A Grounded Theory Study of Maker Knowledge Needs: Postprint

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Abstract

[Purpose/Significance] This study investigates makers' knowledge requirements to provide guidance for developing corresponding service strategies and systems. [Method/Process] Based on grounded theory, data were collected through questionnaire surveys, field investigations, non-interventional tracking observations, and in-depth interviews. SPSS and qualitative analysis software NVivo were employed for data analysis to construct a conceptual model of maker knowledge demand nodes. [Results/Conclusion] The findings indicate that the motivations for makers' knowledge requirements are interest-driven and competition-driven. The characteristics include active learning, preference for "informal learning," divergent thinking, close correlation with community needs, and interdisciplinary knowledge integration. The content encompasses principle knowledge, experiential knowledge, and knowledge contexts. Macro-level development strategies for maker services are proposed.

Full Text

Preamble

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An Investigation into Makers' Knowledge Demand Based on Grounded Theory

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Abstract

[**Purpose/Significance**] This study investigates makers' knowledge demand to provide guidance for establishing corresponding service strategies and service systems. [**Method/Process**] Based on grounded theory, the research employed questionnaire surveys, field trips, non-interventionist tracking observations, and in-depth interviews to collect data, which was then analyzed using SPSS and the qualitative analysis software NVivo to construct a conceptual model of makers' knowledge demand nodes. [**Result/Conclusion**] The study finds that makers' knowledge demand is motivated by interest and competition-driven factors. Key characteristics include active learning, preference for "informal learning," divergent thinking, close correlation with community needs, and interdisciplinary knowledge integration. The content of makers' knowledge demand encompasses principle knowledge, experiential knowledge, and knowledge situations. The paper proposes macro-level development strategies for library services targeting makers.

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1. Introduction

Innovation serves as an inexhaustible driving force for social progress and development. Traditionally, innovation has been perceived as technology-oriented scientific and technological innovation conducted by researchers in laboratories, for which libraries have developed comprehensive service systems. However, with continuous advancements in science and technology and rising levels of public education and scientific literacy, an era of "mass innovation" centered on the general public, powered by economic and social development, and staged through social practice has arrived. Within this wave of mass innovation, a special group has emerged—makers—who strive to transform various creative ideas into reality. Makers represent the "masses" of this movement, yet because they are distributed across different industries and engage in diverse activities, society knows little about their needs, and no public service system has been formed to serve this group. Against this backdrop, libraries should shoulder the responsibility of serving makers, which also represents a necessary step in their own development and transformation.

Over the past five years, research on the maker movement in libraries has flourished. Studies have focused on whether libraries should establish maker spaces, case studies of library maker spaces, discussions on construction and operation models, research on librarians' willingness and ability to participate in maker spaces, and prospects for service innovation and transformation. While some scholars have explored one-stop services for makers in university libraries and proposed embedded service models, few have conducted in-depth investigations and analyses of makers' knowledge demand. In fact, reader demand has always

been the driving force behind library development and transformation.

Mark Hatch, CEO and co-founder of TechShop, devotes an entire chapter to "Knowledge, Learning, Control, and Intelligence" in his book *The Maker Movement*, elaborating on the importance of knowledge for makers and highlighting knowledge demand as a critical need in the innovation process. Moreover, besides the "grassroots" nature of makers, governments, society, and enterprises are all actively involved in promoting the maker movement. As part of this ecosystem, libraries should leverage their "natural resource" of knowledge to play to their strengths. Therefore, this study focuses on makers' knowledge demand, which serves as the prerequisite and foundation for any knowledge service institution to develop knowledge service activities. The purpose is to thoroughly investigate the motivations, characteristics, forms, and connotations of makers' knowledge demand to guide the establishment of corresponding service strategies and systems.

2. Research Design

2.1 Theoretical Foundation

Grounded theory is an inductive theory strictly derived from data, suitable for exploratory and explanatory research. It is particularly appropriate when research topics are relatively unknown, lack sufficient "grand" theories, aim to challenge existing theories, seek to elicit research subjects' understanding and experiences, and focus on developing new theories. Research on makers' knowledge demand encompasses their information behavior and perceptions, making it highly exploratory. Therefore, this study adopts grounded theory for multi-perspective data analysis.

