Construction and Analysis of the Evaluation Index System for Smart Library Development: Postprint

Authors: Meizhen Duan, Chu Jingli, Zhang Dongrong, Zhang Ying

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Abstract

Purpose/Significance This study employs a combined quantitative and qualitative approach to construct an evaluation index system for smart library construction, providing scientific evaluation standards and quantitative assessment tools for measuring the smartness level of smart libraries in practice. Method/Process Based on literature research and object-oriented analysis of smart libraries, a preliminary index system was drafted; the Delphi method was utilized to conduct expert consultation on the preliminary indices to determine the final evaluation index system; the Analytic Hierarchy Process and expert survey method were employed to calculate and determine the weights of evaluation indices; based on the smart library construction evaluation system, an analysis of smart library construction strategies and smart operation was conducted. Results/Conclusion An evaluation index system for smart library construction was established, comprising 4 dimensional indices, 12 first-level indices, and 50 second-level indices; from an evaluation perspective, the smart characteristics and construction strategies of smart libraries were proposed.

Full Text

Construction and Analysis of an Evaluation Index System for Smart Library Development

Duan Meizhen[1,2], Chu Jingli[3,4], Zhang Dongrong[3,4], Zhang Ying[3,4]

[1]Information Research Center of Military Sciences, Academy of Military Sciences, Beijing 100142
[2]Library of Academy of Military Sciences, Beijing 100039
[3]National Science Library, Chinese Academy of Sciences, Beijing 100190

[4]Department of Library, Information and Archives Management, School of Economics and Management, University of Chinese Academy of Sciences, Beijing 100190

Abstract:
[**Purpose/Significance**] This study employs a combined quantitative and qualitative approach to construct an evaluation index system for smart library development, providing a scientific evaluation standard and quantitative assessment tool for measuring the smartness level of libraries in practice. [**Method/Process**] Based on literature review and object-oriented analysis of smart libraries, an initial indicator system was formulated. The Delphi method was then used to conduct expert consultation on these preliminary indicators to finalize the evaluation index system. The Analytic Hierarchy Process (AHP) and expert survey method were applied to calculate and determine the weights of evaluation indicators. Finally, based on the constructed evaluation system, the development strategies and smart operations of smart libraries were analyzed. [**Result/Conclusion**] The study establishes a smart library development evaluation index system comprising 4 dimension indicators, 12 first-level indicators, and 50 second-level indicators, and proposes the smart representation and development strategies of smart libraries from an evaluation perspective.

Keywords: smart library; evaluation index system; Delphi method; analytic hierarchy process (AHP)
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Smart libraries represent the product of emerging technologies such as artificial intelligence in the new era and constitute a key direction for high-quality library development during the 14th Five-Year Plan period [**?**]. Since the emergence of smart concepts like "Smart Planet," smart library construction and development have increasingly attracted attention from researchers and practitioners in related fields, becoming an important research topic in library and information science. Current research in the smart library field primarily focuses on conceptual connotations and constituent elements, technology applications, smart services, and smart librarians [**?**]. Among these, smart library evaluation, as a critical component for advancing smart library development, has reached a consensus in both academia and practice regarding its importance. First, before construction begins, it can provide references for relevant stakeholders in planning and identifying key construction points and breakthroughs. Second, during construction, it can help measure phased achievements, identify deficiencies, and clarify priorities for subsequent work. Finally, upon completion, it can provide a basis for acceptance and offer insights for further improvements. Therefore, research on constructing evaluation systems and models is equally important as other research themes.

However, current research on smart library evaluation both domestically and internationally remains relatively weak, characterized by two tendencies: first, localized evaluations are one-sided; second, holistic evaluations are overly conceptualized. Localized evaluations focus on a single component of smart libraries and have not yet formed a comprehensive perspective. In smart service evaluation, Zhou Lingyuan et al. [?] established a smart library service quality evaluation index using the SERVQUAL model and user perception theory. In smart librarian evaluation, Wu Pengyoudi [?] and Chen Ling et al. [?] constructed librarian competency evaluation systems from different capability levels, while Tang Min built one from different competency domains [?]. Additionally, individual researchers have conducted evaluation studies on smart portals [?] and smart library resource utilization [?]. Although holistic evaluations analyze various dimensions and elements from an overall perspective, existing research remains relatively general with weak practical applicability and operability. Currently, only a few scholars have constructed systematic evaluation systems, such as Liu Yujing et al. [?] from four dimensions (perception, management, service, decision-making) and Deng Lijun et al. [?] from four dimensions (platform, resources, space, service). Furthermore, Li Yuhai et al. proposed four aspects for judging smart libraries: intelligent business management, smart services, smart support environment, and innovative teams [?], while Tang Min suggested that smart library evaluation should be conducted from four aspects: librarians, users, hardware systems, and software systems [?].

