

General review of National Digital Library Development in the National Library of China

SHEN Xiaojuan*, WEI Wei & QI Xin

National Library of China
Beijing 100081, China

Abstract—As an important part of National Digital Library (NDL), the National Digital Library Project (NDLP), which was launched in 2005, has attracted wide attention of the society in general. This paper introduces the general situation of the project from the following aspects, namely, the characteristics, objectives and contents. It also expounds on the basic ideas and the overall structure of the project and gives an introduction to the design of its basic platform, its application platform, its business management system and its standardization control system. In this paper, the digital resources construction and service delivery of the National Library of China (NLC) are introduced to cover both its present operation as well as those in conjunction with the opening of its new library building during its second-phase of library development. Finally, the most important and difficult point in the construction of the National Digital Library Project is analyzed from the following four perspectives: 1) The long-term preservation of digital resources; 2) the construction of knowledge organization system; 3) the organic integration of the digital library and the traditional library; and 4) the risk of project management and system integration.

Keyword—National Library, National Digital Library, Design of digital library system, Construction of digital resources and its public service

National Library of China (NLC) began to build its digital library in 1999. The whole project of National Digital Library of China includes three parts: 1) the construction of infrastructural facilities such as hardware and software; 2) the construction of a standardization system for the NDL; and 3) the digital information storage and retrieval service. The last part is the core emphasis of the NDL construction.

1 General situation of the National Digital Library Project ¹

In 2001, the State Council officially approved the second phase development of National Library of China & National Digital Library Project (**NDLP**). The designs of the NDLP went through readjustments for four times in the next 7 years until their finalization in 2008. Such readjustments included such major revisions or the rewritings as proposals, feasibility study report, scheme design and detailed design. The discussion of this paper is primarily centered on the detailed design.

1.1 The unique features of National Digital Library Construction

The National Digital Library construction consists of specific objectives in three focused areas: namely, the overall objectives the service objectives and the technological objectives.

1.1.1 The overall objectives

The NDL, which will function as a national digital library by collecting, producing and long-term preservation of the most important Chinese digital resources, through the Internet

* Correspondence should be addressed to Shen Xiaojuan (E-mail: shenxj@nlc.gov.cn)

¹ Scheme Design of National Library of China Phase II & National Digital Library Project—Digital Library System Part. S.Y. Technology Engineering and Construction Co. Ltd, 2005.6

and the supporting platforms, is aimed to build a super-large scaled and high-quality Chinese digital collection. In order to provide a solid technological support platform for library resources acquisitions, processing and preservation of digital resources, the NDL also provides Chinese digital resources service at home and abroad through a major network of China, which makes itself the largest production and service center of Chinese digital resources and the most important national infrastructure for information resources. Meanwhile, through advanced technology and distribution methods, it also exhibits the fabulous Chinese culture to the entire nation and the whole world and makes it possible for the realization of library resources sharing at both national and international levels. With the construction of the NDL, a seamless service delivery system that takes the NLC as its core of operation and other major domestic libraries as its supplemental service stations is gradually taking shape for the transmittal of digital library resources and an orchestrated service delivery system based on the co-ordinate network support of the National Digital Library and other major regional public libraries and special libraries.

With the opening of NLC Phase II as the watershed, the overall target is going to be realized in two stages. The first stage is up to the end of 2008, which constitutes the short-term goal; the other stage is from 2008 to 2015, which constitutes the medium and long-term goal. In the first stage, a unified national digital library service portal is to be established with an objective to provide at least 200 TB digital resources. The medium and long-term goal is to build various types of databases (metadata databases, full-text databases, multimedia databases and thematic knowledge databases) and online information repositories, which altogether make the digital collection of the NDL larger and more comprehensive as compared to those of other similar digital library collections. Through providing secondary and tertiary retrieval of Chinese documents and access to databases of various contents, the NDL will be the center for inquiry and service of Chinese digital resources.

1.1.2 The service objectives

The NLC mainly provides services for the following groups: departments of the central government, national legislative bodies, key research projects, educational institutions, manufacturing plants, public and other types of libraries.

For the departments of the central government and national legislative bodies, the NLC mainly provides the following services: 1) Constructing a preliminary information delivery service specifically for legislative and decision-making purposes under an online networked environment; 2) collecting the information of big events; 3) performing selective dissemination of information (SDI); 4) providing reference services for important meetings; 5) information gathering and cataloging on a regular basis; 6) providing special reference service; 7) providing various documentary resources to the Communist Party, government and the Armed forces as well as to the Central Communist Party School.