2.2 Data Sources and Description

Grounded theory research requires sufficient data to achieve theoretical saturation through analysis and induction. In this study, questionnaire surveys served as the preliminary work to understand the content and extent of makers' knowledge demand, informing subsequent field trips, non-interventionist tracking observations, in-depth interviews, and triangulation validation.

2.2.1 Pre-survey

The research team visited computer science, electrical engineering, and mechanical engineering departments at University J that are closely related to maker education, toured innovation laboratories, conducted open-ended interviews with maker mentors and students, and distributed pre-survey questionnaires to gain preliminary understanding of the maker innovation process and knowledge demand.

2.2.2 Formal Survey

The formal survey comprised:

Questionnaire Survey: Based on pre-survey results, the questionnaire was

refined and supplemented. The formal questionnaire included three sections (11 questions total): basic respondent characteristics, makers' knowledge environment, and makers' knowledge demand. The knowledge environment section comprehensively scanned the software and hardware environments affecting knowledge creation, while the knowledge demand section investigated knowledge needs throughout the innovation process.

Field Trips: The team visited the Tongtu Cultural Maker Space in Tongling, Anhui Province, and the Maker Space at the Information Science Branch Library of Wuhan University in Hubei Province, attending relevant presentations by founders. They also examined the national-level Nanjing Maker Space in Pukou, Zhenjiang Wuzhou Maker Space, and several renowned innovation laboratories at University J.

Non-interventionist Tracking Observation: The researchers conducted full-week tracking of a senior maker mentor's "Campus Communication Training" course at University J's Computer Science Department, observing participants' information behavior and perceiving their knowledge demand through open-class interactions.

In-depth Interviews: Interviewees included seven students from University J's Huiyu Innovation Club who had won national and provincial maker competitions, two senior university maker mentors, and one senior manager from a well-known social maker space. Semi-structured interviews averaged 15 minutes for students and 30 minutes for mentors and maker space professionals.

Triangulation Validation: Triangulation uses multiple theoretical perspectives, methods, models, data sources, and researchers to present phenomena more objectively and completely. Beyond the aforementioned investigations, this study also referenced books such as Chris Anderson's *Makers: The New Industrial Revolution* and information from renowned maker spaces like Chaihuo Maker Space's WeChat subscription account and official Weibo to corroborate findings.

2.3 Data Collection and Preprocessing

All questionnaires were distributed online via Wenjuanxing, yielding 204 valid responses for preliminary SPSS analysis. Field trips, tracking observations, and interviews produced over 100 photos, 7 video clips, 10 audio recordings, and more than 10 text documents.

Since all data needed to be imported into NVivo 11, photos, audio, and video files were compressed using Format Factory software to ensure smooth import and processing without compromising analytical integrity.

2.4 Data Analysis

2.4.1 Questionnaire Analysis (1) Basic Respondent Information

The online questionnaire was distributed in May 2017 to university and social makers from Jiangsu, Henan, Shanxi, and other regions, yielding 204 valid responses. Descriptive statistical analysis of basic user information revealed that

respondents covered all age groups, educational backgrounds, and both university and social makers, providing broad representativeness. The majority were male, under 39 years old, with undergraduate degrees or higher, and had been engaged in maker projects for less than 3 years—consistent with the recent rise of the maker movement in China .

(2) Reliability and Validity Testing
Sections 2 (makers' knowledge environment) and 3 (makers' knowledge demand) used Likert scales, which measure attitudes through respondents' ratings of statements. Reliability was tested using Cronbach's Alpha coefficient, with values above 0.8 indicating good reliability. The questionnaire achieved a stability coefficient of 0.922, demonstrating excellent reliability. Factor analysis yielded KMO = 0.916 and Bartlett's test significance of 0.000, confirming good validity.

