increasing attention from scholars worldwide, as shown in Figure 1 [Figure 1: see original paper].

2.2.1 Co-occurrence Network Analysis Results To visually grasp research hotspots in knowledge service models and understand associations between different research themes, the authors generated visual co-occurrence networks from the Chinese and English keyword matrices. Node size represents the degree centrality of keywords in the network (larger nodes indicate greater centrality), while edge thickness represents the frequency of keyword co-occurrence (thicker edges indicate more frequent co-occurrence), as shown in Figure 2 [Figure 2: see original paper] and Figure 3 [Figure 3: see original paper].

Figures 2 and 3 reveal that international research on knowledge service models is more dispersed than domestic research, with different emphases. International research primarily examines knowledge service models from a knowledge management perspective, focusing on innovation in knowledge-intensive service industries, application of new technologies such as cloud computing, ontology, OWL, knowledge representation, and data mining, knowledge services in healthcare domains including primary care, disease, nursing, and health services, and knowledge services in digital libraries. Domestic research concentrates mainly

on the library domain, including library information services and knowledge management, subject service models in university libraries, and personalized services in digital libraries.

2.2.2 Keyword Frequency Analysis Results To understand changes in research themes on knowledge service models domestically and internationally and identify research frontiers, this paper conducted keyword frequency statistics for literature from 2010-2013 and 2014-2017 separately. Excluding the core search terms "knowledge service" and "knowledge service," high-frequency keywords with a frequency of 3 or more were selected, and changes in keyword frequency rankings between 2014-2017 were analyzed, as shown in Table 1 .

Table 1 shows that keywords remaining high-frequency across both periods include cloud computing, innovation, and knowledge management in international research, with innovation receiving more attention than knowledge management. In domestic research, library, university library, digital library, knowledge service model, information service, and subject service remain high-frequency, though attention to university libraries and information services is decreasing. These findings align with the co-occurrence network analysis: international research tends to examine knowledge service models from knowledge management, new technology, and innovation perspectives, while domestic research focuses on library and information service perspectives.

New high-frequency keywords emerging in 2014-2017 indicate that international research has recently focused on new technologies, methods, and paradigms such as digital libraries, big data, open innovation, and pervasive computing, with empirical studies on knowledge service models in Australia, Canada, and the healthcare domain. Domestic research has recently explored library knowledge service models using big data technology and knowledge management methods. Thus, both domestic and international research have recently focused on new technology applications in knowledge service models, with international research emphasizing new paradigms and applications in new domains, and domestic research focusing more on new methods for library knowledge service models.

Overall, changes in high-frequency keywords demonstrate that knowledge management, new technology application, service innovation, and libraries are key content areas in knowledge service model research. With the introduction of new paradigms and technologies such as open innovation and big data, an increasing number of scholars have shifted their research perspective from theory to practice, expanding research scope to multiple domains and disciplines and focusing on the application of knowledge service models.

---

3. Research Hotspots in Knowledge Service Models

Through co-occurrence network analysis and keyword frequency statistics, we can understand the overall research status of knowledge service models. Since

different knowledge service models involve different dominant elements and different methods of knowledge service activities, examining service models from the constituent elements is a common research approach. This paper conducts content analysis of knowledge service model research literature from the four elements of knowledge service (provider, object, means, and content) and finds that innovation-oriented, user-oriented, technology-oriented, and domain-oriented knowledge service models correspond to these four elements and constitute current research hotspots.

3.1 Innovation-Oriented Knowledge Service Model Research From the perspective of knowledge service providers, the knowledge service process is an innovation process. Many scholars, particularly international scholars, have continuously focused on innovation models in knowledge-intensive service industries. For example, N. Corrocher et al., through surveys and statistical analysis of 441 knowledge-intensive service enterprises in Lombardy, Italy, identified four innovation models: interactive innovation, product innovation, conservative innovation, and technology-based organizational innovation. A. Trigo and X. Vence, through empirical analysis of Spanish service industries, discovered three cooperative service innovation models: technology information flow-intensive, client interaction-intensive, and low-intensity interaction (or lone innovator) models. A. L. Asikainen, through comparative analysis of innovation models across different industries, found that knowledge-intensive service industries tend to be "innovators" rather than "improvers."