For the key research projects, educational and production enterprises, the NLC provides the following services: 1) Providing Chinese resources to the educational and scientific research institutions through educational network; 2) cooperating with organizations such as CALIS, CSDL and NSTL to provide supplementary service for their users in educational and scientific research fields; 3) establishing the mechanism of inter-library loan, document delivery and virtual reference services; 4) providing information retrieval, Sci-tech novelty retrieval, and collecting of scientific and technical information. Through the NDL, the content, abstract, and full-text of periodicals and dissertation will also be available. The items of service also include: 1) Developing the documentary information resources; 2) establishing the database with special features; 3) making use of the online resources; 4) providing specialized information resources for the most crucial and strategic units; and 5) pushing information to the scholars' desks according to their needs.

For the general public, NLC will mainly provide the following services: with its own characteristics and Web 2.0 concepts and technologies, the NLC will establish a highly integrated Web 2.0 application services platform, forming an all-round service system to the public users of the Internet which enhanced users' sense of participation and services experience. For those readers who come to the library, NLC will provide them with such service as automatic self borrowing and returning and help them make the suitable choice between digital and physical resources. In addition, it is easy to obtain help at the NLC for

the access to digital resources, for inquiries about the OPAC, the linkage and ordering of digital resources, e-payment and documents delivery. The NLC will also create various types of reference service. For example, the face-to-face reference, reference inquiries over the phones or by filling in inquiry forms and/or via e-mail reference service are such cases in mind, all of which are dynamic, convenient and highly-effective model of service. The NLC will also provide personalized service to users, such as SDI on Internet, RSS, information push service, etc.

Lastly, there are also many types of library services. The digital resource service system will be in the preliminary stage. The service for grass-roots libraries will be available with the backing of the National Cultural Information Resources Sharing Project. The NLC has expanded the coverage of National Union Catalog Centre so as to provide bibliographic data services to all Chinese libraries, thus realizing the sharing of information resources nationwide, upon which the inter-library loan and document delivery service also heavily depend.

1.1.3 Target in technology

The main targets in technology of the NDL include the following aspects:

The capability of digitization	
Tables of contents processing	1.8 million lines/year
Title processing	6 million items/year
Intensive indexing for audio and video	6000 hours/year
Digitization from print resources	300,000 items /year
Digitization of microforms	3,000,000 images/year
Abstract record processing	90,000 items/year
Repository	
Online storage	≥150 TB
Near line storage	≥150 TB
Off –line storage	≥360 TB
Service	
Digital resources output	≥1,000 GB/d
Internet access	≥3 G/sec
Support retrieval	200 million metadata
Website Response	100,000 retrievals/min 10,000 retrievals/sec in MAX
full-text retrieval	100 million pages
Other functions	retrieval in rare books

	mobile wireless terminal service
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1.2 Contents of National Digital Library

1.2.1 The formulation of Standards of National Digital Library

The formulation of Standards of National Digital Library is the foundation for building the National Digital Library. It is an essential prerequisite for the interoperability among digital library systems. The NDL sets up a system of standards and pays special attention to the research and development of key technologies and standards involved in the processing of Chinese information in order to support the construction of the NDL. The standardizing system includes but not limited to the following areas: 1) Chinese character processing; 2) digital objective identifier; 3) digital object data management; 4) general regulation of metadata; 5) special object metadata; 6) knowledge management; 7) digital resources statistics; and 7) long-term preservation, etc.

1.2.2 The construction of the network system, hardware and software platforms and other auxiliary systems

Through the construction of the network system and the hardware and software platforms, the NLC will establish a platform that provides technology support to massive collecting, producing, preserving and managing of digital resources.

For the NLC, the network system is designed as a two-layered structure, which has a kernel and an access layer. It is a star topology-based redundancy connection model, which will guarantee that there is no single point of failure. It will achieve the bandwidth requirements on 10 Gb in backbone and 1Gb to the desktop; and it also has the access ability of fiber to the desktop.

On the hardware and system software platforms construction, the system sets application server, database servers, storage and backup system for all the subsystems.

In order to realize the auxiliary functions of the NLC Phase II, the NLC will develop various systems such as video frequency, smartcard, digital broadcasting, RFID and digital printing.

1.2.3 Business application system and public service support platform of the digital library

The building of an application system of the National Digital Library is centered on the management of digital resources life circle, which includes the construction of the digital resources collecting and harvesting system, digital resources producing system, digital resources management system, and digital resources distributing and serving system. The supporting platform for application is also an essential part of the management of digital resources life circle.

Digital resources collecting system will digitize the various types of traditional paper collections, automatically harvest online resources and fulfill the e-resource deposit online.

Digital resources producing system will finish the format conversion of databases, e-books and e-journals, and produce metadata in order to make all of these resources meet the requirements in management and service of the National Digital Library.

The function of digital resources management system is to take charge of the digital resource security, level of the digital resources, dispatching of resources, limits of authority, metadata and objective data. On the other hand, the system is also able to implement the storage, long-term preservation, remote backup, immigration and emulation of digital resources. Meanwhile, the copyright registration and management of digital resources, processing and management of digital copyright, security authentication on digital resources distribution and the protection authentication of digital resources service and copyright issues are also taken care by the system.