A review of existing research reveals that systematic studies on smart library evaluation are lacking, with several shortcomings: current evaluation index systems suffer from poor operability, hindering practical application; evaluation systems contain redundant indicators, with some overemphasizing technological products; research on index system construction urgently needs support from scientific theories and new methods; existing evaluation models lack strong quantitative attributes, resulting in insufficiently precise evaluation results. The domestic smart library field urgently needs a scientific and operable construction reference framework to guide practical work. This paper combines literature review with object-oriented analysis of smart libraries, employing the Delphi method and Analytic Hierarchy Process to construct a combined qualitative-quantitative evaluation index system for smart library development, providing references for guiding library smartification practices and advancing research in China's library field.

2. Construction of Smart Library Development Evaluation Indicators

2.1 Evaluation Indicator Construction Methods and Approach

The Delphi method, also known as the expert opinion method, is an important qualitative research approach characterized by anonymity, iterativeness, statistical analysis, and controlled feedback. It solicits expert opinions on evaluation indicator design through anonymous feedback, integrates these opinions, and feeds back the results to ultimately determine the specific evaluation index system [?]. This study first combines literature review with object-oriented analysis of smart libraries to initially formulate a smart library development evaluation index system. Then, the Delphi method is employed to invite experts to conduct qualitative and quantitative assessments of the preliminary index system. Finally, expert consultation results are integrated with the characteristics of university smart libraries to determine the final evaluation index system.

2.2 Initial Construction of Evaluation Indicators

To ensure the scientificity and rationality of the index system, this study introduces object-oriented analysis into the smart library evaluation process based on the concept, connotation, and cognitive model of smart libraries. Through analyzing objects and their relationships within the smart library system [?], a preliminary "Smart Library Development Evaluation Index System" was constructed from four evaluation dimensions: "Librarians," "Infrastructure," "Management," and "Services," comprising 12 first-level indicators and 32 second-level indicators (see Table 1).

2.3 Expert Consultation on Evaluation Indicators

Survey questionnaire design is essential for expert consultation. Based on the index system developed at each stage, this study designed consultation questionnaires using a five-point Likert scale, assigning values to each indicator's "necessity" level. Two rounds of expert consultation were designed to evaluate the index system according to the project's actual conditions.

Expert selection is critical to the success of the Delphi method and fundamental to ensuring the scientificity of the index system. This study followed principles of professionalism and authority, examining scholars and teams in domestic smart library practice and research fields to initially select 10 senior experts to form an expert panel. All experts hold senior professional titles and doctoral degrees, are aged 45-65, and come from top domestic universities or representative smart library practice institutions. They are leading figures in domestic smart library research and practice with high authority and in-depth understanding of the research topic at both theoretical and practical levels, enabling them to scientifically and objectively judge the smart library development evaluation index system and provide reasonable and valuable suggestions.

2.3.1 First Round of Expert Consultation (1) Questionnaire Distribution and Recovery. The first round of expert consultation targeted the preliminary "Smart Library Development Evaluation Index System," distributing evaluation questionnaires to the 10 experts in the panel. Eight questionnaires were returned, including one without data scoring but with suggestions for the entire index system, resulting in 7 valid data questionnaires. The consultation covered five aspects: assessing the necessity of each indicator by selecting rating levels (5 = very necessary, 4 = necessary, 3 = neutral, 2 = not very necessary, 1 = unnecessary); evaluating the clarity of each indicator description by selecting rating levels (5 = very clear, 4 = clear, 3 = neutral, 2 = vague, 1 = very vague); providing modification suggestions for indicators requiring changes; proposing additional indicators; offering opinions or suggestions on the entire index system.