Domestic scholars have also examined innovation models in knowledge-intensive service industries. Shen Jing classified knowledge-intensive service innovation models into seven types based on the "association" types among technology equipment suppliers, knowledge service enterprises, and client enterprises: technology equipment supplier-dominated innovation, knowledge service enterprise-dominated innovation, client enterprise-dominated innovation, knowledge service enterprise-assisted innovation, internalized service function innovation, externalized service function innovation, and exemplar innovation. Zou Guifen and Yan Xiaoyan proposed two service innovation models for knowledge-intensive service industries based on service innovation characteristics: the service professional trajectory model and the core/periphery service model.

In summary, international research has long focused on innovation models in knowledge-intensive service industries, typically using empirical methods such as surveys and statistical analysis to extract innovation models with strong practical value. Limited domestic research in this area is primarily theoretical and lacks empirical validation.

3.2 User-Oriented Knowledge Service Model Research From the perspective of knowledge service objects, meeting users'knowledge needs and solving their practical problems is the fundamental goal of knowledge service. Informa-

tion service research in library and information science has shifted from system orientation to user orientation, following user-centered design principles and methods for over 20 years and applying them widely in social tagging, children' s product design, information architecture and visualization, and personalized search. Optimizing knowledge service models based on user needs has become another hotspot for scholars domestically and internationally.

A. Druin early proposed a user-centered design method for digital libraries, and her research team subsequently applied this method to develop the International Children' s Digital Library, creating new tools and methods for cooperative and participatory design in digital libraries. Y. Feng et al. pointed out that meeting user needs is crucial to enterprise success, requiring the establishment of a consumer service center-oriented knowledge push system, and proposed specific implementation plans. A. Smedlund noted that banks must shift their focus to consumers in the knowledge transfer and user value creation process, transforming their services toward collaborative solution-based value creation models. A. Hinz and A. Digh innovatively proposed a digital library service model that extends the digital library into a human-centered workspace using prototyping methods to address users' difficulties in documenting or retrieving documents. D. Lin and T. Ishida proposed a participatory service design method that effectively evaluates user-centered service quality in multilingual knowledge exchange contexts.

Domestic scholars have primarily examined user-oriented library knowledge service models from an information service perspective. For instance, Li Yumei classified library knowledge service objects into three types: demand-driven, worker bee, and enthusiast, and proposed three user-oriented knowledge service models: user self-service, specialized service, and personalized service. Xu Jing and Guo Jing argued that library subject knowledge services should integrate into users' problem-solving processes and environments, proposing a user-centered subject knowledge service model that emphasizes user participation and experience. Zhang Haitao et al., through survey analysis of 976 university library users, proposed a one-stop knowledge service model for university libraries that comprehensively collects, analyzes, reorganizes, customizes, mines, and transfers knowledge through effective technical support and knowledge sharing services at a single location or portal to provide users with scientific, systematic, comprehensive, and efficient problem solutions.

In summary, international scholars emphasize proposing new knowledge service model concepts or designing new systems and methods, primarily using experimental research, participatory design, and prototyping methods with strong applicability, though the generalizability of these models remains limited. Domestic scholars focus on analyzing library knowledge service practices, primarily using theoretical interpretation and survey methods that extend information service research, but lack empirical validation.

3.3 Technology-Oriented Knowledge Service Model Research Advanced information technologies such as the Internet, big data, and cloud computing have become important means for optimizing and innovating knowledge service models, attracting continuous attention from scholars domestically and internationally. I. Savvas and N. Bassiliades addressed issues in public service sectors such as large resource volumes and high requirements for legitimacy and accuracy by proposing a process-oriented, ontology-based Web knowledge management system conceptual framework validated through case analysis. S. S. C. Shang et al., using literature review, content analysis, and expert interviews, proposed four knowledge service models in the Web 2.0 technology environment: exchange, aggregation, collaboration, and open models. Y. Rao and S. Lu proposed a knowledge service feature model based on cloud computing technology, including service requirements, knowledge service processes, and knowledge service quality, and constructed a service-oriented knowledge cloud platform (Eknoware).

Domestic scholars Liu Naiqiang and Wu Weihong proposed that SaaS-based knowledge management systems could serve as a new model for library knowledge services to achieve diversification, personalization, precision, and specialization. Wang Hong proposed a cloud computing-based ubiquitous library personalized knowledge service model, including intelligent aggregation, intelligent push, intelligent perception, and intelligent sharing. X. Yang et al. proposed a digital library cloud service model based on sharing alliances, encompassing information services, information retrieval, and data processing and management.

In summary, technology-oriented research on knowledge service model optimization, transformation, and application has strong practical value and has attracted widespread attention from scholars domestically and internationally. International scholars focus on examining how to improve knowledge service model effectiveness using advanced information technology or in advanced information technology environments from a knowledge management perspective, while domestic research primarily conducts theoretical discussions on technology-oriented knowledge service models in libraries.