Digital resources distributing and serving system is to provide centralized services and decentralized services of digital resources to all users.

The application supporting platform is established for the purpose to address issues of business necessities of the NDL in accordance with the established guidelines and standards. It is meant to give support to all subsystems for their vigorous engagement in business co-coordinating, in data exchanging and in functional support for all of its subsystems.

1.2.4 Construction and service of digital resource

Digital resources construction and service is the central part of the National Digital Library. Centering on the construction the Chinese digital information, the NLC will build a service center and a long-term preservation center of Chinese digital information by means of centralized Chinese metadata discovery and registry, constructing and purchasing Chinese digital object data, and the collecting and preserving information resources online.

1.3 The specialties of the National Digital Library

In the stage of making the preliminary design, the National Digital Library has identified itself as one of the national-level digital library systems, and taken full consideration of the interconnection with other national-level digital library systems, industry-based digital libraries and regional digital libraries. Even though such is the case, the NDL system is nevertheless quite different from other digital library systems mainly in the following four areas.

First of all, the NLC shoulders the responsibility of collecting all books ever published in China and provides service to the entire country and even to the whole world. Likewise, the NDL should also take the responsibility of collecting and preserving the Chinese digital resources with an emphasis in setting up a Chinese digital resources preservation and inquiry center.

Secondly, in services, the NDL provides services for the following groups: 1) Departments of the central government; 2) national legislative bodies; 3) key research projects; 4) educational and production enterprises; 4) public and private documentary and informative institutions and libraries.

Thirdly, in the area of technologies, the NDL system is not independent and/or close-end. It is in support of compatibility, interoperability and openness with other digital library in structural design, construction of hardware and network platform and research and development of software. Therefore, the NDL gives support to the construction of Chinese digital libraries and help to share all of the digital resources.

Fourthly, in the framework and standards of resources, NDL will implement content management framework as the basis of technology, hardware architecture connecting with framework and application software connecting with framework. In the development of standards, NDL will adopt the mature international, national and industry standards, meanwhile NDL will formulate the other standards that have no corresponding international standards.

2 System design of the National Digital Library Project²

2.1 Thought of design

In the development of the NDL, the integration of different kinds of resources needs to be taken into consideration. For example, such materials integration should include traditional printed collections and the digital collections, all kinds of digital collections, the printed collections and the online resources, and the digital resources belonging to NLC's and other

² Detailed Design of National Library of China Phase II & National Digital Library Project---Digital Library System Part. China Electronics Engineering Design Institute, 2008.2

related institutions. Giving priority consideration to the method of information integration at the metadata level, the National Digital Library System will establish unified and centralized metadata base so as to digitalize all kinds of information resources and also to extract metadata that are kept together and managed in accordance with the unified metadata standards. NDL will support the metadata harvest of distributing heterogeneous digital resources through OAI, and provide distributed searches to users through OpenURL. Meanwhile, the NDL will provide support in such measures of integration as multi-base searching and information navigation. Furthermore, the further research of methods of information resources integration will be carried out by means of advanced knowledge organization system.

The whole NDL system can be divided into one core business framework and four subsystems, together with the existing library business automation systems and office automation systems (Fig. 1). In keeping itself relatively independent and self-sufficient, each and every sub-system can obtain data from both the core business framework and other sub-systems. The NDL system will be an integral structure possessing such special features as the open-ended nature as well as a basic framework of Service-Oriented Architecture in order to meet the requirements of system integration capabilities.

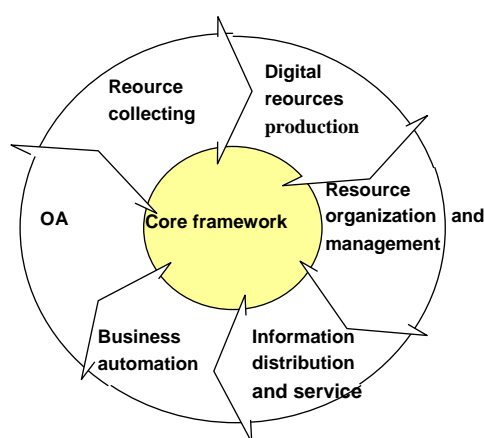


Fig. 1. The NDL system plan

In service integration, with the huge number of resources, the NDL should solve the following two problems. One is how to make these resources understood and used by the reading public, the other is how to make the public use the new type of service of the NDL. Both the resources and services of the NDL urgently need a full-range displaying window to make it visible to the reading public. For instance, electronic resources portal, through which readers are provided with remote and seamless access to the information they need, can actually make more efficient use of the library's information resources. They can systematically integrate the expanded services such as navigation and retrieval of electronic resources, enquiries of collection, interlibrary loan and document delivery, the virtual reference, cited references and Web search engines, and other services into one organically integrated operation. In the meantime, the NDL will set its business procedures and provide services around the following 4 areas, namely, 1) Revealing and describing resources; 2) navigating and retrieving resources; 3) resource management; and 4) user authentication and customized service.