(2) Questionnaire Data Analysis. Expert scoring data were analyzed using average values, proportion of high-scoring experts (ratings 5 and 4), and normalized standard deviation, with calculation methods shown in formulas (1)-(4). The central tendency of expert opinions was reflected by average values and the proportion of high-scoring experts (ratings 5 and 4). The dispersion degree was reflected by normalized standard deviation, which involves normalizing each expert's scores for every indicator first, then calculating standard deviation based on normalized data. Normalization aims to eliminate individual expert biases and prejudices, reducing evaluation errors. For instance, some experts tend to score the entire index system high overall, where 3 represents a low score in their rating, while others score low overall, where 3 represents a high score. Standard deviation is used to evaluate the dispersion degree between individual values and the mean, typically meaningful when the sample size is $ $5.

The average score formula for each indicator is:

$$\bar{x} = \frac{x_1 + x_2 + \cdots + x_n}{n} \quad (x_n \text{ is the score from expert } n, n \text{ is the number of experts}) \quad (1)$$

The proportion of high-scoring experts (ratings 5 and 4) for each indicator is:

$$\text{Necessity Percentage} = \frac{\text{Number of experts rating 5 and 4}}{\text{Total number of participating experts}} \quad (2)$$

The normalization formula for each expert's score on each indicator is:

$$z_{ij} = \frac{x_{ij}}{\sum_{i=1}^{m} x_{ij}} \quad (3)$$

where x_{ij} is expert j's score for indicator i, and $\sum_{i=1}^{m} x_{ij}$ is the sum of all scores from expert j.

The normalized standard deviation formula is:

$$\sigma = \sqrt{\frac{(z_1' - \bar{z}')^2 + \cdots + (z_n' - \bar{z}')^2}{n}} \quad (4)$$

where z_n' is the normalized score of expert n, and $\bar{z}'$ is the average of all normalized expert scores.

Necessity Determination. For expert assessment of indicator necessity, high-score proportion (necessity percentage) and normalized standard deviation were calculated to determine inclusion, with established criteria. If necessity percentage $< 60\%$, regardless of normalized standard deviation, experts have not reached consensus on the indicator's necessity, and it may be removed or merged with other indicators. If necessity percentage > 60% but normalized standard deviation > 0.005, the indicator requires modification based on expert textual feedback before inclusion in the second round. If necessity percentage > 60% and normalized standard deviation < 0.005, the indicator has reached consensus.

Based on first-round necessity scoring, among the 32 second-level indicators in the preliminary system, 27 reached consensus as necessary indicators. Three indicators (business capability and innovation ability, intelligent collaborative platform construction level, and information literacy education service development degree) had necessity percentages > 60% but normalized standard deviations > 0.005, requiring modification before the next round. Five indicators (self-cognition ability, information network sharing level, library virtual reality space construction, librarian performance evaluation smartification level, and research data management development degree) had necessity percentages < 60% and were considered for deletion or merger.

Clarity Determination. For expert assessment of indicator clarity, high-score proportion (clarity percentage) and average values were calculated, with established criteria. If clarity percentage < 60% or average value < 3.5, indicator clarity consensus was not reached; otherwise, consensus was achieved.

Based on first-round clarity scoring, among the 32 second-level indicators, 26 reached consensus as clear indicators. Six indicators (professional technical personnel proportion, capability and performance evaluation system, self-cognition ability, smart librarian support environment, information network sharing level, and knowledge organization and dissemination service development) did not reach clarity consensus. In fact, even when data showed consensus, modifications were still needed based on necessity and expert feedback.

(3) Expert Consultation Suggestions. The expert panel generally approved the overall framework, considering the dimension and first-level indicator designs relatively comprehensive, while suggesting second-level indicators could be more specific. The panel provided suggestions from both macro and micro perspectives.

Macro-level perspectives and suggestions on dimension design:

Librarian Dimension: Educational background and specialization should be deemphasized. The new round of technological revolution has introduced lifelong learning concepts, with knowledge update cycles continuously shortening, making educational credentials less important for smart librarians. In smart library construction, librarians should continuously learn, innovate, be willing to experiment, and keep pace with the times and technological development.

Infrastructure Dimension: Attention should be paid to the multi-point breakthrough and group advancement characteristics of the new technological revolution, primarily including "three networks and five technologies" (Internet, mobile Internet, IoT; big data, cloud computing, AI, blockchain, 5G), all of which should be reflected in the evaluation indicators. Additionally, applications of new technologies like big data and cloud storage, as well as barrier-free information platforms, fully embody the "new form" characteristics of smart libraries and should be prominently featured in the index system.