3.4 Domain-Oriented Knowledge Service Model Research From the perspective of knowledge service content, domain knowledge and user knowledge needs vary significantly across industries, making it essential to provide professional knowledge services oriented toward domain knowledge. J. Wakerman et al., through a review of Australian rural primary healthcare service models, proposed five rural health service models: town-oriented decentralized services, integrated services, comprehensive primary healthcare services, remote area outreach services, and remote medical services (IT/Telehealth). S. P. Lin and H. Y. Yang, using an asthma care mobile platform (ACMS) as an example, explored key factors influencing patients' choice of e-health service models through questionnaire surveys. H. Thim and N. Weber proposed a knowledge management model for healthcare departments, including standardized manage-

ment and team learning, to promote tacit knowledge sharing and learning. M. Sprenger, using an e-mental health service App as an example, employed focus group methods to explore e-health business service models, including secure platform construction, medical data sales, crowdsourcing, and telemedicine, noting that business service models could enhance feasibility by focusing on value creation for different customer groups, involving third-party insurance companies, and expanding funding sources.

Domestic scholars Liu Ji and Li Li proposed rural domain knowledge service models for new rural construction: cultural knowledge network model, village affairs public service network model, scientific knowledge collaboration network model, and agricultural product knowledge service network model. Lou Cequn and Bi Dayu, analyzing agricultural knowledge center concepts, summarized three agricultural knowledge center service models for farmers. Ren Yulan, combining data mining and visualization technologies, proposed a multifunctional, multi-level digital knowledge service model for ancient Chinese medical texts, including personalized information retrieval, hypertext-linked reading modes, and intelligent assistance and knowledge discovery services. Liu Yu et al. proposed knowledge service models for manufacturing industry clusters, including government-led, industry association-led, and leading enterprise-led models, and evaluated service quality using fuzzy comprehensive evaluation methods.

In summary, domain-oriented knowledge service model research is highly applicable and requires sufficient understanding of domain knowledge and business practices. Comparative analysis reveals that international scholars focus more on healthcare knowledge service models, while domestic research examines agricultural, traditional Chinese medicine, and manufacturing domain knowledge service models. International research primarily employs empirical methods such as surveys, case analysis, expert interviews, and focus groups, while domestic research is mainly theoretical.

---

4. Research Frontiers in Knowledge Service Models

Knowledge service model research typically examines the ways and methods of service activities from one or several service elements. This paper continues to examine relevant literature from the four elements of knowledge service (provider, object, means, and content), combined with high-frequency keyword statistics from 2014-2017 and content analysis of related literature. The findings reveal that knowledge service models under open innovation, knowledge service innovation models under design thinking, knowledge management models in big data environments, and the application of knowledge service models in healthcare constitute future research frontiers.

4.1 Knowledge Service Models Under Open Innovation The concept of open innovation was first proposed by H. Chesbrough in 2003, referring to

a dynamic process of interaction, integration, and coordination among various innovation elements. It requires establishing close connections between organizations and all stakeholders to achieve sharing of innovation elements among different organizations and individuals, building a network system for innovation element integration, sharing, and value addition, and purposefully promoting innovation through the inflow and outflow of various innovation elements in the network system. H. Chesbrough et al. further proposed four elements of open service innovation: everything-as-a-service, co-innovation with customers, open services, and business model transformation.

In recent years, international scholars have recognized that the open innovation paradigm provides new perspectives, methods, and environments for knowledge service model research. For example, A. Mina et al., through analysis of open service innovation activities in UK enterprises, found that business service providers, compared with manufacturing enterprises, are more active open innovators, more inclined to engage in informal open innovation practices, with scientific knowledge playing an important role. Manufacturing enterprises' open innovation is also associated with service-containing business models and informal knowledge exchange activities. K. H. Kang and J. Kang, through surveys of Korean service industries, examined the relationship between external knowledge resource models and service innovation performance, identifying three external knowledge resource models: joint development, technology procurement, and external information procurement. Survey results indicated an inverted U-shaped relationship between joint development models and service innovation performance; technology procurement models negatively affect service innovation performance up to a certain threshold but positively beyond it; and external information procurement models positively affect service innovation performance. L. Cricelli et al., through the European Community Innovation Survey, found that open innovation models have become an inevitable trend in enterprise knowledge management and innovation.