2.2 General design

According to the above-mentioned ideas, the general design of the National Digital Library is shown in Fig. 2.

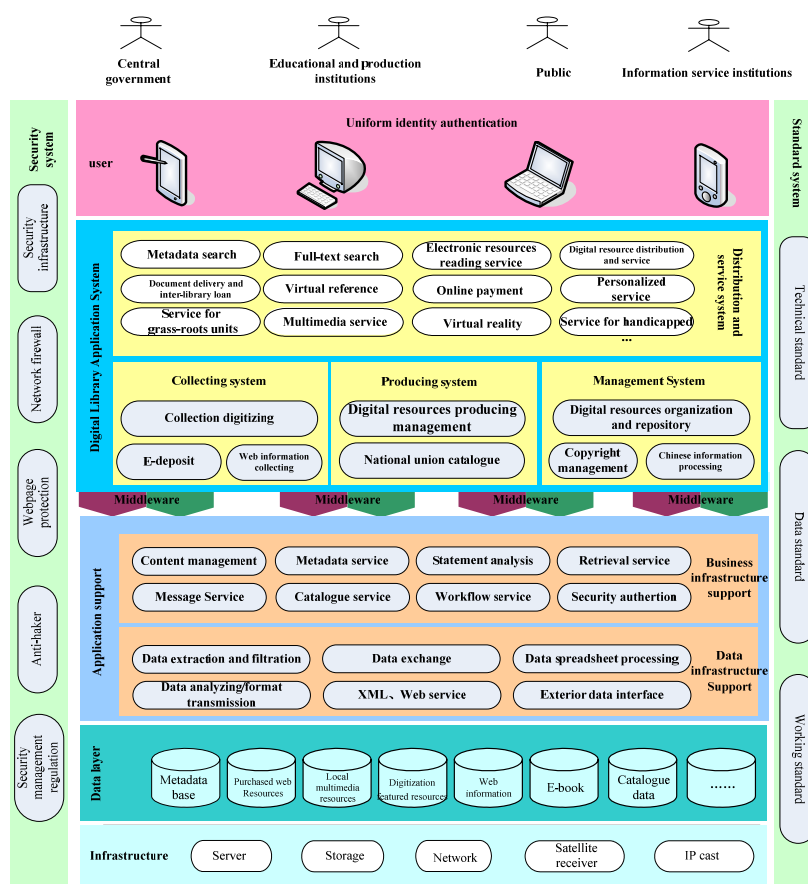


Fig. 2. The general design of National Digital Library.

The National Digital Library system is actually to consist of several layers such as the user layer, the business application layer, an application support layer, a data layer and an infrastructure layer. It interprets the life cycle of the digital resources of the NDL with great integrity and supports the complete procedure which contains content creation, organization description, preservation, management and digital resources release. The overall system of the NDL, which is composed of all kinds of software, is a complex and multi-level system. In the system, every software system, supported by such system platform as the network system, server system and storage system, is not isolated in its functional operability but is closely orchestrated in accordance with a set of definite standard and regulations. Different software systems can supplement and support each other in function. And data exchange and sharing among software systems is also likely.

2.3 Design of basic platform

2.3.1 Design of network system

National Digital Library's network system mainly includes the access network, the local LAN, the wireless LAN, the security system of networks, the remote disaster backup networks, and other components. Ethernet technology is to be applied in the network system.

NDLP will connect itself to the main network in China, such as China Education and Research Network (CERNET), China Science and Technology Network (CSTNET), etc.

The local structure of the main local area network using the core level, the access layer of a two-tier structure design and a star of redundant connections will ensure no single point of failure, 10 Gb backbone, Gigabit to the desktop of bandwidth requirements, and a small amount of fiber to the desktop nodes. The wireless network will support both the WAPI and IEEE802.11 standard.

2.3.2 Design of storage system

The NLC has a large number of various types of digital resources, which is to be stored in an appropriate way and in a suitable medium according to the resources type and application.

The repository policy of NLC is to combine the online, near line and offline repositories together. The whole system should have the ability to control the life circle of the data. In this system, the data transmission is realized among different storage equipment of various levels and mediums by means of management software.

The following are stored online: the database, real-time bibliographic records, data needed in the process of digital resources distribution and service, and the temporary data produced in the process of digitalization. The FC disk arrays are the storage media.

For the data with low-frequency of visiting, high-quality digital files for permanent preservation, the digitalized data, the data provided by the domestic suppliers, resources collected from the Internet, data coming from the National Culture Information Sharing Project, and the purchased resources, the way of near-line storage is applied. All of the data is preserved in the low-cost SATA drives with large capacity.