Management Dimension: Evaluation of data-driven applications across various systems should be strengthened, focusing on raw data storage, cleaning, and utilization, as well as prediction, recommendation, user profiling, and academic profiling based on big data. Moreover, as the entry point for smart libraries, platforms should be open, treating all people and objects as management platform objects to achieve distributed, lightweight, and iterative management.

Service Dimension: Data literacy and "data quotient" cultivation should be emphasized in information literacy, with indicators for service agility added. Attention should be paid to emerging technology applications in libraries such as AI, AR, and VR.

Micro-level specific suggestions on second-level indicator modifications:

Professional Technical Personnel Proportion: The term "professional technical personnel" was unclear; it was suggested to modify it to "professional information technology personnel proportion." Capability development and training policies, and capability and performance evaluation systems were difficult to assess and required clarification.

Broadband Network Coverage: The issue is no longer coverage but bandwidth; full network coverage does not guarantee smooth usage.

Information Network Sharing Level: Information sharing is often achieved through information systems rather than networks.

Suggestions for additional indicators: Library business data collection equipment and technology applications; off-campus remote access via VPN and other technical means; depth and granularity of literature resource discovery; space utilization accessibility and convenience; intelligence of knowledge mining and organization; librarian incentive mechanism design; think tank service function design.

(4) Indicator Revision Results. After comprehensive consideration of expert necessity and clarity scores along with textual suggestions, the research team analyzed expert opinions and revised the preliminary smart library development evaluation index system accordingly, forming the second-round expert consultation questionnaire.

2.3.2 Second Round of Expert Consultation **(1) Questionnaire Distribution and Recovery.** The second round of expert consultation was conducted via email, targeting the 7 experts who participated in the first round. The consultation covered four aspects: assessing indicator necessity using rating scales (5 = very necessary, 4 = necessary, 3 = neutral, 2 = not very necessary, 1 = unnecessary); providing modification suggestions for indicators requiring changes; proposing additional indicators; offering opinions on the entire index system.

(2) Data and Feedback Analysis. Expert scoring data were analyzed using arithmetic mean method (see formula (1)). Indicators with average necessity scores > 3 were considered qualified for inclusion; otherwise, they were deleted. Based on results, "average annual overseas visits" scored exactly 3, and "library publishing and publishing service development degree" scored 2.86, failing to meet requirements and thus were removed.

In the second round, experts generally agreed that the revised index system was clearer and more rational than the first version, with significantly enhanced operability. Additionally, experts provided improvement suggestions for some second-level indicators. For example, they suggested that evaluation and incentive systems are typically interconnected, so "construction and application maturity of librarian smart evaluation system" and "construction and application maturity of librarian smart incentive system" could be merged into "construction and application maturity of librarian evaluation and reward-punishment system." The indicator "average annual academic conference attendance" could be better operationalized as "funding supporting librarian learning and relearning."

(3) Final Establishment of Evaluation Indicators. After the second round of expert consultation and revision, the research team added, deleted, merged, and modified indicators to ensure scientificity, forward-looking perspective, and operability, ultimately forming the "Smart Library Development Evaluation Index System" comprising 4 dimension indicators, 12 first-level indicators, and 50 second-level indicators.

3. Determination of Smart Library Development Evaluation Indicator Weights

A complete evaluation system typically includes index system construction and indicator weight determination. The index system reflects the attributes of the evaluated object, while weights reflect the importance of these attributes. Based on the previously determined evaluation indicators, this section uses the Analytic Hierarchy Process (AHP) to determine indicator weights through a combination of quantitative and qualitative methods.

3.1 Determining Indicator Weights Using AHP

Two approaches exist for calculating weights of dimension and first-level indicators using AHP. The first approach follows the basic AHP method: constructing individual judgment matrices based on each expert's evaluation data, calculating each expert's weight assignments for relevant indicators, then performing weighted calculations across all experts. The second approach involves weighted averaging, median, or mode processing of each expert's relative comparison values before constructing judgment matrices to calculate final indicator weights. Each approach has advantages and disadvantages. Given this study's relatively small expert panel and varying perspectives on smart libraries as an emerging concept, the first approach was selected to determine weights for "dimension indicators" and "first-level indicators," avoiding the loss of information carried in relevant data.

