

Metropolitan digital library services evaluation: Measures and approaches^①

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Abstract This paper reviews the evaluation model and measurements according to metropolitan digital library activities. Through literature review and historical research, the authors argue that the evaluation of the digital library (DL) is still in a research stage and not yet of value to the real achievement of the DL in operation. Because of the variety of the understandings of the digital library and the complexity of the technical factors, we can put forward a set of reference models, measurements and approaches to combine with the various research on the evaluation theory and practice in the digital library area. The authors primarily discuss and conclude with a digital library evaluation model and measurement index system according to the requirements of the world metropolitan libraries.

Keywords Digital library, Digital resources, Evaluation, Evaluation model, Evaluation index system

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1 Foreword

Cities are the centerpiece of human civilization, where libraries are located and functioning as dissemination centers of information, knowledge and culture. International metropolitan libraries, composed primarily of public libraries in large cities, plus the national, academic, special and research libraries that serve the public as well, are homes to world's written heritages and have made notable progress in digital library development. They jointly shoulder the responsibilities of preserving cultural heritages, conducting social educations, spreading information and developing intelligent resources, though their focuses may vary.

Today, international metropolitan libraries are facing both the opportunities and challenges in terms of combining traditional library functions with digital technologies and extended applications to foster a "hybrid library". Nowadays when a library, and in particular a comprehensive mega-library is rated, its capacity in collecting, processing, sorting, distributing and utilizing digital resources is always involved. In other words, its digital library component is an integral and indispensable part of the metropolitan library evaluation.

Apart from an array of success stories that have flourished in China's digital library programs since the late 1990s, there are problems, revealed by the lack of planning



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and coordination in operation, redundant management, excessive and repetitive digitization programs, development of the digital library by unsophisticated programs of digitization; and most importantly, an oversight of performance evaluation when a program commences. Digital library research writings in foreign countries, contrarily to China, are measured, evaluated and overseen by related executors, directors and supervisors at different levels and in different ways, throughout the whole process. Their program initiation and approval, execution and completion, warrant our in-depth study.

2 Research Outline

This research is a part of the program “Research on the Measurement System of the International Metropolitan Libraries”, announced in 2005 as a key project of the “National Funds for Philosophy and Social Sciences Research” led by Professor Wang Shiwei, Deputy Director of the Shanghai Library. It targets the issues involving digital library evaluation that will have a universally applicable solution to compensate the absence of a viable evaluation model. It is hoped that guidelines for digital collections and services for traditional libraries will be developed in order to build the mentioned hybrid libraries, namely the physical libraries that are going digital.

It is widely recognized that all libraries leveraging the computer and network technologies to enhance the digitized resources, information storage, management, delivery and services are considered as digital libraries. In his landmark book “Practical Digital Libraries: Books, Bytes and Bucks”, Michael Lesk argued that digital libraries are far from just the aggregates of digitized information. Digital library evaluations are generally divided into three categories; namely the technical indicators such as software and applied system, the achievements or the findings of a given project and initiative, and entities offering digital recourses and services, a.k.a. the “hybrid” libraries. If by characteristics of the evaluation systems/models, they fall into the business-oriented type, and focus on what libraries have inputted, i.e., the extent and rationality of resources acquisitions; the service-oriented type, i.e. examining end users’ perceptions and gains and the contributions made by digital libraries.

This paper defines “digital library” as “the integral or partial to the digital service system organized by social entities such as repositories of documents and information”, and it gives inertia to a meaningful performance of digital resources and services of the hybrid libraries. Important indicators of the other two types of evaluations are introduced but as a whole. It highlights the evaluation of the service quality of institutional entities and doesn’t apply to specific projects such as digital library R&D and construction.

3 The Evaluation Model

The obscurity of the definition of “digital library” has led to the intricacy of digital library evaluation, about which mixed interpretations are generated. A review of



published literature has concluded that DL evaluation as a research topic in foreign countries remains in the stage of “academic discussion” albeit a number of models and frameworks have already been advanced.

Any evaluation is a process of measurement and scaling of the object. It is conducted by the subject per the evaluation model. The subject, object and model form a triangle topology, as shown in figure 1.

The evaluation subjects are entities who are specifically motivated to take the initiative to library performance assessment. Generally speaking, they consist of library observers, supervisors, intermediary organizations, patrons and libraries themselves. Thus library evaluations are structured by subjects into management evaluation, user evaluation and self-evaluation.

