User Information Service Needs Analysis and Service Strategies for Library Makerspaces (Postprint)

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

Abstract

[Purpose/Significance] Utilize the KANO model to conduct hierarchical evaluation of user information service needs and construct a satisfaction matrix for library makerspaces, identify key factors for improving user satisfaction, and propose improvement strategies for library makerspace information services. [Method/Process] Employ KANO model analysis to design a questionnaire on information service needs for library makerspaces from four dimensions: environment and facilities, maker librarians, resources and access, and user services, and use statistical analysis of survey results to determine the types of user information service need indicators and construct a satisfaction matrix. [Results/Conclusion] Propose strategies for improving library makerspace information services, mainly including improving information services according to maker user need types, determining key factors for information service improvement based on the satisfaction matrix, continuously adjusting information services as maker user needs change, and constructing an evaluation feedback mechanism for information service satisfaction.

Full Text

Library Makerspace User Information Service Needs Analysis and Service Strategies

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Abstract

[Purpose/Significance] This study utilizes the KANO model to evaluate the hierarchical structure of user information service demands in library mak-

erspaces and constructs a satisfaction matrix, identifying key factors for improving user satisfaction and proposing strategies for enhancing information services in library makerspaces. [**Method/Process**] Employing KANO model analysis, a questionnaire on library makerspace information service demands was designed across four dimensions: environment and facilities, maker librarians, resources and access, and user services. Statistical analysis of survey results yielded demand categories for user information service indicators and constructed a satisfaction matrix. [**Result/Conclusion**] Strategies for improving library makerspace information services are proposed, including: refining information services according to user demand types, identifying key improvement factors based on the satisfaction matrix, continuously adjusting services in response to evolving user demands, and establishing a feedback mechanism for information service satisfaction evaluation.

Keywords: KANO model; library makerspaces; information service; user demands

1. Introduction

In the era of mass entrepreneurship and innovation, with national policy-level emphasis and comprehensive support, China's innovation and entrepreneurship movement is showing vigorous development momentum. As society's center for information storage, integration, and dissemination, libraries have an unshirkable social responsibility to provide information and knowledge services for innovation and entrepreneurship, representing an important opportunity for future role reshaping and functional transformation.

Domestic theoretical research on library makerspaces can be traced back to July 2012, when Li Kai introduced the makerspace concept in his article "The New Librarianship Turn in American Public Libraries" [1]. Research gradually gained momentum after 2014, focusing primarily on three aspects: (1) Case studies of library makerspaces, such as Feng Jiqiang et al. who noted that building makerspaces requires technical support and collaborative progress [2]; Wang Min and Xu Kuan who introduced the status of American library makerspace services and explored construction strategies for Chinese libraries [3]. (2) Research on the value and significance of library makerspaces, such as Kong Xianghui and Sun Chengjiang who proposed that makerspaces can promote innovation and are significant for building an innovative nation [4]; Tao Lei who pointed out that makerspaces will advance libraries' transformation into idea and creativity incubators [5]. (3) Research on library makerspace construction, such as Li Yanbo who argued that makerspace construction mainly includes collaborative, entrepreneurial, and centralized distribution models [6]; You Yue and Jia Ping who summarized key factors affecting library makerspace construction including environmental factors, resource equipment, service design, service teams, and cooperation mechanisms [7].

The KANO model, first proposed by Professor Noriaki Kano, is an effective tool for classifying user demands and analyzing demand hierarchies. Based on analysis of how user demands impact satisfaction, it reflects the non-linear relationship between products/services and user satisfaction, thereby accurately identifying key factors for enhancing user satisfaction [8]. Numerous scholars have refined the measurement variables of the KANO model. For example, C.C. Lee et al. studied practical applications combining the KANO model with other models for more effective user satisfaction measurement [9]. Y. Sireli et al. integrated the KANO model with Quality Function Deployment (QFD) in product and service design [10]. Y. Li et al. incorporated the Analytic Hierarchy Process (AHP) into KANO model applications to improve the reference value of evaluation results [11]. Hou Zhi and Chen Shiping explored specific methods for integrating KANO model with TRIZ theory [12]. Scholars have also actively explored KANO model applications in service quality evaluation, such as Tang Xiaoling et al. who studied digital library service quality evaluation index system construction based on KANO model and QFD [13], and Yang Jialuo who used KANO model to analyze public library user demands and specific measures for improving service satisfaction [14].

Current research shows that studies on library makerspace services rarely connect with libraries' unique information service attributes, lacking active attention to and in-depth understanding of information services integrated throughout the innovation process. However, as the makers movement develops in depth, maker users' information needs are increasingly characterized by diversification, complexity, and personalization, often creating gaps between the information services provided by library makerspaces and actual user needs. Therefore, research on maker users' information needs is particularly important. This paper attempts to apply the KANO model to evaluate hierarchical user information service demands and construct a satisfaction matrix for library makerspaces, helping libraries identify key factors for improving maker user satisfaction and thereby enhancing library makerspace information service levels.