3.1.1 Constructing the Hierarchical Structure Model Following AHP implementation principles and based on the final smart library development evaluation index system, Yaahp software was used to construct the hierarchical structure for dimension and first-level indicators, as shown in Figure 1 [Figure 1: see original paper]. "Smart Library Development Evaluation" represents the decision goal level, the middle two layers (dimension indicator level and first-level indicator level) constitute the criterion level, and the final layer is the alternative level.

3.1.2 Constructing Judgment Matrices Judgment matrices represent the relative importance ratios between relevant elements at the same hierarchical level regarding upper-level elements. As shown in Figure 1, associations exist between the goal level and dimension level, and between dimension level and first-level indicator level. Therefore, based on evaluation data from 7 domain experts obtained in the second round of consultation, 7 groups of judgment matrix clusters were constructed: "Goal-Dimension Level," "Librarian Dimension-First-level Indicator Level," "Infrastructure Dimension-First-level Indicator Level," "Management Dimension-First-level Indicator Level," and "Service Dimension-First-level Indicator Level." Taking "Goal-Dimension Level" as an example, the constructed judgment matrix S is shown in Table 2 , where W_{ab} represents the relative importance between elements A and B regarding the goal level.

3.1.3 Single-Level Ranking and Consistency Check Based on evaluation data from 7 consulting experts, 7 groups of judgment matrix clusters were constructed to calculate each expert's weight assignments for relevant indicators in the index system and perform consistency checks. The consistency ratio is calculated as $CR = CL/RI$, where RI is the average random consistency index. When $CR < 0.1$, the judgment matrix consistency is considered acceptable; when $CR > 0.1$, the judgment matrix requires appropriate modification. This study used Yaahp software for matrix calculations, setting the "automatic adjustment algorithm" option to select appropriate algorithms for adjusting judgment matrices based on data conditions. Individual expert indicator weights were calculated, and weighted calculations were performed across the 7 experts' results to obtain final single-level ranking weights for the smart library development evaluation indicators.

3.1.4 Hierarchical Total Ranking After determining the single-level ranking weights of the expert group, the relative importance weights of all elements in the first-level indicator layer regarding the highest decision goal layer (smart library development evaluation) were calculated. During calculation, data from each expert were normalized to ensure all element weight sums equal "1," yielding each expert's weight values for all first-level indicators. Finally, weighted calculations across all experts produced the final indicator weights.

3.2 Determining Indicator Weights Using Expert Survey Method: Second-Level Indicators

As the final layer of the entire index system, the second-level indicator layer plays a decisive role in the system's operability and implementability. Therefore, determining the importance weights of second-level indicators relative to the goal layer is crucial for future practical application. However, given the large number of second-level indicators, pairwise comparison implementation and calculation would be excessively difficult compared to dimension and first-level indicator layers. Consequently, this study adopted direct expert weight assignment. The implementation process included two steps: first, inviting the expert panel to score the importance proportion of each second-level indicator within its first-level indicator; second, performing weighted calculations on expert scoring data to obtain final importance proportions of second-level indicators relative to first-level indicators.

3.3 Final Determination of Smart Library Evaluation Indicator Weights

Through the above weight determination processes for dimension indicators, first-level indicators, and second-level indicators, the weights of each indicator element relative to the decision goal layer (smart library development evaluation) were calculated through weighted synthesis. The complete smart library development evaluation index system was ultimately constructed, including 4 dimension indicators, 12 first-level indicators, and 50 second-level indicators, as shown in Table 3 .

4. Smart Library Construction and Development from an Evaluation Perspective

4.1 Smart Representation of Smart Libraries Under the Evaluation Index System

To better demonstrate the overall effectiveness of smart library construction and operation under the evaluation index system, this study employs a "system-space" hybrid approach to construct a smart library system architecture, as shown in Figure 2 [Figure 2: see original paper]. The system analysis level is primarily based on the evaluation index system construction results, approaching the system architecture from four dimensions: infrastructure, management, services, and people, reflecting the library's smart elements and functional layout. The space analysis level, based on the data-driven operational characteristics of smart libraries, abstracts three spatial layers from the internal operational data elements of smart library systems: perception network layer, data management layer, and data application layer, reflecting the smart operation processes and mechanisms. In this framework, data-driven smart operation processes serve as crucial support and internal drivers for various functional elements, while the functional elements and their attributes represent the results and external manifestations of smart operations. The integration and collaborative operation capabilities of relevant elements and functions under the "system-space" hybrid framework constitute the concrete embodiment of the library's "smart" capabilities.