For hardly-used digital resources, digital resources need to be permanently preserved and the backup data, the way of offline preservation are adopted with magnetic tape and CD-ROM as its media. Magnetic tape storage will be used to store the resources needed to be preserved for a long time.

Through the above-mentioned three storage methods, data will transmit from online to offline and then to the near-line migration.

2.4 Platform Design for Practical Application Support

The Platform for Practical Application Support is set up in accordance with business necessities of the NLC and also within its established guidelines and standards. This platform is to give support to its sub-systems for system coordination, data exchange and environmental management.

The Practical Application Supporting Platform will reconstitute some of the basic business functions of the various subsystems, such as content management, metadata services, retrieval services, news services, bibliographic services, processes, services, security authentication, data processing forms, XML, data format conversion services, etc. As a part of a system of separate framework for the development, the interface between two modules will be replaced by the one between module and framework, which simplifies the number of interfaces, unified interface specification and integration.

2.5 The business system design

The business system of the NDL includes 4 systems: 1) digital resources collecting and harvesting system; 2) digital resources processing system; 3) digital resources organization and management system; and 4) digital resources distribution and service system.

The function of digital resources collecting and harvesting system is to digitize all types of material through the digitalization process of printing, audio and video materials. It also collects the disorderly and scattered online resources with a specific aim to make them in an orderly fashion at the preliminary stage. This system provides a convenient route to upload dissertation and e-publications rapidly, through which all-round information is available, and the foundation for the digital resources sharing in the future is laid. The system includes 3 sub-systems: 1) digitization of print resources subsystem; 2) online resources harvesting subsystem; and 3) legal deposit of digital resource subsystem.

The function of the digital processing system is to make necessary format transformation of databases, e-books and e-journals, to make the metadata description, and to establish the systematical knowledge. It consists of two subsystems: digital resources processing management sub-system and the National Union Catalogue sub-system. The former one is to establish and store all types of metadata, resources database and knowledge database. The

platform for metadata processing, integration, retrieval is set up to provide working windows and tools for those staff who are engaged in the processing of digital resources. The processing platform of resources database is to provide working windows for the construction of a database of ontological knowledge and its information retrieving tools for those staff who are engaged in the processing of digital resources and building a model for knowledge navigating. Thus, a foundation for building an ontological knowledge database and its information retrieving tools can be laid.

Abiding by the OAIS framework of reference, the digital resources organizing and managing system will shoulder the responsibilities of organizing and also for long-term preservation of digital resources. The system will manage the digital resources using data warehouse technology, and will support registration, processing, management, resource authentication and security services and copyright protection certification. It includes three subsystems: digital resources organization and storage subsystem, copyright management system and Chinese information processing system.

Digital resources distribution and service system is divided into two areas. One is about the distribution of digital resources; the other is about providing relative service. Digital resources distribution subsystem will package all types of digital resources, including text, images, audio, video, etc, and provide the resources in special format which can be made ready for format sharing and transfer. In distributing the digital resources, their uniqueness of type, specialty and content of the digital resources should be taken into consideration so as to satisfy the specific needs of the different categories of users. In the service of digital resources aspect, all kinds of service based on the Internet can be realized through unified user authentication, unified retrieving, library domain analysis, etc. According to the purposes of the service, the whole system can be divided into many subsystems. For example, these include but not limited to the releasing and service subsystems, metadata search component, the virtual reference subsystem, interlibrary loan and document delivery subsystems, electronic reading room management subsystem, the grass-root level resource distribution and on-demand sub-system, mobile services sub-system, service system based on digital television, etc. With the unceasing expansion of the service scope, there will be more subsystems for further service refinement.

2.6 The standards of the National Digital Library Project

Abiding by all applicable library standards, the NDL Project will formulate a series of standards of its own and will metamorphosis it into a set of national library standards in due course. The standard system of the NDL include standards in such fields as standardized processing of Chinese characters, digital objective identifier, digital object management, general regulation of metadata, special object metadata, knowledge management, digital resources statistics, and long-term preservation. (Fig. 3).

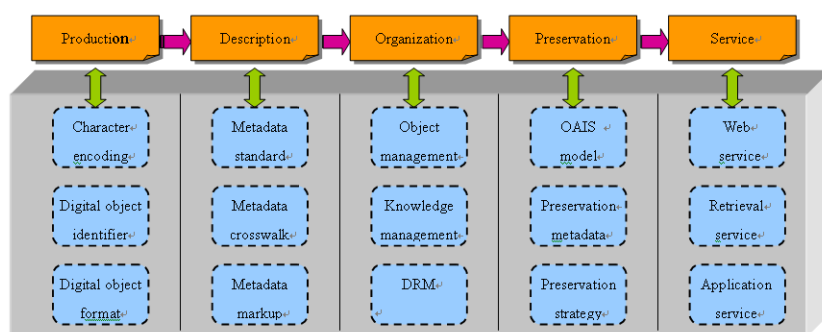


Fig. 3. Standard system of China's National Digital Library Project

2.6.1 Standardized processing of Chinese characters

Among the various standards being established by the National Digital Library Project, the standardizations of Chinese character writing is one of its paramount concerns. In view of the fact that an enormous amount of Chinese print resources are of antiquarian in nature which make it all necessary for setting up the following standards to regulate their processing,

namely, attributes of Chinese characters, full-text process for ancient documents by using the guidelines of XML, ancient Chinese character processing in general and those especially contained in antiquarian books, and guidelines for processing esoteric words and words of avoidance, etc.