2. Analysis Methods for User Information Service Demands in Library Makerspaces Based on the KANO Model

2.1 Overview of the KANO Model The KANO model defines user demands into four categories: Must-be demands (M) are functions users consider essential. When fulfilled, users may not show satisfaction or dissatisfaction, but when unfulfilled, they become very dissatisfied. One-dimensional demands (O) are functions users expect, where fulfillment proportionally affects satisfaction. Attractive demands (A) are latent user needs; fulfilling these causes satisfaction to rise sharply, while not fulfilling them does not cause obvious dissatisfaction. Indifferent demands (I) are functions that do not affect user experience whether provided or not, toward which users are neutral. Reverse demands (R) are functions users do not want or that cause strong dissatisfaction, where provision

level is inversely proportional to satisfaction. Additionally, questionable results (Q) refer to doubtful outcomes that generally only appear when users cannot understand the question, consider it unreasonable, or make errors [15].

2.2 KANO Model Analysis Method Based on the KANO model's demand classification principle, Noriaki Kano designed a structured questionnaire and analysis method [16]. The questionnaire presents paired positive and negative questions: positive questions measure user satisfaction when a product or service feature is provided, while negative questions measure dissatisfaction when it is not provided. The questionnaire offers five progressive optional answers measured on a 5-point scale: 5—Satisfied, 4—Should be that way, 3—Neutral, 2—Barely acceptable, 1—Dissatisfied (see) [17]. The KANO analysis evaluation table (see) then serves as the core standard for determining user information service demand types.

2.3 Satisfaction Improvement Based on the KANO Model Noriaki Kano noted that analyzing user sensitivity to the fulfillment ratio of each demand type enables targeted improvement of high-sensitivity demands to enhance product quality or service levels [18]. C. Berger et al. defined customer satisfaction coefficients as indicators for improving product quality or service levels, with calculation formulas: Satisfaction Index (SI) = (A + O) / (A + O + M + I), Dissatisfaction Index (DSI) = (O + M) / (A + O + M + I) × (-1) [19]. In this study, library makerspace information service satisfaction coefficients range between 0 and 1, where values closer to 1 indicate greater impact on user satisfaction. Dissatisfaction coefficients range between -1 and 0, where values closer to -1 indicate greater impact on user dissatisfaction. Coefficients closer to 0 indicate smaller impact on satisfaction or dissatisfaction.

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3. Survey and Analysis

3.1 Questionnaire Design The library makerspace information service demand questionnaire was designed in two parts: (1) Basic demographic information including gender, age, education level, and occupation; (2) Core indicators for library makerspace user information service demands. Library makerspace information services fall within the scope of library services, representing a new service model for libraries to promote knowledge innovation in the era of mass entrepreneurship and innovation, expanding organizational forms and service platforms. Library performance evaluation systems are tools or indicator systems built from the perspective of meeting user demands, with user needs as the starting point and orientation. Chinese scholars' research and practice on library service performance evaluation systems began in the 1990s, with many adopting the SERVQUAL or LibQUAL models and proving their scientific reliability in practice. In establishing survey indicators, the author conducted extensive literature review around SERVQUAL and LibQUAL models. Comprehensive

literature review shows that dimensions commonly covered in SERVQUAL and LibQUAL questionnaires include: environment and facilities, librarians, information resources and accessibility, and service effectiveness [20]. Additionally, due to the personalization and diversity of user service demands leading to heterogeneous and changing library services, SERVQUAL and LibQUAL applications for different library services have established indicator systems with varying degrees of difference. Library makerspace users have distinct innovation and entrepreneurship knowledge service and intelligence service needs different from general library users, requiring targeted design and adjustment in constructing the demand indicator system.

The author designed a semi-open questionnaire primarily from four dimensions—environment and facilities, maker librarians, resources and access, and user services—based on SERVQUAL and LibQUAL models. Each dimension comprises several refined demand indicators. The Delphi method was then employed, inviting 25 library and information science professors and 7 library directors with operational makerspaces to form a 32-member expert panel. Experts identified the most relevant demand indicators and added important ones not included in the questionnaire based on personal judgment. Using the Likert five-point scale as reference, experts scored the importance of identified and added indicators. Finally, descriptive statistical analysis was applied to calculate mean values and standard deviations to determine experts' cognitive convergence on each indicator, serving as the basis for final selection. After screening and adjustment, 26 key user demand indicators were obtained (see).