4.2 Knowledge Service Innovation Models Under Design Thinking

Design thinking is both a design philosophy and a human-centered methodology that emphasizes idea generation and creativity stimulation. Combined with user-centered design methods and principles, it can guide and promote knowledge service innovation practice and enhance knowledge service effectiveness. Scholars and practitioners have begun recognizing the important value of design thinking in guiding library knowledge service innovation practice. The global innovation design company IDEO believes that design thinking-based library knowledge service innovation models involve users as advocates, designers, and evaluators of library knowledge service innovation, participating in actual innovation processes, while librarians serve as designers of knowledge services who guide and innovate knowledge service models. O. G. McGrath noted that higher education institutions should combine design thinking methods and project management principles in creating and operating maker spaces, focusing on the cyclical and iterative processes of design thinking. A. R. Benedetti used

focus groups and surveys to design user-centered vocabularies to enhance library service effectiveness.

Currently, the application of design thinking in library knowledge service innovation models is still in its infancy. In the future, the application of design thinking in maker spaces and product design models, as well as service and operation models in knowledge service institutions, will gradually deepen.

4.3 Knowledge Management Models in Big Data Environments Big data environments have transformed traditional knowledge service models, making knowledge management in big data environments a foundational concern for knowledge service model research in recent years.

First, applying big data technology to knowledge services will form technology-oriented knowledge management models. D. Martín et al., considering prosumer characteristics and knowledge management methods, proposed the ProSumer Pattern (ProSP) knowledge management framework based on a cloud-hosted network solution to provide problem-oriented solutions. J. Q. Li et al. noted that service computing represents a new principle of information technology and business management, where service-oriented technical architecture can bridge the gap between business services and information technology, and subsequently designed university knowledge management service models and knowledge representation service models, discussing their application issues. Guo Yajun et al. proposed an enterprise technology innovation knowledge management model oriented toward market demand, supported by big data technology, based on deep development of big data resources, and using networked collaborative innovation as a means.

Second, in big data environments, knowledge service providers, users, internal and external service environments, and internal and external knowledge resources will be fully integrated into the knowledge service process, forming new knowledge production and creation models for knowledge management. T. Nakanishi noted that big data implies economies of scale and scope but lacks economies of association, and thus proposed a new knowledge creation grid for the big data era to create knowledge value from big data. S. C. Kao and C. H. Wu, through data analysis of Taiwan' s manufacturing and service industries, found that goal-driven models and network topology are closely related to product or service innovation, with the SECI knowledge creation process in network topology playing an important moderating function in goal-driven models. Domestic scholars Huang Jialiang and Guo Bin, after elaborating on knowledge sharing behaviors in virtual communities and the characteristics and application value of "community big data," proposed a big data-based virtual community knowledge sharing model composed of knowledge sharing resources, knowledge sharing subjects, knowledge sharing technology, and knowledge sharing culture.

Applying big data to achieve transformation and optimization of knowledge management models has become inevitable. Among these, technology-oriented

knowledge management models based on big data technology will continue to serve as important support for knowledge service practice, while user-participatory, multi-source fusion-based knowledge production and creation models will become an important topic in knowledge service model research.

4.4 Application of Knowledge Service Models in Healthcare As people' s living standards and information literacy continue to improve, demand for knowledge in the healthcare domain has grown stronger. Healthcare knowledge services, including mental health services, health care services, and e-health services, require continuous innovation in knowledge service models by integrating new technologies and methods. For example, D. Howe et al., combining literature review, expert consultation, and clinical practice, proposed nine key principles for guiding the development of youth mental health service models in Australia to ensure service quality. T. Greenhalgh et al., through literature research and case analysis, proposed a knowledge co-creation model for community health services. M. J. Rho, through comparative analysis of compliance patterns and usage behaviors of 160 diabetic patients on independent gateways and tablet devices, noted that e-health service models need to be optimized according to compliance pattern differences across devices. Domestic scholars Qiu Xinxiang et al., using cluster sampling for controlled experiments, found that the KAP (Knowledge, Attitude, Practice) health education path can effectively improve pneumoconiosis patients' disease cognition, promote positive attitudes, and foster healthy behaviors. Yao Suyu et al. also used controlled experiments to find that a continuous quality improvement management model based on the full process positively affected leukemia patients' health knowledge mastery and quality of life.