The objects are those whose performances are to be measured, along the lines of those three types of DL evaluations presented in Chapter 2 are categorized. The

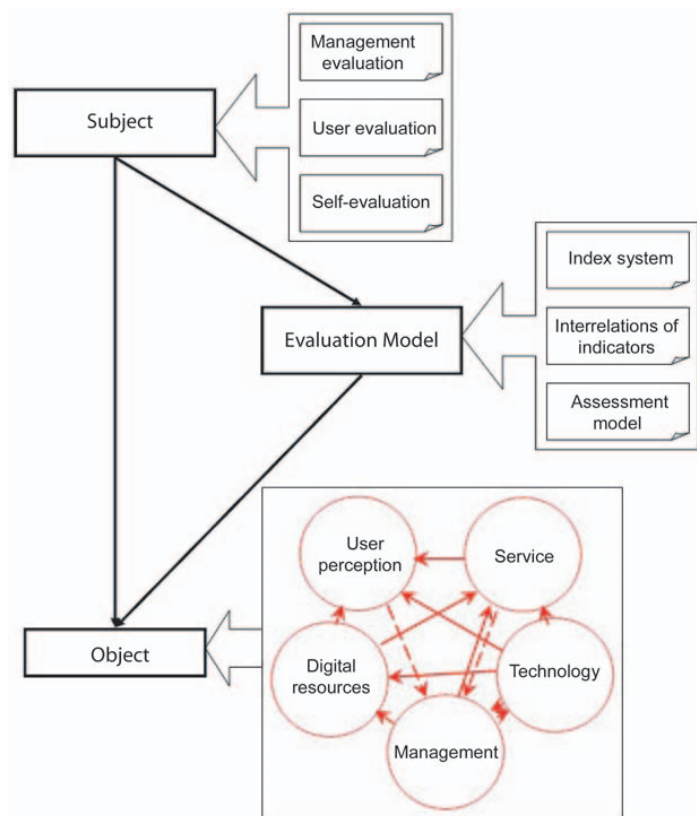


Fig. 1 The subject-object-evaluation model triangle.



evaluation of the digital resources and services of a hybrid library is different in purpose, then targeting at the software and technologies or DL programs. This paper is the first of its kind that differentiates DL evaluations by their stated missions. Furthermore, various evaluation models with different perspectives and tools measurement may be established to assess the same object. Thus the DL evaluation can accordingly be separated into several sub- categories such as comprehensive evaluation and single evaluation, macro-evaluation and micro-evaluation, or input evaluation and output evaluation.

As long as the evaluation is concerned, the object, though being treated as an objective entity, is nonetheless inescapable of value judgments from the subject. The significance of evaluation lies in the measurement of how much the object can satisfy the subject, which depends on the subject's perception and understanding of the properties and functions that the object bear. On the basis of perception and understanding, the evaluation model is formed, which is a process of abstraction by the subject towards the object. Generally, it dose not factor culture into the consideration and procedural matters. This evaluation model pays more attentions to the library business flow and progress that have something in common. Different types of libraries with their unique characteristics, however, may show varying degrees of intensity to such systems.

Thus it can be concluded that this evaluation model is a kind of value-biased carrier. A same object can be evaluated by a range of models stemming from different perspectives. An evaluation model is composed of indicators. Indicators are derived from the results of measurements and the standards of evaluation practices. Evaluation occurs in discourses, measurement is not necessarily a process equivalent to evaluation — the same value of measurement and evaluation results may project totally different images in different conditions and contexts. The purposes and the requirements of evaluation, therefore, are the determinants.

Thus we can summarize that the evaluation model is in fact established on the basis of the knowledge of the object, appended by a set of measuring methods and value-judging systems. Figure 1 illustrates that a comprehensive DL evaluation divides its objects into five organic components; namely, digital resources, services, technologies, management and users' cognition, which are measured by relevant indicator systems and evaluation models. An evaluation can be applied to such single category, or vise versa using another viewpoint or model. The establishment of a logical model, based on scientific methodologies, is regarded paramount for a successful evaluation.