3.2 Survey Method Data collection employed questionnaire surveys in two formats: (1) Online surveys via Wenjuanxing platform, distributing 125 questionnaires and receiving 120 valid responses; (2) On-site paper questionnaires, distributing 105 and receiving 72 responses. In total, 230 questionnaires were distributed with 192 returned (83.5% response rate). Questionnaires with more than 2 questionable results were considered invalid, yielding 181 valid questionnaires (94.3% validity rate).

3.3 Respondent Profile Analysis Survey respondents were primarily users from 12 established library makerspaces, including public libraries (Shanghai Library, Guangzhou Library, Shenzhen Library, Changsha Library, Chengdu Library, Suzhou Library) and university libraries (National Science Library, Chinese Academy of Sciences; Tsinghua University Library; Fudan University Library; Wuhan University Library; Shanghai Jiao Tong University Library; Nanjing Tech University Library). As shown in , respondents represent diverse genders, ages, education levels, and occupations, comprehensively reflecting library makerspace user information service demands.

3.4 Survey Results Analysis Questionnaire results were analyzed using Wenjuanxing platform for quantitative statistics, with Excel and SPSS 19.0 for

item, reliability, and validity analysis. Item analysis employed T-test methodology, using the top 27% and bottom 29% of total scores as extreme groups. Results showed significant differences ($p < 0.05$) between high and low groups across all 26 indicators, demonstrating good discriminative power [21].

Reliability analysis used Cronbach's α coefficient, where values > 0.7 indicate high reliability, 0.35-0.7 moderate reliability, and < 0.35 low reliability [22]. Analysis showed $\alpha = 0.889$ for positive questions and $\alpha = 0.912$ for negative questions, indicating good internal consistency and credible results.

Validity analysis used KMO values as the test standard. SPSS 19.0 calculated KMO = 0.818 for positive questions and KMO = 0.796 for negative questions, with significance probability = $0.000 < 0.05$, confirming factor analysis applicability. Principal component analysis revealed five initial eigenvalues > 1, indicating five public factors for analysis. Post-rotation factors explained $>$ 70% of total variance, demonstrating good overall questionnaire validity.

Research results on library makerspace user information service demands are shown in . Based on the KANO analysis evaluation table, the frequency of each information service demand indicator across four demand types (A, O, M, I) was counted, with the most frequent type assigned as the indicator's demand category.

As shown in , must-be demands (M) include: providing hardware/software infrastructure for information services; maker librarians having good information service and subject service capabilities; innovation information resources being rich and selectable; having standardized information service processes; and prompting information ethics and moral norms for maker activities.

One-dimensional demands (O) include: maker librarians having good service attitudes; maker librarians having innovation awareness and capabilities; having efficient information resource access methods; regular updating of innovation information resources; expert involvement in guiding innovation activities; holding small/medium lectures and seminars; building virtual maker information service platforms; having timely and effective user experience and evaluation feedback mechanisms; and conducting maker information literacy education.

Attractive demands (A) include: developing personalized information service plans for specific innovation projects; supporting mobile device access to makerspace information services outside the library; innovation project decision analysis; knowledge discovery services based on existing information resources; screening and evaluation services for innovative technical solutions; and innovation achievement incubation services.

Indifferent demands (I) include: tidy and comfortable makerspace information service environment; maker librarians having unified service identification; virtual maker information service platform being user-friendly with easy navigation; providing various information push services (e.g., equipment reservation, lectures, training); providing multiple channels for contacting maker librarians;

and regularly conducting makerspace information service promotion and marketing activities.

3.5 Analysis of User Information Service Demand Satisfaction Improvement calculates satisfaction coefficients (SI) and dissatisfaction coefficients (DSI) for each demand indicator using the improvement formulas. Analyzing SI and DSI values reveals user sensitivity to changes in information resources and services, identifying high-sensitivity items as key improvement elements [23]. The 26 indicators were plotted in a satisfaction matrix with SI as the X-axis and DSI as the Y-axis (absolute values used), with mean SI and DSI values as center lines (see [Figure 1: see original paper]).

In the satisfaction matrix shown in [Figure 1: see original paper], the overlapping area of high satisfaction and high dissatisfaction represents the key improvement zone, most effective for enhancing user satisfaction.

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4. Strategies for Improving Library Makerspace Information Services

Compared with other makerspaces, library makerspaces not only provide venues, equipment, and infrastructure but also offer innovation-related information resources and services, representing their core value. Improving library makerspace information services requires deep integration into maker innovation activities, consistently oriented by user demands. Based on KANO model analysis, primary strategies include:

4.1 Improving Information Services According to User Demand Types Libraries should prioritize demand types by importance: Must-be > One-dimensional > Attractive > Indifferent [24]. For different improvement goals, different demand types should be emphasized: improving Must-be and One-dimensional demands more effectively reduces dissatisfaction, while improving Attractive demands most significantly enhances satisfaction [25].