---

5. Conclusion and Outlook

This paper understands knowledge service and knowledge service models from an industry perspective. Knowledge service, i.e., knowledge-intensive service, relies on knowledge from different subjects, domains, and forms, employs advanced information technology as a means, and provides knowledge-based products or services to society in a problem-oriented and value-added manner. A knowledge service model describes the constituent elements of knowledge service activities and their interrelationships, representing a refinement and generalization of knowledge service activity methods. Using keyword frequency statistics and co-occurrence network analysis, this paper systematically reviewed relevant literature and found that knowledge service model research shows an overall growth trend domestically and internationally, though international research themes are more dispersed with different emphases. International research primarily examines knowledge service models from a knowledge management perspective, focusing on extracting models from specific knowledge service activities with empirical analysis and application research. Domestic research mainly examines

knowledge service models from an information service perspective, concentrating on libraries, particularly university and digital libraries, with conceptual analysis, experience summarization, and case studies. Further content analysis from the four elements of knowledge service revealed that current research hotspots focus on innovation-oriented, user-oriented, technology-oriented, and domain-oriented knowledge service models, while future research frontiers will involve knowledge service models under open innovation, knowledge service innovation models under design thinking, knowledge management models in big data environments, and the application of knowledge service models in healthcare.

Based on comparative analysis of the current status, hotspots, and frontiers of knowledge service model research domestically and internationally, this paper offers the following recommendations for domestic research: (1) Break through traditional library and information science research boundaries and expand research domains to different industries and multiple disciplines, particularly knowledge-intensive service industries and healthcare, while promoting extensive cooperation across disciplines and domains. (2) Learn from international research experience by shifting from theoretical research to applied research, conducting knowledge service model application studies oriented toward knowledge value addition and innovation based on domain knowledge across industries, actual user problems and knowledge needs, and advanced information technology. (3) Comprehensively apply qualitative and quantitative methods, conducting more empirical research to enhance research depth and effectiveness, providing service strategies with practical guiding significance for improving knowledge service quality and effectiveness, thereby promoting the healthy and sustainable development of China' s knowledge service industry in the new era.

References

[1] OECD. The Knowledge-based Economy [R/OL]. [2017-08-10]. http://www.oecd.org/sti/scitech/1913021.pdf.

[2] National Science Board. Science & Engineering Indicators [R/OL]. [2017-11-15]. https://nsf.gov/statistics/2016/nsb20161/uploads/1/9/chapter-6.pdf.

[3] Shen Jing. Knowledge-intensive Service Industry Innovation [M]. Beijing: Beijing Library Publishing House, 2006.

[4] Li Xiaopeng, Yan Duanwu, Chen Zuxiang. Current Status, Trends, and Major Academic Viewpoints of Knowledge Service Research at Home and Abroad [J]. Library and Information Service, 2010, 54(6): 107-111.

[5] Zhong Ying, Mai Shuping, Mo Xuanhai, et al. Comparative Analysis of Knowledge Service Research at Home and Abroad [J]. Information Studies: Theory & Application, 2011, 34(5): 110-114.

[6] Bettiol M, Maria E D, Grandinetti R. Codification and Resonance in Medicine, 2012, 20(2): 268-84.

[7] Bolisani E, Scarso E, Zieba M. How Small KIBS Companies Manage Their Intellectual Capital? Towards an Emergent KM Approach [C]//Proceedings of Frontiers of E-business Research. Tampere: Tampere University of Technology & University of Tampere, 2004: 292-515.

[8] Santos-Vijande M L, Lopez-Sanchez J A, Gonzalez-Mieres C. Organizational Learning, Innovation, and Performance in KIBS [J]. Journal of Management & Organization, 2012, 18(6): 870-904.

[9] Zhang Xiaolin. Disruptive Transformation and the Post-Library Era: Promoting Knowledge Service Supply-side Structural Reform [J]. Journal of Library Science in China, 2018, 44(1): 4-16.

[10] Wang Hao, Gu Jun, Su Xinning. Ontology-driven Knowledge Management System Model and Its Application [J]. Journal of the China Society for Scientific and Technical Information, 2013, 39(2): 98-110.

[11] Ren Pingping. Review of Domestic Library Knowledge Service Research (1999-2011) [J]. Library and Information Service, 2012, 56(7): 5-10.

[12] Souza Y S, Gavronski I, Jacobs A. Global Sourcing of Knowledge Services and Innovation: An Integrative Literature Review [J]. Internext: Revista Electronica de Negocios Internacionais da ESPM, 2015, 10(2): 46-63.

[13] Zhang Xiaolin. Toward Knowledge Service [M]. Chengdu: Sichuan University Press, 2001.

[14] Jiang Yongchang. On Knowledge Service and Information Service [J]. Journal of the China Society for Scientific and Technical Information, 2001, 20(5): 572-578.