The interrelation of the indicators is a part of the evaluation model prone to be neglected. When an assessing system is set up, a series of indicators are identified at first, followed by assigning them with different weights. In the case that there are more indicators involved, sorting and classification are needed as well. All these are then filed into a document to standardize approaches on statistical and analysis. Ultimately an evaluation system is thereby established. However, ideal system still needs to explicate two more types of relations connecting indicators:



- The relation of forms: to meet different needs, an assessing system is supposed to be capable of determining the complexity of the evaluation according to objectives and scales it should also be capable of defining a number of “indicator groups” to fit in with different emphases; and of citing values relevant to the applied models (e.g., absolute value vs. relative value, and the coherence of the unit of the values cited). This is to say, each indicator needs to be defined in terms of applied scope and values, and will be matched with each other in real pictures.
- The relation of contents: the indicators are interdependent and inter-restricted. Sometimes indicators are different interpretations of a same property or feature, in which case a simplified system is possible by merging those overlapping in meanings. Reversely, an indicator may have varied applicabilities availabilities within different settings, which affects the selection of indicators and the adoption of variable scales and measurement units.

To sum up, we propose that the DL evaluation model be constructed with the following essential features:

- Integrity: it reflects the subject’s overall understanding of the object, and can reach the goal of the evaluation directly or indirectly.
- Operability: including the accessibility of data and the intuitiveness of evaluation.
- Flexibility: the assessing system can be merged or partitioned as requested by certain goals or objectives. All evaluation approaches are optional, such as the fineness of the indicator, absolute value or relative value, the unity of value, etc.
- Expandability: the index system can be limited, modified or expanded in certain settings by the subject so as to become upward compatible and not to interfere with the completeness of the whole system.
- Rationality: the text used as the basis of evaluation should standardize the method of naming, defining, forming, data acquisition, sampling and implementation of measuring and calculating. Ideal, relevant software should be developed to have all indicators registered and converged to realize the task of automatic data acquisition, examination, tracking, studying, judging and accumulation, and ultimately, the data mining.

4 Standards and Practices

It is next to impossible to present in this paper an exhaustive list of the scores of DL evaluation cases and related standards that our study has reviewed, including those DL initiatives, systems and organizations. In table 1, there are eight standards or items with relatively high correlation to this study, which are screened out and briefly compared.

The table provides assistance to our study of the evaluation of the digital library resources and services of city public libraries, which are examined as “hybrid” libraries combining tradition library operation with services in digitized form.





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Table 1 Standards and items of DL evaluation

Standard/item	Content	Number of Indicators	Characteristics
ISO 2789:2002: Information and documentation — International Library Statistics, Appendix A	Performance indicators for electronic library services, including 4 core indicators (the number of sessions, downloads and visits, etc.) and 4 optional indicators (the number of retrievals, rejects, etc.).	8	<ul style="list-style-type: none"> Objective and static indicators, falling short of the evaluation of investment, staffing and effect; Slightly outdated as an established model.
NISO Z39.7-200X: Information Services and Use: Metrics & statistics for libraries	A complete collection of standards for library statistics and measurement; a number of indicators are associated with digital library resources and services.	23	<ul style="list-style-type: none"> Conventional digital library resources, statistics of visits, relevant services, and training are listed; Likely to be lagged behind.
ARL E-Metric Initiative	"Evaluation index system for digital resources usage", focusing on statistical data capture	20	<p>Relatively functionally complete. Four aspects are considered:</p> <ol style="list-style-type: none"> 1. Availability of the statistical data; 2. Effectiveness of the proposed methods; 3. Possibility of collecting the designated data; 4. Feasibility of collecting the specific data.
ISO11620 (1992/1998): Library performance indicators	Standards for traditional library evaluation, involving the degree of satisfaction, reader service, technical service, staffing, etc.	29 indicators in 5 categories	<ul style="list-style-type: none"> Few digital library features such as information services and digital resources provision are involved
European Library Performance Measurement and Quality Management System, "EQUINOX", 1998	"Digital Library Performance Measurement Indicator System", comprising 14 indicators in 5 categories, i.e., digital resources usage, cost of electronic service, infrastructure, staff developing and training, and user satisfaction.	14	<ul style="list-style-type: none"> Can be seen as an appendix to ISO11620. Comprehensive evaluation objectives, including resources, services, user satisfaction and investment; Some indicators are difficult to obtain or too complex