Must-be demands are most critical, equivalent to hygiene factors in two-factor theory. Fulfillment does not greatly increase satisfaction, but deficiency causes sharp dissatisfaction growth. Among the 26 indicators, five Must-be demands represent makers' minimum requirements and basic information services libraries must provide. Libraries should standardize service processes, improve hardware/software infrastructure, provide integrated innovation information resources combining literature, policies, technologies, intellectual property, and talent, and build maker librarian teams with subject backgrounds and strong information service capabilities.

One-dimensional demands are expected information services whose fulfillment strongly impacts both satisfaction and dissatisfaction. Nine One-dimensional demands were identified, with improvement priority determined by SI ranking: conducting maker information literacy education, holding lectures/seminars,

building virtual platforms, expert guidance, effective feedback mechanisms, regular resource updates, efficient access methods, librarian innovation capabilities, and good service attitudes.

Attractive demands can significantly boost satisfaction. Six Attractive demands were identified, covering all innovation stages: project decision analysis in conceptual stage, knowledge discovery and technical solution screening in R&D stage, and achievement incubation services. Libraries should provide embedded full-process services. Additionally, supporting mobile access breaks temporal and spatial limitations, meeting convenience needs in the high-speed network era.

Indifferent demands do not affect satisfaction regardless of fulfillment. Six such indicators were identified. Statistical analysis by age, gender, education, income, and occupation reveals that tidy environment, information push services, and unified librarian identification are Indifferent across all groups. However, platform user-friendliness and multiple contact channels are One-dimensional for under-14 and junior-high-educated groups, while promotion activities are Must-be for postgraduates/professionals but Attractive for freelancers/migrant workers. Targeted services for these segments can more efficiently improve satisfaction.

4.2 Identifying Key Improvement Factors via Satisfaction Matrix In [Figure 1: see original paper], 11 indicators fall in the key improvement zone, representing the most critical areas for satisfaction enhancement. Libraries should: (1) Serve as information resource guarantors in innovation activities through literature delivery, data mining, and selective dissemination, while conducting information literacy education to improve comprehensive resource application capabilities. (2) Build information service teams with innovation awareness and stage-specific service capabilities, including maker librarians as "information experts" embedded throughout innovation processes and external experts for targeted guidance. (3) Develop virtual maker information service platforms with resource/training, subject service/exchange, achievement transformation, and user experience modules.

4.3 Continuously Adjusting Services with Evolving User Demands As society develops, KANO-defined demands progress: One-dimensional demands become Must-be, and Attractive demands evolve into One-dimensional. Transition cycles vary by industry. Library makerspace information services have unique characteristics and cannot rely on fixed demand types. Continuous KANO analysis should be maintained to understand progression patterns and characteristics, enabling continuous, scientifically sound service adjustment and system improvement.

4.4 Establishing Information Service Satisfaction Evaluation Feedback Mechanisms User satisfaction is crucial for evaluating library makerspace in-

formation service performance and sustainable development. Libraries should conduct comparative surveys of user demands and current satisfaction to build efficient evaluation feedback mechanisms guiding service optimization. shows most demands remain Must-be or One-dimensional, with few Attractive demands, indicating low fulfillment of high-level information needs and lack of "delightful" services. Therefore, building satisfaction evaluation feedback mechanisms is urgently needed to obtain dynamic demand changes and develop targeted, high-level demand fulfillment services.

Ultimately, library makerspace information services must be user-demand-oriented. Good service models require not only open information resource sharing but also fundamental improvements in resource allocation and service methods. Deeply understanding maker users' service demands and preferences is key to improving library makerspace information services. Future research should also address operational finance, mechanisms, and performance evaluation system construction.

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Analysis of User Demands for Information Service in Library Makerspaces and Service Strategy

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Abstract: [Purpose/significance] This study makes an evaluation of user demands hierarchy for information service in library makerspaces through the KANO model, then it builds the satisfaction matrix. It also identifies the key factors to improve the satisfaction degree. At last, it puts forward strategies for improvement of information service in library makerspaces. [Method/process] This paper designed a questionnaire about user demands for information service in library makerspaces from four dimensions that include environment and infrastructure, makerspace librarian, resource and acquisition and user service by the analytical methods of KANO model. Then, based on the statistical analysis of the findings, the research gains indicator types appraisal of user demands for information service in library makerspaces and then built satisfaction matrix. [Result/conclusion] This paper puts forward the strategies of perfecting information service in library makerspaces, which mainly includes perfecting information service according to the types of user demands, identifying the key factors of improving information service according to the satisfaction matrix, adjusting information service continuously with the change of user demands, establishing appraisal feedback mechanism for satisfaction evaluation of information service.

Keywords: KANO model; library makerspaces; information service; user demands

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