4.1.1 Smart Representation from a Space Analysis Perspective Centered on user behavior and needs satisfaction, Figure 3 [Figure 3: see original paper] abstracts the cyclic process from the overall architecture system. First, user demand is the key and core to ensuring sustainable library development. In the specific operational process, libraries utilize network transmission and intelligent perception technologies to intelligently identify user behaviors and needs within the library system. According to metadata standards and specifications preset by librarians in the system, user behavior data are automatically recorded and transmitted to user data platforms for organized storage. Then, the big data pool integrates multi-source data including information resource data and user data, performs automatic profiling and feature tagging for each user or user group based on manual or machine modeling using big data and deep learning technologies, and ultimately generates products meeting basic user needs either automatically by computer systems or through deep services provided by professional librarians combining their expertise with system analysis results. Finally, librarians store generated smart products in the library knowledge base and user feedback in user databases, providing more data support for subsequent user demand analysis and satisfaction. In new service cycles, the system continuously optimizes data models based on user feedback and new behaviors through iterative processes to provide more personalized and in-depth services.

In this operational process, library "smartness" is manifested in two aspects: first, the intelligent processing of data including intelligent collection, organization, and analysis, as well as machine model construction based on big data technology and deep learning, representing essentially machine intelligence; second, the "wisdom" input and participation of librarians, including the construction of various standards, specifications, and models required for system operation, and demand solutions provided by librarians based on their professional knowledge with the assistance of technical systems and resources. These two aspects of "smart" representation fully embody the "human-machine coupling" operational characteristics of smart libraries.

4.1.2 Smart Representation from a System Analysis Perspective As shown in Figure 2, the smart library system mainly includes four modules: infrastructure layer, smart management layer, smart service layer, and smart people. During construction and operation, the smart representation of each functional module is manifested at three levels: first, system platforms or devices built based on information technology possess intelligent and automated characteristics; second, librarians with professional knowledge and capabilities can create and generate intellectual resources; third, librarians and system platforms assist each other to achieve intelligent management and smart services.

First, the deployment of underlying network transmission, intelligent perception, and intelligent control technologies and devices in smart libraries serves as a key channel and important window for data acquisition during system operation. These can intelligently monitor, identify, and collect real-time dynamic data from various systems, equipment, and collections within the library, as well as perceive, identify, and collect various behavioral data generated from user-library interactions. Relevant data are then transmitted to different data modules in the smart management layer, where the library big data operation and management center uniformly manages all data, providing technical support and security assurance for achieving comprehensive perception and interconnection, precise and efficient services and management, and data fusion and information sharing among different systems and business departments within the library. In the smart library system architecture, resource procurement management, information resource management, personnel data management, and system data management in the smart management layer, as well as service projects in the smart service layer, all depend on infrastructure construction and normal operation.

Smart management, based on various system platforms and databases, utilizes Internet, IoT, big data, and AI technologies to perform management functions. It describes, organizes, and optimizes multi-source data related to resources, personnel, and systems, thereby achieving efficient and precise management as a key hub in the smart library system architecture. The formation and development of smart management require infrastructure support and actual participation of smart people, and its development has a decisive impact on the effectiveness of smart services. The resource procurement management system module: librarians comprehensively consider resource performance, user needs, supplier evaluation, funding, and strategic development goals to construct procurement models, enabling personalized self-service selection through established online procurement processes and automatic collection of procurement resource metadata. The information resource management system module: performs digital processing of various collection resources, establishes standardized metadata, and uses data mining and semantic recognition technologies for automated and intelligent indexing of relevant resources, thereby achieving integration of massive information resources and providing guarantees for unified retrieval and deep knowledge mining. The personnel data management system module: collects dynamic behavioral data of users through perception technologies and system logs, combines them with static user data to construct data models and user profiles, identifies user needs, and creates conditions for subsequent personalized and precise services. The system data management module: primarily monitors static and dynamic data of library physical spaces and equipment assets, facilitating orderly operation and optimized management.