2.6.2 Digital Objective Identifier

The National Library has more than 120 million digital resources of full text, and other various types of digital resources. It makes good sense in terms of resources discovery and utilization to have all these digital resources in a much larger subject scope to be incorporated into one centralized management and distribution system. It will be of great significance to regulate all of these resources in a unified Digital Objective Identifier system. Therefore, the NDL creates China's Digital Objective Identifier system, which is based on the Handle System technology and management framework.

2.6.3 Standard of object data management

National Library needs to establish the correspondent object data management standards for text, images, audio, video and other types of digital resources. Meanwhile, on the basis of analyzing the various digital resources coming from different methods such as self-building, purchasing, archiving, and deposit collections, the related management standards for digital resources acquisition, conversion, testing, packaging and storage are also needed.

2.6.4 Standards for metadata

The NDL will develop metadata standards which include metadata application standards, the core metadata standards, specialized metadata design standards and more than 10 kinds of specialized metadata standards, management metadata standards, and some major metadata mapping program standards.

2.6.5 Statistic standards for digital resources

There has been a lacking of a sound system of indicators and measurement in dealing with digital resources. Therefore, the NDL will establish a set of statistical standards for digital resources so as to meet the need of digital resources construction and management and to provide the library community with authoritative guidance for citing statistical references.

2.6.6 Knowledge management

As the basis of knowledge service and other high-level service provided by the library, knowledge management is one of the hot issues of common interest among those librarians working in digital libraries in recent years. It is stemming from a necessity to have information resources reorganized into knowledge according to the knowledge structure. This will provide a foundation for the library to provide knowledge-based service and in-depth information service. Therefore, the NDL will devote itself to study also on the subject of knowledge management.

2.6.7 Long-term preservation

It is the responsibility of the National Library to preserve permanently the library resources of strategic importance. At present, in the long-term preservation area, there is already an OAIS model for reference. Patterned against OAIS, the NDL will establish its own long-term preservation system even though there are many problems to be solved in application. For this reason, the NDL has begun the study on long-term preservation that includes the long-term preservation of metadata, the standard of information packets and packaging, and the technology and application scheme of long-term preservation of digital resources.

3 Digital resource construction and service of the National Library of China³⁴

The construction of digital resources has been an important part of the overall development project of the NDL. Thus, the NDL has established one by one "Regulations of Digital Resources Construction", and the guidelines for the construction of digital resources of 2003-2005 and 2006-2010. These guidelines and regulations firmly establish the principles for the digital resource construction of NLC in the following way: it places the digital resource in Chinese language as the basic foundation and all foreign-language resources as its supplement; it depends on purchasing to obtain digital resources in library common use and on digitizing to develop digital collection from unique local library resources. According to this principles, the construction of digital resources of the NDL centers on digital resources in Chinese language, digital resources for long-term preservation and production and collection of metadata in Chinese language. There are three main ways the NDL deemed appropriate for its digital resources construction. The first one is self-building. This includes the digitization of its unique and special collections in terms of the types of collections and also those library resources dated prior to 1949 from a historical periodization perspective so to speak. The second one is to cooperate with outsourcing to other libraries, institutions, and/or commercial data vendors worldwide based on the principle of equality and mutual benefit for resources exchange and commissioned processing. The last one is to purchase the published electronic resources from either domestic or foreign markets to avoid any possible redundant construction.

3.1 The status of digital resource construction at NDL

National Library began the digitization of its collections in 2000. By the end of 2007, the total volume of its digitized resources had already been exceeded 200 TB. The digital resource of NLC comes from 1) legal deposits; 2) purchased database; 3) self-built database (usually from its unique collections and Web-based information); and 4) the digital collection from harvesting the Internet resources. The last two channels are the major instruments for NDL digital resource construction.

National Library receives the legal deposit of digital resources, which includes tapes, video tapes, laser disk, VCD, DVD, and other electronic publications. Up to now, the NLC has 1,620,000 pieces of all kinds of electronic publications and 46 electronic newspapers.