[15] Chen Zeqian, Bai Xianyang. The Development Trajectory of China' s Scientific and Technical Information Undertaking: From Information Service to Knowledge Service [J]. Modern Information, 2007, 27(12): 11-15.

[16] Miles I, Kastrinos N, Bilderbeek R, et al. Knowledge-intensive Business Services: Users, Carriers and Sources of Innovation [R]. [2018-03-20]. https://www.escholar.manchester.ac.uk/uk-ac-man-scw:75252.

[17] Kuusisto J, Viljamaa A. Knowledge-intensive Business Services and Coproduction of Knowledge-intensive Business Services: The Role of Public Sector [C]//Proceedings of Frontiers of E-business Research. Tampere: Tampere University of Technology & University of Tampere, 2004: 292-515.

[18] Zhang Huabao. Comparison of Two Perspectives on Interpreting the Concept of "Knowledge Service" [J]. Library Tribune, 2011, 31(2): 1-2.

[19] Online Chinese Dictionary. Pattern [EB/OL]. [2017-07-25]. http://xh.5156edu.com/html5/327955.html.

[20] DICTIONARY. Pattern [EB/OL]. [2017-07-25]. http://www.dictionary.com/browse/pattern?s=t.

[21] DICTIONARY. Mode [EB/OL]. [2017-07-25]. http://www.dictionary.com/browse/mode?s=t.

[22] Applegate L M, Austin R D, McFarlan F W. Corporate Information Strategy and Management: Text and Cases [M]. New York: McGraw-Hill Irwin, 2003.

[23] Chen Jianlong. Research on Information Service Models [J]. Acta Scientiarum Naturalium Universitatis Pekinensis (Philosophy and Social Sciences), 2003, 40(3): 124-132.

[24] Xu Kaiying, Liu Jia, Ban Xiaolin. Research on University Library Subject Knowledge Service Models [J]. Library and Information Service, 2007, 51(3): 53-55.

[25] Zeng Jianxun, Zhao Jie, Wu Wenna, et al. Research on Citation-based Knowledge Linking Service System [J]. Information Studies: Theory & Application, 2009, 32(5): 1-4.

[26] Mao Gang, Xiao Xueting, Li He. Research on Knowledge Service Models for Major Science and Technology Programs [J]. Information Science, 2015, 33(7): 35-38.

[27] Corrocher N, Cusmano L, Morrison A. Modes of Innovation in Knowledge-intensive Business Services: Evidence from Lombardy [J]. Journal of Evolutionary Economics, 2009, 19(2): 173-196.

[28] Trigo A, Vence X. Scope and Patterns of Innovation Cooperation in Spanish Service Enterprises [J]. Research Policy, 2012, 41(3): 602-613.

[29] Asikainen A L. Innovation Modes and Strategies in Knowledge-intensive Business Services [J]. Service Business, 2015, 9(1): 77-803.

[30] Zou Guifen, Yan Xiaoyan. KIBS Service Innovation and Its Implications for Library Knowledge Service Innovation [J]. Information and Documentation Services, 2008(5): 96-99.

[31] Bowler L, Koshman S, Oh J S, et al. Issues in User-centered Design in LIS [J]. Library Trends, 2011, 59(4): 721-752.

[32] Druin A. The Role of Children in the Design of New Technology [J]. Behaviour & Information Technology, 2002, 21(1): 1-25.

[33] Hourcade J P, Bederson B B, Druin A, et al. The International Children' s Digital Library: Viewing Digital Books Online [J]. Interacting with Computers, 2003, 15(2): 151-167.

[34] Druin A. What Children Can Teach Us: Developing Digital Libraries with Children [J]. Library Quarterly Information Community Policy, 2005, 75(1): 20-41.

[35] Walsh G, Druin A, Guha M L, et al. DisCo: A Co-design Online Tool for Asynchronous Distributed Child and Adult Design Partners [C]//Proceedings

of the International Conference on Interaction Design and Children. New York: ACM, 2012: 11-19.

[36] Manally B, Guha M L, Mauriello M L, et al. Children' s Perspectives on Ethical Issues Surrounding Their Past Involvement on a Participatory Design Team [C]//Proceedings of the 34th Annual CHI Conference on Human Factors in Computing Systems. New York: ACM, 2016: 3595-3606.

[37] Feng Y, Xu H, Yan S. Research on the Construction of Customer-centered Integrative Knowledge Push System [C]//International Symposium on Electronic Commerce and Security. Los Alamitos: IEEE, 2008: 971-975.