Table 1 Continued

Standard/item	Content	Number of Indicators	Characteristics
ARL: COUNTER: Counting Online Usage of Network Electronic Resources	Standardize the online usage of network digital resources	55 vocabularies are defined; 8 codes of report and their levels are stipulated	<ul style="list-style-type: none"> Aiming at an independent and universally accepted standard of statistics of online database usage. The approaches of using electronic resources have changed a lot due to the rapid growing technologies.
SERVQUAL/LibQUAL+/DigiQUAL	<ul style="list-style-type: none"> SERVQUAL is a system to measure the user satisfaction with all service providers, including indicators and methods. LibQUAL+ was improved on the basis of SERVQUAL by ARL to evaluate traditional library services; DigiQUAL+ was developed by ARL to evaluate the National Sciences Digital Library project 	LibQUAL+ 22 questions	<ul style="list-style-type: none"> Based on massive survey, library service quality is divided into five aspects: service efficiency, reliability, overall environment, collection provision and access to information. Currently it falls into the following three categories: service effects, resources control and library environment.
Chinese Ministry of Culture, "Rules and standards for evaluation indicators of provincial-level libraries"	Indicators are classified into 6 grades: Grade I. 6 parts; Grade II. 28 items; Grade III. 67 sub-items; Grade IX. 11 factors. ... Total score: 1,000	Between 4 and 5	No specialized DL evaluation indicator. Other relevant indicators include: <ul style="list-style-type: none"> Amount of acquisition of electronic collections; MARC data; Amount of databases; Number of computers; The web and the website...



All the eight systems listed above have their own advantages, yet obviously they are all less than enough to meet our aims of evaluation. They need modification. Their respective stands, however, deserve reference. Generally, they are separated into the user-centered type and administration-centered type, both adopting the indicators of usage measuring (the measurement of service), which reflects to a large extent the user perception, or satisfaction with library services; and the measurement of resources, in order to assess the library performance and efficiency. Both have their strong and weak points. An evaluation based on nothing but users' perception is able to represent the value of library services by measuring its output, but fails to yield a balanced and fair judgment of the overall functions of library. This is unrealistic and subjective. On the contrary, an evaluation merely from the perspective of administration angle is to affirm empirically the practices in current use. This is often found trivial and indulged in the existing programs and business flows and it is difficult to find the real problems and get betterment. Therefore, a more comprehensive and reasonable rational approach is to the two means of measurement to be applied simultaneously.

5 The DL Evaluation Model and Objectives for Public Libraries

This study places ordinary city libraries in a central position, while factor the more salient features of "international metropolitan libraries" into consideration. In other words, the assessing system of the metropolitan library evaluation is more diverse and comprehensive, whose indicators can meet the demands of different ordinary city libraries.

City libraries, as traditionally classified in the library science, are public libraries, national libraries, research libraries and academic libraries that are located within the city limits and are open to the general public. More specifically, metropolitan libraries are situated in populous and culturally diverse world-class cities. Our research delved into national libraries and public libraries in fifteen world metropolises, including Washington, New York, Toronto, London, Paris, Berlin, Moscow, St. Petersburg, Alexandria, Sidney, Tokyo, Singapore, Beijing, Shanghai and Hong Kong. These libraries are chosen because they are world famous libraries or libraries located in world class cities. They have been playing a pivotal role in their own countries in promoting library and information service development. They serve a huge population and receive proportionally sufficient funding from both government and society. Certainly these libraries are representatives of leading library service providers on world-side scale and standing at the front in the library circle.

The four areas that city libraries are having immediate impact on the development of their digital resources and service system:

- Versatile in function: a city library is supposed to serve the public first and foremost, and is incumbent on delivering equal access to knowledge and also to narrowing diminishing information divide. A city library shall also be committed to resources and services aiming to promote city's scientific, technological, educational, economic and cultural development.



- Guardian of culture and civilization: many city libraries are regional repositories of culture, especially the written heritage. They have a function to systematically collect and preserve resources in any media and any historical perit.
- Research center: many city libraries are research libraries as well, responsible for urban management, social and cultural development and information consultation, along with the routine disciplinary and professional researches.
- Service provider: this is the essence of the modern library, and the most important footing of library evaluation.

Based on these areas and understandings of the library evaluation, we propose an evaluation model for digital resources and service system of city libraries, as shown in figure 2.

The DL evaluation assess system based on the model shown in figure 2 is expected to help the metropolitan library reach the following eight goals:

- To provide users with sufficient digital resources. “Sufficient” means the recipients of DL services within an appropriate area are guaranteed with a certain amount of digital resources, which can be quantifiably measured by the indicators of resource collection and availability.
- To provide users with easy, barrier-free access to relevant facilities and equipments.
- To ensure satisfying library loans aided with sequent services, including web-based remote service.
- To secure the permanent preservation of all kinds of resources, digital and non-digital. Permanent preservation usually refers to life cycle management of digital