(3) Makers' Knowledge Environment
The knowledge environment encompasses the accessibility of knowledge acquisition and smoothness of knowledge exchange, indirectly reflecting knowledge demand. Only 15.69% strongly agreed they could conveniently find needed knowledge throughout the innovation process, 14.71% strongly agreed they had multiple knowledge acquisition channels, 19.61% strongly agreed their maker space regularly provided free professional training, 16.67% strongly agreed their team had maker mentors, and 19.12% strongly agreed they had convenient, comfortable, and modern knowledge exchange environments. Meanwhile, 30-40% rated their knowledge environment as average, indicating that current environments inadequately meet makers' knowledge demand and offer substantial room for service improvement .

(4) Makers' Knowledge Demand
A complete maker innovation process includes four stages: idea generation, prototype development, product manufacturing, and promotion/sales. The questionnaire examined knowledge demands at each stage .

2.4.2 Qualitative Data Analysis from Interviews Using NVivo 11 and following Strauss's coding hierarchy (open coding, axial coding, and selective coding), the researchers first reviewed photos, audio, video, and text fragments to name and create a free node system. Based on open coding results, concepts were assigned and marked as child nodes. These were then compared and analyzed by reference points, relevance, and importance to screen new codes, forming 9 independent categories (axial coding). Finally, selective coding synthesized these into 3 core categories: principle knowledge, experiential knowledge, and knowledge situation. The coding process required continuous refinement and revision. Upon completion, NVivo's mapping function was used to construct a conceptual model of makers' knowledge demand nodes based on node relationships [Figure 1: see original paper] .

3. Analysis of Makers' Knowledge Demand

Through questionnaire surveys and grounded theory analysis of field trips and in-depth interviews, this study reveals makers' knowledge demand from multiple dimensions.

3.1 Motivations for Makers' Knowledge Demand

Makers' knowledge demand is driven by two primary motivations: interest and competition.

3.1.1 Interest-Driven Motivation

The research frequently encountered maker teams composed of individuals from diverse disciplinary backgrounds, job positions, age groups, and educational levels united by common interests. Interest serves as the best teacher, guiding exploration, discovery, and creation, while also providing the strongest motivation for tireless knowledge seeking.

3.1.2 Competition-Driven Motivation

Both university and social makers are aware of and participate in numerous competitions, driven by the global maker movement and national policies promoting mass innovation and entrepreneurship. Competitions allow makers to demonstrate their abilities and passion, help university makers earn rewards and enhance their resumes, and enable social makers to attract investor funding. Thus, competition represents another important motivation for knowledge demand.

3.2 Characteristics of Makers' Knowledge Demand

3.2.1 Active Learning

The dual motivations of interest and competition distinguish makers' knowledge demand from that of exam-oriented students. Makers engage in intrinsically motivated, sustained learning with clear objectives and remarkable proactivity. Many makers pursue learning and creation during their spare time with enthusiasm and enjoyment.

3.2.2 Preference for "Informal Learning"

Makers enjoy hands-on creation and comprehend knowledge through practice, making their activities inherently "informal learning." They acquire knowledge through exchanges, discussions, workshops, salons, gatherings, and brainstorming sessions. While this doesn't eliminate the need for foundational principle knowledge, makers clearly prefer these non-traditional learning formats over book-based study.

3.2.3 Divergent Thinking Characteristics

Makers constitute a special group within the general public, characterized by keen observation, diligent thinking, strong hands-on abilities, and divergent thinking. Chaihuo Maker Space, one of China's most renowned maker spaces, describes itself as providing a free and open collaborative environment that

encourages cross-disciplinary exchange and promotes creative realization and commercialization. Makers are defined as "innovative creators" because their projects are typically innovative and they excel at and enjoy applying new technologies and tools. Consequently, makers' knowledge demand often leads that of the general public—for instance, they were early adopters of 3D printing technology.

3.2.4 Close Correlation with Community Needs

Analysis of papers from ASIS&T's 2016 annual conference reveals that information science research increasingly focuses on knowledge innovation and real-life applications. Similarly, makers' projects often aim to solve community problems. At the ITIE2016 "Maker Spaces for Students and Educators" conference in Wuhan, exhibited projects such as an electric wheelchair from an American maker team and a gas leak alarm system from Shaanxi Danfeng maker team were all developed from practical community needs.