[38] Smedlund A. Service System for KIBS End-user Value Creation [C]//Proceeding of the 11th European Conference on Knowledge Management. Berkshire: Academic Conference LTD., 2010: 953-465.

[39] Hinz A, Digh A. Re-finding Physical Documents: Extending a Digital Library into a Human-centered Workplace [C]//Proceedings of the International Conference on Theory and Practice of Digital Libraries. Heidelberg: Springer, 2012: 57-63.

[40] Lin D, Ishida T. Participatory Service Design Based on User-centered QoS [C]//Proceedings of the International Joint Conferences on Web Intelligence. New York: IEEE Computer Society, 2013: 167-172.

[41] Li Yumei. Analysis of User-oriented Library Knowledge Service Models [J]. Library Work and Study, 2009(5): 7-10.

[42] Xu Jing, Guo Jing. Exploration of University Library Subject Knowledge Service Models [J]. Library and Information Service, 2010, 54(17): 14-18.

[43] Zhang Haitao, Song Tuo, Liu Jian. Research on University Library One-stop Knowledge Service Model [J]. Information Science, 2014, 32(6): 104-108.

[44] Savvas I, Bassiliades N. A Process-oriented Ontology-based Knowledge Management System for Facilitating Operational Procedures in Public Administration [J]. Expert Systems with Applications, 2009, 36(3): 4467-4478.

[45] Shang S S C, Li E Y, Wu Y L, et al. Understanding Web 2.0 Service Models: A Knowledge-creating Perspective [J]. Information & Management, 2011, 48(4/5): 178-184.

[46] Rao Y, Lu S. Service-oriented Knowledge Acquisition Paradigm and Knowledge Cloud Platform [M]//Knowledge Engineering and Management. New York: Springer, 2014.

[47] Liu Naiqiang, Wu Weihong. Constructing a Library SaaS Model Knowledge Service Cloud Platform [J]. Library Work and Study, 2010(9): 28-31.

[48] Wang Hong. Discussion on Cloud Computing-based Ubiquitous Library Personalized Knowledge Service Model [J]. Information Science, 2012, 30(8): 1196-1199.

[49] Yang X, Wang D, Jiang L, et al. Study on Cloud Service Model of Digital Libraries Based on Sharing Alliance [M]//Computer and Computing Technologies in Agriculture VIII. Switzerland: Springer International Publishing, 2014.

[50] Wakerman J, Humphreys J S, Wells R, et al. Primary Healthcare Delivery Models in Rural and Remote Australia: A Systematic Review [J]. BMC Health Services Research, 2008, 8(1): 1-11.

[51] Lin S P, Yang H Y. Exploring Key Factors in the Choice of E-health Using an Asthma Care Mobile Service Model [J]. Telemedicine and E-health, 2009, 15(9): 884-890.

[52] Thim H, Weber N. Management of Tacit Knowledge to Overcome Learning Barriers Between Professions [J]. European Conference on Knowledge Management, 2012, 41(5): 1163-1171.

[53] Sprenger M. Supporting the Viability of E-health Services with Pattern-based Business Model Design [C]//Proceedings of the International Conference on Well-being in the Information Society. Switzerland: Springer International Publishing, 2016: 161-175.

[54] Liu Ji, Li Li. Analysis of Knowledge Service Network Models in New Rural Construction [J]. Science and Technology Management Research, 2008, 28(9): 31-33.

[55] Lou Cequn, Bi Dayu. Research on Agricultural Knowledge Service Models for Farmers in Knowledge Centers [J]. Information Science, 2012, 30(3): 426-429.

[56] Ren Yulan, Li Zheng, Liang Hong, et al. Construction of Digitalization and Knowledge Service Models for Ancient Chinese Medical Texts [J]. World Science and Technology-Modernization of Traditional Chinese Medicine, 2013, 15(1): 45-48.

[57] Liu Yu, Liu Xiaoni, Zhang Jian, et al. Research on Selection of Knowledge Service Models for Manufacturing Industry Clusters [J]. Journal of Intelligence, 2013, 32(1): 164-168.

[58] Liu Yu, Hu Wei. Research on Knowledge Service Supply Chain Operation Model for Manufacturing Industry Clusters Based on Value Chain [J]. Science and Technology Management Research, 2013(21): 133-137.

[59] Chesbrough H. The Logic of Open Innovation: Managing Intellectual Property [J]. California Management Review, 2003, 45(3): 33-58.

[60] Chesbrough H. Open Services Innovation: Rethinking Your Business to Grow and Compete in a New Era [M]. San Francisco: Jossey-Bass, 2011.