Smart services are activities that directly or indirectly utilize librarian wisdom to meet user needs, where infrastructure serves as the service means, data is the key core, and librarians are the main providers of in-depth intellectual services. Smart services mainly include three aspects: Space services: primarily addressing users' spatial needs by combining information technology with library physical scenarios and information resources to provide intelligent, immersive, and open innovative space services. The creation of innovative scenarios and intelligent space services represents concrete manifestations of library "smartness." Resource guarantee and management services: primarily addressing users' information resource needs by providing one-stop integrated retrieval and discovery services for all types of resources based on the big data operation and management platform in the smart management module, performing deep analysis and knowledge mining based on search topics and results to automatically generate knowledge graphs and research trend reports. Additionally, based on user behavioral data and built-in system models, user profiles are constructed to push high-quality information resources and services. Capability cultivation and intellectual support services: these services primarily depend on librarian intellectual input. On one hand, through information literacy, data literacy, and innovation literacy services, librarians improve users' abilities to apply information and data using various convenient technical devices and tools, transmitting a "teaching how to fish" wisdom. On the other hand, by employing big data and AI analysis and mining methods, librarians create decision support services and products for users, transmitting a "giving a fish" wisdom.

Smart people, as an important supporting element of the smart library system architecture, are both managers and operators of smart libraries and beneficiaries of smart library construction achievements. The formation and operation of all elements in the smart library system architecture cannot be separated from human participation and rely on human wisdom for selection and expression. Librarian wisdom is mainly manifested at two levels: assisting machine operation and providing intellectual services.

4.2 Smart Library Construction Strategies Under the Evaluation Index System

Based on the determined evaluation indicator weights, this section analyzes the importance of various indicator elements and proposes reference ideas for smart library construction practice.

4.2.1 Dimension Indicators and Smart Library Construction In smart library construction, the importance of service, management, infrastructure, and librarian smartification for library smartification construction ranks from high to low. Services carry the largest weight value in the entire index system, aligning with the library development philosophy of "service is king, user is supreme" and the nature and positioning of cultural service institutions. During library smartification, smart services should be considered a very important and core goal. Management and infrastructure rank second in weight, with the expert group considering these two factors equivalently important for smart library construction and development, which corresponds to their roles in library construction. Management is the core of orderly library operation and development, as well as the prerequisite and guarantee for efficient services, representing an important component of library soft power. Without smart management, various software and hardware resources cannot maximize their utility. Infrastructure serves as an important carrier and intermediary for management and service work, representing a key manifestation of library "intelligent" characteristics. Without intelligent and smart infrastructure configuration, smart management and services cannot be realized. Librarians account for 16.52% of the total index system weight. Although this is the smallest among the four dimensions, the difference is not extreme. Therefore, smart library construction should proceed step-by-step, prioritizing management and infrastructure smartification while increasing investment in librarian team smartification when conditions permit.

4.2.2 First-Level Indicators and Smart Library Construction **(1) Librarian Dimension.** The librarian dimension includes three first-level indicators, with A3 Subject Capability and Cognition carrying the largest weight, equivalent to the combined weight of the other two indicators. This indicates that in librarian team construction, capability cultivation and enhancement are paramount. In fact, talent team construction planning and training systems both serve to promote librarian team and capability development. A2 Talent Training System carries greater weight and importance than A1 Talent Structure and Distribution, demonstrating that institutional guarantees are key support for librarian construction in smart libraries.

(2) Infrastructure Dimension. Within the infrastructure dimension, B3 Information Platform Construction carries the largest weight, accounting for nearly half of the first-level indicators' importance. This shows that information platform construction is most critical in library infrastructure development, inseparable from the current technological environment. In the new technological environment, both libraries and other entities cannot operate without information technology support, and efficient management and services largely depend on information platform construction. B2 Public Space Smartification ranks second in importance, representing the application and extension of new technologies in library physical spaces beyond network virtual spaces like information platforms, and is essential for achieving library intelligence. B1 Information Communication Infrastructure carries the smallest weight. Although such infrastructure does not have high direct utility in smart library operation, it is necessary for developing a series of smartification initiatives. Therefore, in the current environment, infrastructure construction should first ensure basic information communication facilities and technology applications, with emphasis placed on information platform construction.

(3) Management Dimension. Although no extreme values exist among first-level indicator importance proportions in the management dimension, differences remain. Operations Management carries the largest weight, representing the highest stage of library management processes. Its smartification level greatly influences smart library construction and smart service realization. Literature Resource Construction and Management ranks second in importance within the management dimension, with a gap not far behind Operations Management, representing the core of library management and service processes. Literature resources are the foundation of library construction and development, and their construction and management have decisive impacts on service quality and long-term development. Regarding Personnel Management, people are the only element capable of subjective initiative, the "living" existence in libraries. Collecting and managing user and librarian data is the prerequisite for operations management and key to achieving smart services. Therefore, in smart library construction, sufficient attention should be paid to operations management, highlighting the importance of data-driven libraries. Literature resource construction and management should also be placed at the core of smart library construction, with personnel management considered concurrently.