3.2.5 Interdisciplinary Knowledge Integration

The Sino-Japan-Korea Summer Program on Innovative Engineering Design (SPIED), co-founded by Jiangsu University and other institutions, requires student teams to comprise members from computer science, mechanical engineering, electronic information, and other disciplines to collaborate on projects. Many makers interviewed reported difficulties completing projects due to lack of non-disciplinary knowledge. Indeed, most contemporary maker projects require multidisciplinary knowledge integration.

3.3 Content of Makers' Knowledge Demand

Based on the conceptual model, makers' knowledge demand content can be divided into three categories: principle knowledge, experiential knowledge, and knowledge situation.

3.3.1 Principle Knowledge

In 1996, the OECD's report *The Knowledge-Based Economy* classified human knowledge into four categories, including principle knowledge (know-why)—knowledge about why things happen, primarily manifested in natural sciences, technology, industrial development, and product improvement. This aligns perfectly with the STEAM (science, technology, engineering, art, mathematics) education philosophy advocated by maker education. Principle knowledge refers to book-based knowledge acquirable through reading or instruction.

Shenzhen Chaihuo Maker Space has long been committed to maker education, assisting dozens of schools in establishing maker spaces and training maker mentors. Its marketing director noted in an interview that insufficient knowledge reserves prevent many maker spaces from moving beyond exhibition-level services, emphasizing that maker activities require foundational principle knowledge as a threshold. The tracked course at University J began with Arduino fundamentals, including programming syntax, hardware component functions, and underlying principles from computer science and mechanical engineering.

3.3.2 Experiential Knowledge

Another category in the OECD classification is experiential knowledge (know-how)—skills and capabilities for doing things. Mark Hatch states in *The Maker Movement* that "real knowledge is born from experience. You can only fully understand something by immersing yourself in its details. Hands-on discovery and exploration are necessary conditions for innovation." Many makers emphasized the importance of experiential knowledge, explaining their preference for informal learning. In the tracked week-long course at University J, a graduate student assistant proficient in Arduino provided hands-on guidance to beginners, significantly improving learning efficiency compared to self-study.

3.3.3 Knowledge Situation

Human learning, growth, and knowledge innovation occur within social interaction groups and contexts—what Nonaka calls "ba" (field). Knowledge creation requires a physical context or "field" that can take various forms, from physical office spaces and brainstorming areas to virtual networks and email. Whether in Anhui's Tongtu Cultural Maker Space or Nanjing Maker Space, comfortable environments, creative product displays, and modern facilities all contribute to this "field" that inspires makers and facilitates learning. This study adopts this "field" concept to define "knowledge situation."

3.3.4 In-Depth Analysis

In the third tier of the conceptual model, "basic knowledge," "interdisciplinary knowledge," and "information and digital literacy" belong to principle knowledge; "hands-on practice," "exchange and discussion," and "mentor guidance" belong to experiential knowledge; while "knowledge environment," "innovation platform," and "community needs" constitute knowledge situation .

4. Macro Development Strategies for Library Maker Services

Mapping the maker project process against the identified knowledge demand content reveals clear relationships between maker activities and knowledge needs [Figure 2: see original paper]. Based on these findings, this paper proposes three macro-level strategies for library maker services.

4.1 Identify Appropriate Role Positioning for Libraries

The global maker movement is driven not only by makers themselves but also by government promotion, social engagement, and corporate participation—libraries are just one component. Serving makers doesn't require completely overhauling existing service systems or comprehensively meeting all maker needs. Standing still hinders library development, while blindly following trends without self-awareness jeopardizes future prospects.

As [Figure 2: see original paper] shows, knowledge demand is rich and diverse during the "prototype development" and "idea generation" stages but relatively

less intensive during "product manufacturing" and "promotion/sales." In fact, not all makers participate in the promotion/sales stage—most university maker projects conclude at product manufacturing, while some social makers transfer patents to specialized marketing teams. Libraries should identify their role positioning based on knowledge demand at each project stage, leveraging their strengths to provide targeted services.