[61] Mina A, Bascavusoglu-Moreau E, Hughes A. Open Service Innovation and the Firm' s Search for External Knowledge [J]. Research Policy, 2014, 43(5): 853-866.

[62] Kang K H, Kang J. Do External Knowledge Sourcing Modes Matter for Service Innovation? Empirical Evidence from South Korean Service Firms [J]. Journal of Product Innovation Management, 2014, 31(1): 176-191.

[63] Cricelli L, Greco M, Grimaldi M. Assessing the Open Innovation Trend by Means of the Eurostat Community Innovation Survey [J]. International Journal of Innovation Management, 2016, 20(3): 1080-1093.

[64] IDEO. Design Thinking for Libraries [EB/OL]. [2017-05-06]. http://www.designthinkingforlibraries.com.

[65] IDEO. Design Thinking for Libraries: A Toolkit for Patron-centered Design [R/OL]. [2017-05-11]. http://www.designthinkingforlibraries.com.

[66] McGrath O G. Making a Makerspace: Designing User Services to Serve Users [C]//Proceedings of ACM SIGUCCS Conference. New York: ACM, 2016: 95-98.

[67] Benedetti A R. Promoting Library Services with User-centered Language [J]. Portal: Libraries and the Academy, 2017, 17(2): 217-234.

[68] Liu Chengshan, Li Yu, Wang Jieliang. Research Status and Trend Analysis of Big Data in Library and Information Science [J]. Information Studies: Theory & Application, 2016, 39(4): 20-26.

[69] Martin D, Alcarria R, Robles T, et al. Prosumer Framework for Knowledge Management Based on Prosumer Service Patterns [J]. International Journal of Software Engineering & Knowledge Engineering, 2016, 26(7): 1145-1173.

[70] Li J Q, Bian Y J, Qiao M H. Analysis and Design on University Knowledge Management Service [C]//Proceedings of the International Conference on Economic and Business Management. Paris: Atlantis Press, 2016: 634-639.

[71] Guo Yajun, Zhao Lulu, Zhao Jing. Enterprise Technology Innovation Knowledge Management in Big Data Environment [J]. Modern Information, 2016, 36(7): 13-17.

[72] Nakanishi T. Toward a Realization of Knowledge Creation Grid for Big Data Era [C]//Proceedings of the 3rd International Conference on Advanced Applied Informatics. New York: IEEE, 2014: 167-172.

[73] Nonaka I, Toyama R. The Knowledge-creating Theory Revised: Knowledge Creation as a Synthesizing Process [J]. Knowledge Management Research & Practice, 2003, 1(1): 2-10.

[74] Kao S C, Wu C H. The Role of Creation Mode and Social Network Topology in Knowledge Creation Performance: Mediation Effect of Creation Process [J]. Information & Management, 2016, 53(6): 803-816.

[75] Huang Jialiang, Guo Bin. Research on Big Data-based Virtual Community Knowledge Sharing Model and Architecture [J]. Information Studies: Theory & Application, 2016, 39(2): 93-96.

[76] Howe D, Batchelor S, Coates D, et al. Nine Key Principles to Guide Youth Mental Health: Development of Service Models in New South Wales [J]. Early Intervention in Psychiatry, 2014, 8(2): 190-197.

[77] Greenhalgh T, Jackson C, Shaw S, et al. Achieving Research Impact Through Co-creation in Community-based Health Services: Literature Review and Case Study [J]. The Milbank Quarterly, 2016, 94(2): 392-429.

[78] Rho M J, Kim H S, Yook K H, et al. Compliance Patterns and Utilization of E-health for Glucose Monitoring: Standalone Internet Gateway and Tablet Device [J]. Telemedicine Journal and E-health: The Official Journal of the American Telemedicine Association, 2017, 23(4): 298-304.

[79] Qiu Xinxiang, Zheng Qianling, Xia Lihua, et al. Application Research of KAP Model Health Education Intervention for Pneumoconiosis Patients [J]. China Occupational Medicine, 2014, 41(3): 265-268.

[80] Yao Suyu, Liang Changlan, Sheng Yuping, et al. Effect of PDCA Management Model on Health Knowledge Mastery and Quality of Life in Leukemia Patients [J]. Chinese Journal of Disease Control & Prevention, 2016, 20(8): 843-846.

Author Contributions: Zhang Lu: Designed the research framework, collected and analyzed data, and wrote the paper; Shen Jing: Determined the research direction, revised the research framework, and revised the paper.

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