(4) Service Dimension. Within the service dimension, Resource Guarantee and Management Services carry the largest weight, followed by Capability Cultivation and Intellectual Support Services, with Space Services carrying the smallest weight. The importance proportions of the first two far exceed space services, aligning with current user needs and library development environments. In today's digital and networked era, service methods and content accessible without leaving home better conform to user behavior habits and needs, making them more popular. As an important component of information service institutions, resource capability is libraries' greatest distinguishing feature from other information institutions and their greatest advantage. Capability cultivation and intellectual support services represent important aspects of libraries continuously expanding service content and enhancing service capacity during development. In summary, in cultivating smart library services, resource services should be prioritized, while strengthening capability cultivation and intellectual support services, deploying more funds and energy into these two service categories.

4.2.3 Second-Level Indicators and Smart Library Construction

Among the 50 second-level indicators, 6 have weight values $> 4\%$ relative to the goal layer of smart library development evaluation, ranked by weight as: D31 (Decision Support and Think Tank Service Development Degree), C31 (Resource Utilization Analysis Smartification Level), D22 (Knowledge Resource Deep Mining Service Accessibility), D23 (Personalized Service Precision Degree), C32 (User Behavior Analysis Smartification Level), and

D21 (Resource Discovery and Utilization Accuracy and Convenience). D21 is the only indicator with weight > 5%. These results show that service precision, intellectualization, and personalization, as well as smart analysis of user behavior and resource utilization, are most important for smart library construction. Additionally, many indicators have relatively low weights, such as blockchain technology and AR/VR applications in libraries. Comparing high-weight and low-weight indicators reveals that while introducing and applying emerging technologies is important, data-driven development and service content optimization are more critical in smart library construction. Therefore, in practical construction, libraries and other practice entities should grasp the essence of smart libraries, highlight key construction points, and simultaneously consider other aspects.

Smart library evaluation is an important component in advancing smart library development. Its research, together with studies on conceptual features, technology applications, and service models, constitutes a complete smart library theoretical system. The evaluation index system constructed in this study demonstrates strong practicality and operability, providing not only new ideas for future smart library evaluation research but also theoretical guidance for smart library construction practice, facilitating the standardization and normalization of smart library construction, management, and evaluation work. However, these research results were constructed under current development environments and cognitive levels. For future smart library construction practice and research development, the evaluation system requires further in-depth study and improvement.

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Author Contributions:
Duan Meizhen: Data investigation and paper writing;
Chu Jingli: Conceptual guidance and paper review;
Zhang Dongrong: Paper revision and review;
Zhang Ying: Data compilation and paper revision.

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Research on the Construction of Evaluation Index System of Smart Library Development in Colleges

Duan Meizhen[1,2], Chu Jingli[3,4], Zhang Dongrong[3,4], Zhang Ying[3,4]

[1]Information Research Center of Military Sciences, Academy of Military Sciences, Beijing 100142, China
[2]Library of Academy of Military Sciences, Beijing 100039, China
[3]National Science Library, Chinese Academy of Sciences, Beijing 100190, China
[4]Department of Library, Information and Archives Management, School of Economics and Management, University of Chinese Academy of Sciences, Beijing 100190, China

Abstract:
[**Purpose/significance**] The evaluation index system of smart library develop-

ment is constructed by combining quantitative and qualitative methods, which provides scientific standard and quantitative tool for the evaluation practice of smart library. [**Method/process**] Based on literature research and object-oriented analysis of smart library, the index system was preliminarily formulated. Then, aiming at the preliminary indicators, Delphi method was used to carry out expert consultation, and the final evaluation index system was determined. Meanwhile, Analytic Hierarchy Process (AHP) and expert survey were used to calculate and determine the weight of evaluation indexes. Finally, based on the evaluation index system, the development strategy and operation of smart library were analyzed. [**Result/conclusion**] The evaluation index system of smart library development was constructed, which consisted of 4 dimensions, 12 first-level indexes and 50 second-level indexes. Under the perspective of evaluation, the smart representation and development strategy of smart library were provided.

Keywords: smart library; evaluation index system; Delphi method; analytic hierarchy process (AHP)