4.2 Develop Targeted Library Maker Service Plans

Among the three core categories of maker knowledge demand, "principle knowledge" largely corresponds to existing library services that can be optimized and upgraded according to makers' characteristics. "Experiential knowledge," emphasizing practice and exchange, differs from traditional library services and requires providing tools, renovating spaces, and cultivating mentors. Since every project stage depends on "knowledge situation," libraries must create dedicated knowledge environments and platforms while strengthening community connections.

Whether optimizing disciplinary knowledge organization or creating entirely new services, a detailed plan is essential. The complete cycle of user research, self-assessment, solution design, implementation, and impact evaluation requires comprehensive short-, medium-, and long-term strategic planning based on clear role positioning.

4.3 Establish a Public Service System Through Multi-party Collaboration

Mass innovation and entrepreneurship provide an excellent environment for maker development and represent a strategic choice for libraries to implement national strategies and transform themselves. However, libraries face challenges including lack of relevant service concepts, resources, and capacity. As public institutions primarily funded by government appropriations, relying solely on fiscal funds for maker space construction has obvious drawbacks, most notably insufficient motivation and funding.

Libraries can explore cross-boundary integration with technology incubators for resource sharing and service mutual assistance, collaborate with educational, cultural, and research institutions to build knowledge networks that promote sharing and innovation, and partner with enterprises to secure personnel and financial support for various maker projects. Seeking multi-party cooperation represents a viable path for libraries to successfully develop maker services.

References

[1] Hatch M. The Maker Movement[M]. Translated by Yang Ning. Beijing: China Machine Press, 2015: 67-90.
[2] Siobhan S. Maybe we could use our makerspace to 3D print some profes-

sional librarians, MLS and all?[J]. Feliciter, 2015, 61(1): 23-27.
[3] Liu Ziheng, Tu Zhifang. Cool reflections on the "maker space" trend in libraries[J]. Library Development, 2017(2): 43-46.
[4] Dixon N, Ward M. The maker movement and the Louisville Free Public Library[J]. Reference & User Services Quarterly, 2014, 54(1): 17-19.
[5] Li Hongpei, Yan Xiaoyan. American library makerspaces: Cases and implications[J]. Library Science Research, 2013(15): 98-102.
[6] Brady T, Salas C, Nuriddin A, et al. Makeability: Creating accessible makerspace events in a public library[J]. Public Library Quarterly, 2014, 33(4): 330-347.
[7] Li Yanbo. On the operation model and development strategy of library makerspaces[J]. Library Development, 2015(2): 69-72, 76.
[8] Koh K, Abbas J. Competencies for information professionals in learning labs and makerspaces[J]. Journal of Education for Library & Information Science, 2015, 56(2): 114-129.
[9] Luo Qiaoyan, Zhu Jun. Analysis of influencing factors on university librarians' willingness to participate in makerspace construction[J]. Library and Information Service, 2015, 59(22): 45-49.
[10] Ye Hongxin. Mass innovation and university library services[J]. Library & Information, 2015(1): 134-135, 141.
[11] Sun Chao, Li Xia. Exploring one-stop services for student makers in university libraries[J]. Library Tribune, 2015(10): 57-61.
[12] Diao Yu, Yang Qun. Research on embedded maker services in university libraries[J]. Library Work and Study, 2017(2): 107-110.
[13] Li Shanshan. Research on library collaborative innovative embedded service model for the "maker" group[J]. Library and Information Service, 2015, 59(13): 63-67, 95.
[14] Lu Zhangping, Liang Wei, Liu Guifeng, et al. Research on the evolution of library innovation space from the perspective of information-knowledge-intelligence transformation[J]. Library Development, 2017(6): 11-17.
[15] Cheng Gang. Research on knowledge service systems for innovative development of technology-based SMEs in big data environments[J]. Information Studies: Theory & Application, 2016, 39(3): 42-46.
[16] Li Peng, Han Yi. Case study of collaborative information seeking and retrieval behavior from the perspective of grounded theory[J]. Library and Information Service, 2013, 57(19): 24-29, 56.
[17] Lyons E, Coyle A. Analyzing Qualitative Data in Psychology[M]. Translated by Bi Zengzhong. Chongqing: Chongqing University Press, 2010: 51.
[18] Li Huijun, Ge Jing, Xi Youmin. Understanding business models: A philosophical triangulation perspective[J]. Chinese Journal of Management, 2016, 13(11): 1587-1596.
[19] Ke Huixin, Huang Jinghua, Shen Hao. Statistical Analysis Methods in Survey Research[M]. Beijing: Beijing Broadcasting Institute Press, 1992: 36-37.
[20] Fan Kexin. Quantitative Methods in Sociology[M]. Nanjing: Nanjing University Press, 2004: 36-46.
[21] Geng Qian, Mao Nina, Wang Fengxuan, et al. Research on competency