By the end of 2007, the amount of purchased database has reached 127, of which 55 are Chinese and 72 are foreign language. Nearly involved in nearly all scientific fields, these databases (some of which are full-text databases) includes 27,000 periodicals, 756,000 books, 1,767 newspapers, 1,740,000 dissertations and 1,610,000 conferences papers.

The NLC has made great efforts to digitalize the unique and special collections. Up to now, the self-built digital resources include e-book, doctoral dissertation, Minguo (Republic of China) periodicals, online tutorial, online exhibition, oracle bones, Dunhuang Materials, metals and stones rubbings, chronicles, Xi Xia Materials and Lunar New Year Drawings. The type of digital resources contains text, pictures, and videos and so on. All of these consists 50 self-built databases. And the total amount of digitized special collection in NLC now stands at 130 TB, of which 120 million pages are in full-text. The NLC is moving forward on course steadily.

In the area of harness from the Internet resources and then making long-term preservation of them, the NDL began an experiment in 2003. Up to now the NLC has collected and preserved the information from the government Web-sites of the Internet totaling over 20,000. In addition, there are 245 kinds of e-newspaper in Chinese language, 18 Websites information about Chinese Studies, Olympic Games, aeronautics and astronautics, the construction of new countryside, materials of intangible cultural heritage and so on also being collected.

³ Digital Resources Construction Regulation of National Library of China. National Library of China, 2005.6

⁴ Digital Resources Construction Planning of National Library of China 2006--2010. National Library of China, 2005.7

3.2 Quo status of digital resource service and future plan

In the digital resources services, the National Library provides outsourcing resources to the readers according to the purchase agreement, so most of these services are only available in the library Intranet. In recent two years, to satisfy the service requirement, the NLC has put more efforts to ask for more right to the usage of the database. Up to now, access to 30 databases has been provided via proxy, 418,000 Chinese e-books can be read through the remote reader's card and 18 databases are available through remote access account.

In May 2005, the National Library opened the gateway to provide digital resources services, and integrated its digital resource to fulfill the seamless interconnection among resources. The readers have greatly improved the efficiency while using the massive information resources of the NLC, by means of integrated retrieve of databases after logging on by reader's card.

In addition, the National Library also opened Open URL interface to the Google, so Google users can query the electronic periodicals in Chinese and foreign languages through the Google Scholar. After fixing the needed resources, readers can select different ways of service through the website of the NLC.

In 2007, the NLC first tried its attempt to grant 7,000 "National Library Service Cards for Grass-root Libraries" to over 1,300 libraries in the county to provide them with the access to 418,000 Chinese e-books purchased by the National Library Center.

In the service sector of the self-built digital resources, NLC followed the principle of "providing service hand in hand with building the NDL at the same time", the majority of self-built digital resources, of which there are no copyright issues involved, has been provided free of charge on the Internet. For those resources that have copyright concerns, some of them have already been made to the public at the time when NLC increased its efforts in solving the copyright problems. Up to now, 67% of the self-built digital resources have already been released. But each of all these various types of resources has its own publishing and service systems which sorely need to be integrated.

For the modern Chinese language books, the NLC has obtained RMB ¥ 30 million annually from the Ministry of Finance specifically earmarked to deal with the copyright problems. The National Library tries to mount each year over 10,000 Chinese e-books cleared of copyright issues on the Internet for the reading public to gain access free of charge.

In addition, with the opening of the National Library of China Phase II, the NLC is planning to provide more digital resources service in order that the service can get closer to the user's daily work and learning environment and conversely readers can acquire what information/document that they need in a more convenient and faster way. These new types of services are detailed below.

In National Library of China Phase II, readers will be loaned an electronic palm-reading device by the Library through which the readers can read large amounts of electronic books at any place and at any time. If readers carry their own mobile reading device with themselves, they can download, renew and borrow e-books from the portal of the NLC and to read them at any place and at any time.

Library users can register on the Internet to become online readers of the NLC, and thus be able to browse all the digital resources by logging on the Internet. Meanwhile, the reader's management system brings about convenience and possibility to the readers who cannot avail themselves to the library. Through the Internet, readers will be able to easily utilize such services as information navigation, full-text search, e-books borrowing, the virtual reference, information exchange, interlibrary loan and document delivery. Thus, the utilization of digital resources of the NLC will be greatly expanded not only in scope but also in terms of ratio and frequency.

The NDL will integrate those digital resources that are suited for broadcasting through digital television and/or through networked platform for digital televisions. In this way, readers

can enjoy the digital resources service from the cable television network without ever leaving home or going to the National Library Center. Furthermore, some personalized service, such as ordering and reserving books and accessing to multimedia reading, etc., which will be made available through the function of a cable television network.

National Library also plans to make use of the possible convergence technology of the mobile communications platform and the mobile digital library service platform. This will allow the majority of mobile end-users to become the "mobile readers" of the National Library Center. NLC can send various kinds of timely information to the readers who have subscribed to this type of service. It can also provide the readers with document retrieval service on the information they have ordered. When the electronic edition of the book is made available online as requested, the reader who originally placed the order can either read it online or have it downloaded.