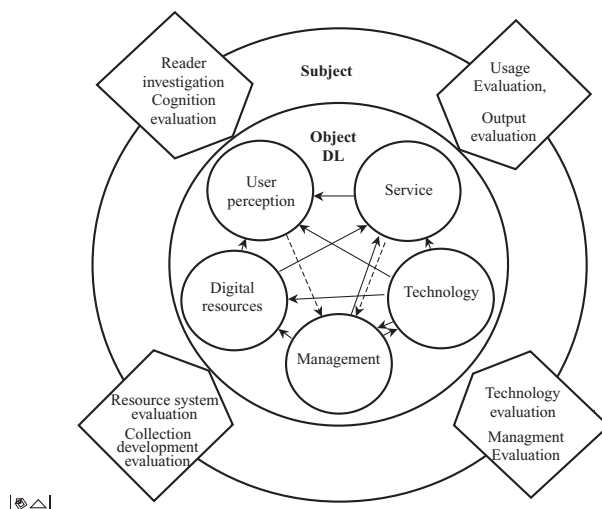


Fig. 2 DL evaluation model.



contents and their carrier. Guidelines assisted with improved governance mechanisms are in need to pertinently regulate the keeping of digital resources, including digitized library holdings, electronic subscriptions and free web resources.

- To encourage people to make full use of digital resources and launch relevant campaigns and conduct trainings.
- To guarantee readers satisfaction with library services.
- To provide users with resources diverse in languages, media and means to use.
- To provide staff with opportunities of a variety of training courses.

6 The Outline of DL Assessing System of City Public Library

An assessing system should consist of a group of standardized texts, in which the general principles, glossaries and definitions, notes of indicator classification, detailed rules, means of statistic gathering of interpretation, guides for implementation and case-studies. The definitions of glossaries should be given standardized descriptions in order to realize web-based glossary management in the future. The following is a general outline of an assessing system and its basic description.

Performances of digital resources, service, management and user perception shown in the above table are briefly demonstrated by 13 primary indicators and 18 secondary indicators, among which 9 are for digital resources, 13 for services, 8 for management and 1 for user perception. Indicators marked with asterisk, i.e., indicators belong to the R02/S03/S04/S05/M02/P01 codes can be applied repeatedly in actual use. They serve as the measurements of a variety of digital resources or services objects provided that they can be differentiated in advance; and can be defined as indicators of all types of digital resources. In practical assessment of digital resources or applied systems the tracking reports are provided as the basis of evaluation and selection for the next year. The indicators labeled with “a” can replace others, which means indicators with or without “a” can be used alternatively or jointly.

Either primary or secondary or both types of indicators can be applied in actual use. In the last case, some of the primary indicators can be omitted, since a multiple number of secondary indicators make up the primary ones; or attributions of some secondary indicators will be relocated. In traditional library evaluations, if the performance of some indicators has been taken into account, several primary indicators can be selected to directly reflect performance of this type so as to simplify the overall assessment of digital resources and services. For instance the digital resources performance can be evaluated either by the “Total amount of full-text database” indicator directly or by a sum of several primary indicators. Corresponding stipulations can be made in “guides to the implementation” of specific evaluation activities, and will be verified and configured in the follow-up evaluation systems.

Upon the completion of indicator measurement, the absolute values acquired from the evaluation should be translated into relative values or scores for the purpose of comparison. The weighting schemes of the indicators can be predetermined by



Table 2 A DL assessing system (Level 1 and level 2)

Code	Indicator	Definition	Level	Value	Subjective /Objective	Absolute /Relative	Remark
Performance of digital resources							
R01	Amount of secondary literature database	All secondary literatures and bibliographic record databases	1	Number of records	Objective	Absolute	Excluding full-text databases of e-journals
R011	Amount of self-developed secondary literature database	Self-developed databases of bibliographic records, index and abstracts	2	Number of records	Objective	Absolute	
R012	Ownership of the secondary literature database	Amount of locally preserved secondary literature databases	2	Number of records	Objective	Absolute	Excluding the databases that were acquirable in given periods and are inaccessible since expiry of subscription
R02	Amount of full-text database		1	Number of pieces/bytes	Objective	Absolute	Including full-texts of e-journals, e-books and free web resources
R021	Amount of self-developed full-text database	Amount of self-digitized data	2	Number of pieces/bytes	Objective	Absolute	
R022	Ownership of full-text database	Total amount of collected digital resources, no matter acquired from which channel	2	Number of pieces/bytes	Objective	Absolute	Excluding the databases that were acquirable in given periods and are inaccessible since expiry of subscription
R03	Amount of multimedia databases		1	Number of bytes	Objective	Absolute	
R031	Amount of self-developed multimedia digital resources	Amount of self-digitized multimedia resources	2	Number of bytes	Objective	Absolute	
R04	Total amount of self-developed digital resources	Sum of R011, R021 and R031	1	Number of pieces/bytes	Objective	Absolute	Able to replace R011/R021/R031