models for public library librarians[J]. Library and Information Service, 2016, 60(7): 25-33.
[22] Jennings G. Tourism Research Methods[M]. Translated by Xie Yanjun, Chen Li. Beijing: Tourism Education Press, 2007: 271-282.
[23] Chaihuo Maker Space Introduction[EB/OL]. [2017-09-18]. http://www.chaihuo.org/about/introcn.
[24] Anderson C. Makers: The New Industrial Revolution[M]. Translated by Xiao Xiao. Beijing: China CITIC Press, 2015: 118-125.
[25] Sun Zhen. Utilization of information and technology: Innovating knowledge and improving living standards—Current hotspots and trends in information science research from ASIS&T 2016 conference papers[J]. Library & Information Science Knowledge, 2017(3): 81-94.
[26] Welcome to SPIED 2017[EB/OL]. [2017-09-18]. http://ire-asia.org/ire/spied/?page_{id}=933.
[27] Wen Tingxiao, Gong Jiaoteng, Zhang Rui, et al. Knowledge correlation: Connotation, characteristics and types[J]. Library, 2011(4): 32-35.
[28] Qi Qi. Chaihuo Maker Space signs contracts with 42 schools[EB/OL]. [2017-09-18]. http://news.eastday.com/eastday/13news/auto/news/china/u7ai4160344_{K4}.html.
[29] Wu Caihuan. From "social epistemology" and "knowledge communication theory" to tacit knowledge communication—Theoretical foundation and behavioral paradigm of library activities[J]. Library Theory and Practice, 2016(4): 1-5, 34.
[30] Liu Zhiguo, Xu Yongbin, Xu Jing. Knowledge situation: The theoretical basis for library space construction[J]. Library Journal, 2014, 33(9): 40-48.
[31] Wang Youfu. Popularizing citizens' information literacy: A realistic choice for popularizing bibliographic knowledge in the digital age[J]. Library & Information Science Knowledge, 2014(2): 54-59.
[32] ALA Digital Literacy Task Force. What is digital literacy?[EB/OL]. [2017-09-18]. http://connect.ala.org/files/94226/what%20is%20digilit%20(2).pdf.
[33] Li Xiao. Research on construction models of university library makerspaces in China[J]. Library and Information Service, 2016, 60(7): 88-91.
[34] Kou Yin, Liu Yuchu. Research on integration of library and technology incubator innovation services[J]. Library Development, 2017(10): 16-20.
[35] Liu Li, Jia Dongqin. Interpretation of New Zealand National Library's 2030 Strategic Guidance[J]. Journal of the National Library of China, 2017, 26(4): 56-63.
[36] Liu Jinshan. Luis Herrera: New visions for library makerspaces[J]. Library Development, 2017(6): 100-101.

Author Contributions

Liang Wei: Conducted research, data processing and analysis, wrote initial draft.
Lu Zhangping: Developed research topic and outline, guided paper writing and revision.
Liu Guifeng: Guided paper revision.
Wang Zhengxing: Guided paper revision.