In terms of rendering services to the library community apart from document delivery, interlibrary loan, and the union catalog services, the National Library plans to establish a few digital experimental libraries at the provincial public library level, and to share digital library resource and provide such services as building mirror sites, on-line real-time talks and remote training of librarians. Moreover, through the grass-root service system, the NLC is also going to distribute its digital resources to the grass-roots libraries. The grass-roots libraries can select the resources they need according to a resources list provided periodically by National Library Center. For the public, the digital resource of the NDL is also made accessible through the National Cultural Information Resources Sharing Project. The NDL will also provide digital services to the general reading public with its unique service features associated with the newly built educational network, research network, and the Gigabit connections of the Central Communist Party School and the State Administration of Radio, Film and Television.

4 An analysis of the central issues and difficulties of the National Digital Library system construction⁵⁶

4.1 The construction of a long-term preservation system for digital resources

The most ancient paper-made documents collected by the National Library are dated back more than one thousand years. But it is very difficult to preserve modern digital resources in storage for a few decades. So, the problem of how to take effective measures within the context of resources management to ensure that digital resources can still be used after several decades, or even several hundred years is one of the hardest problems to be solved in the NDL Project.

Open Archive Information System (OAIS) has become the ISO standard and many foreign digital library projects have already begun using OAIS model for long-term preservation of digital resources system construction. But OAIS is only a conceptual model. So, there is another hard problem as how to establish a long-term preservation system within the NDL system based on the OAIS framework. Meanwhile, long-term preservation is not only a technical problem, but also involves digital resources management, business processes, and/or other issues. More serious research is needed on this long-term digital resources preservation area in terms of its practical applicability versus reality.

4.2 Construction of a knowledge organization system

The central mission of a knowledge organization system is to reorganize the digital information resources stored in digital libraries in accordance with the knowledge structure rather than simply relying on the external features, and organize and utilize the resources by means of finding, confirming, retrieving and rationally organizing pertinent information

⁵ Shen, X.J., Fu, P., & Sun, W. An introduction to National Digital Library of China. *New Technology of Library and Information Service*, 2006, 8: 2-7; 68.

⁶ Fu, P. Construction and development perspectives of National Digital Library. *Library and Information Service*, 2005, 49(11): 5-8; 19.

according to a given knowledge system. It is an important direction for the construction of a digital library and at the same time a difficult point as well to establish a knowledge organization and processing system in order to support knowledge services. So, serious attention should be paid to organize information resources in such a way for the library users to engage in in-depth information searching and retrieving and also to make the Library to send knowledge to the users in their work, living and learning environment in an efficient and effective manner.

4.3 On the organic integration of the digital library system and the tradition library system

During the process of constructing the NDL, this digital library project has always been considered as an extension of a supplement to the traditional library with the hope that the digital library in the future can integrate well into the traditional library. Even though in practical work, we are still facing or will face the following thorny issues: how to deal with the integration issue of managing the life cycle of digital resources with those paper-made library resources in traditional libraries; how to manage and deploy the metadata and objective data in a unified way for the resource that is partially paper-made and partially in digitized form; how to find both the requested paper-made documents and the digital documents in a timely manner so as to provide the requestor with a choice of document format selection and the convenience; how to make better planning for the overall construction of the NLC in terms of building a most advanced digital library.

The integration of digital library system and the traditional library system is not just at the system level, but more importantly, it is in such aspects as management mechanism, operation mechanism, resources construction, resources service and business management. And for the NLC, it has still quite a long way ahead.

4.4 Risks for project management and system integration

As an informatization project, the implementation of National Digital Library Project is bound to improve and perfect the business management of the NLC in the process of its informatization on the one hand. On the other hand, as a complicated and systematic project, it will inevitably face numerous risks. There is a shortage of experience and in-depth knowledge in the library community for the large-scale informatization project. Therefore, it is a substantial challenge for the NLC to carry out an effective project management with risk control in order to make sure that each and every subsystem can complete its assigned task in due time.

In addition, for the national digital library system, to avoid and/or lower the technical risks is just as important as it chooses appropriate technological line and the essential core products. The upgrading caused by the development in technology and business conditions should be taken into consideration. The improvement of system flexibility and scalability in design is also necessary. It is also important for the smooth operation of the system to have a team responsible for system's operation and maintenance.

After the opening of the National Library of China Phase II, the focal point of the NDL construction will change from the construction of a basis support platform in the first phase to the construction of a system of application and integration in the second phase. This is the core and most difficult part of the construction of the NDL Project. With the building of the application system, the business model of the NDL is getting more mature and the NDL system is becoming more sophisticated. Thus, it is becoming possible that the goal of this project will be finally realized in full.

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