Table 2 Continued

Code	Indicator	Definition	Level	Value	Subjective /Objective	Absolute /Relative	Remark
S01	Amount of computers for users		1	Number of seats	Objective	Absolute	Excluding the computers exclusively for OPAC retrieval
S011	Amount of web-connected computers for users	Total amount of web-connected computers or seats	2	Number of seats	Objective	Absolute	
S012	Wireless access to the Internet	Amount of seats/bandwidth for users to access to the Internet with their own computers	2	Amount of seats/AP*bandwidth	Objective	Absolute	Values can be stipulated specifically
S02	Number of online enquires		1	Total number per year/ median number per day	Objective	Absolute	Values can be stipulated specifically
S021	User satisfaction with online reference service		2	Percentage of user satisfaction	Data collected from subjective survey	Relative/percentage	Values are stipulated specifically in guide
S03*	Number of visits to website/resources	Click rate of web pages	1	Total number per year/ median number per day	Objective	Absolute	
S031	Number of visits of web pages and resources	Visits by independent IPs	2	Total number per year/ median number per day	Objective	Absolute	
S032	Number of retrievals of resources	Absolute number of enquiries	2	Number	Objective	Absolute	
S04*	Number of registered user	Registered user with permission to visit web pages	1	Number of person	Objective	Absolute	
S041	Ratio of registered users to target users		2	Percentage	Objective	Relative	Definition of target user value required

Table 2 Continued

Code	Indicator	Definition	Level	Value	Subjective /Objective	Absolute /Relative	Remark
S042	Usage rate of registered user	Number of log-in per unit time per person	2	Number	Objective	Absolute	Definition of unit time required
S05*	Number of downloads		1	Number of pieces/bytes	Objective	Absolute	
S051	Number of downloads per person	By number of registered users	2	Number of pieces/bytes	Objective	Absolute	Definition of unit time required
M01	Total expenditure on electronic resources	Total investment for electronic resources purchase per year	1	Unit of money	Objective	Absolute	
M01a	Percentage of expenditure on electronic resources		1	Percentage	Objective	Relative	
M021	Unit cost of resources usage	Average cost of usage of a given resources per person per time	2	Unit of money	Objective	Absolute	Calculated with the direct cost of resources purchase or subscription; excluding the cost of management and equipment
M022	Unit time of resources usage	Average time of usage of a given resources per person per time	2	Time	Objective	Absolute	
M023	Usage rate of computer	Average time of usage per computer per day	2	Time	Objective	Absolute	
M03	Amount of user training for resources usage	Time or times of user trainings	1	Time/ times	Objective	Absolute	
M031	Percentage of trained persons	Rate of trained persons to total number of target users during the evaluation	2	Percentage	Objective	Relative	Target user can be the registered users or the total number of users
M04	Training for staff	Average times or time of trainings for each staff	2	Time/ times	Objective	Absolute	Specific stipulation required
P01	Degree of satisfaction	Data from the satisfaction questionnaires	1	Percentage of respondents	Subjective	Relative	

Users' perception

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different subjects through employing Delphi approach. All should be established in evaluation models.

7 Conclusion

Based on the research on major international DL evaluation standards and programs as well as the domestic practices, this paper proposes an assessing system suitable for hybrid libraries to evaluate their DL constructions and services, which is graded depending on the level of details. Users of this system are recommended to be flexible in selecting indicators, stipulating measurements, and working out evaluation models and guides to the implementation under its framework, so as to create an assessing system that can fit their own needs.

It deserves to be noticed that the proposed system is but an initial achievement of a pilot study, still far from being specific, practical, operable and integral. As such, it should be regarded as a methodology than as an assessing system. Moreover, the evaluation of DL construction and the web page of metropolitan libraries, as well as the sum-up of international DL evaluations are too broad to be covered by this study.

This study of the evaluation is expected to function as the guidance for DL construction, management and service, while facilitating the overall development of digital library projects in related areas of China, in particular the development of Chinese hybrid libraries. A rational assessing system, in summary, will steer and identify criteria factors of the development of DL construction and services. It defines positions and responsibilities of all subjects, draw more attentions from policy makers at all levels, promote the sustainable development of digital library, and ultimately, make contributions to a civilized and harmonious society.

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