Innovative Construction of National Science and Technology Information Supporting System

—On the Development of National Science and Technology Library

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Abstract: *The National Science and Technology Library (NSTL) is an important sci-tech document and information service institution in China. As an information sharing system, it takes an important role in supporting Chinese science and technology research and education. The innovative development model and operating mechanism, the digital resource construction policy, the web-based information service system of NSTL ware introduced in this paper, from the aspects of its establishment background, current development, resource construction achievement and information service effectiveness. In addition, the issues on developing a resource sharing system and building a national information infrastructure in China ware also described.*

Keywords: *Information Resource Sharing, National Information Service system, Chinese Sci-tech Library, National Science and Technology Library, NSTL*

Scientific and technological information resource is an important national strategic resource, and is an important guarantee condition for the national innovation system. The construction of scientific information system is an important factor for enhancing the country's sci-tech innovation capability. The establishment of National Science and Technology Library (NSTL) was a major event in current history of document and information service development in China, directly affected the country's sci-tech innovation capability and sustainable development capacity, and its services have effectively supported varied sci-tech activities all over the China[1].

1. Establishment and Management of NSTL

In the 1990s, the scarcity of document and information resource sharing, the reform of foreign currency exchange system, and the soaring prices of western scholarly journals are among the major factors that resulted in the substantial subscription decrease to foreign sci-tech publications in China, which greatly affected the

development of the scientific research, technological innovation and higher education in China.

1.1 Establishment of NSTL

In 1998, the Ministry of Science and Technology embarked an ambitious project that would build a centralized collection of western scholarly publications to meet the information needs of research and education. The centralized collection of scholarly publications was to reform the existing information management system and solve the problems that had been hindering the sci-tech document and information services in China. These problems included the decentralized resource management system, the duplication of document collections, and the lower utilization of information resources and so on.

After a period of collaborative preparatory of the Ministry of Science and Technology, coordinated by the Ministry of Finance, the State Economic and Trade Commission, the Ministry of Agriculture, the Ministry of Health and the Chinese Academy of Sciences, NSTL was established on June 12, 2000[2], in accordance with the approval by the State Council of China. The establishment of NSTL created a new model for joint construction and sharing of sci-tech document and information resource, which was an important achievement of the Chinese governmental sci-tech management system reformation.

The aims of NSTL are to collect and exploit document and information in natural sciences, engineering and technologies, agricultural sciences, and medical sciences as required by national sci-tech development, and to provide public document and information services for the nationwide sci-tech users[3]. The main objectives of NSTL are to build a domestic first-class, international advanced web-based sci-tech information service and national information supporting system.

1.2 Virtual Management Framework

As a virtual sci-tech information institution, NSTL consists of 9 member institutions: the Library of the Chinese Academy of Sciences, the Institute of Scientific and Technological Information of China, the Library of Chinese Academy of Agricultural Sciences, the Library of Chinese Academy of Medical Sciences, China Machinery Industry Information Institute, China Metallurgical Information & Standardization Research Institute, China National Chemical Information Center, Library of Standards of China National Institute of Standardization and Library of National Institute of Metrology of China. These institutions are all important national information agencies in China, which already has a history of decades of development, has a wealth of information resources and rich service experiences.

The director in general is responsible for the implementation of the decisions made by NSTL steering committee, which is the decision-making body. The steering committee is composed of experts in varied sci-tech fields, specialists in document and information field, leaders from the member institutions, as well as the officers from government departments in charge. The Ministry of Science and Technology, on behalf of other 5 Ministries, gives the guidance and supervision on the routine work of NSTL. NSTL is financially supported by a special national project. The management framework of NSTL is shown Figure 1.

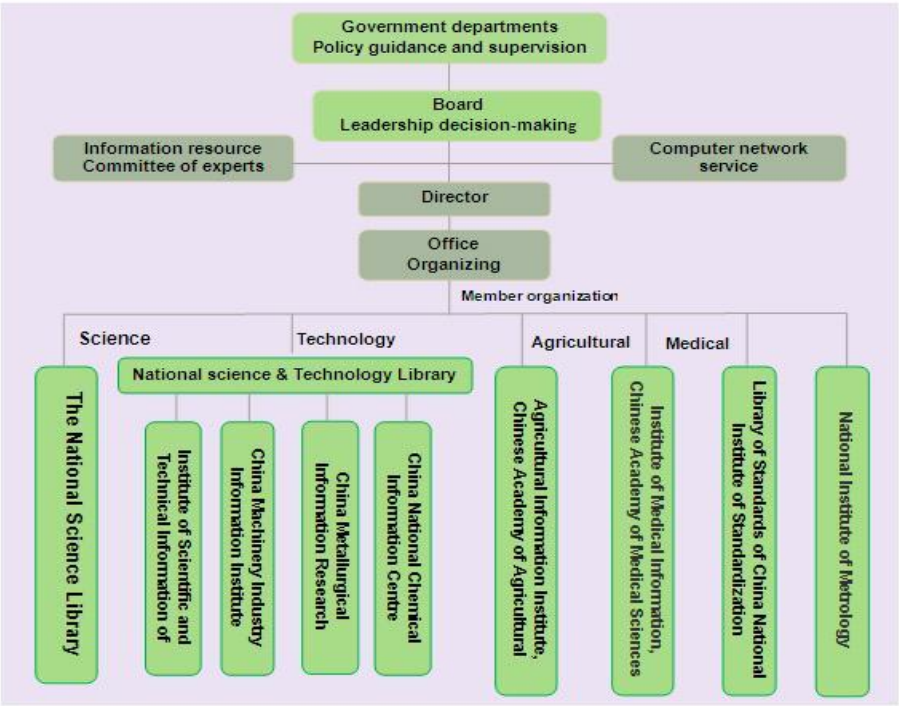

Figure 1．The management framework of NSTL organization system

1.3 Innovative Management Mechanism

NSTL has adhered to the principles of the cooperation, collaboration, openness and sharing, in order to promote the joint construction and sharing of document and information services among its member libraries, to avoid duplicate subscription and boost healthy development, from the aspects of organizational planning, administrative model, operational mechanism, technical means, service models and so on. The running mode of NSTL is shown in Figure 2.

Figure 2 . Running mode of NSTL

This innovative operation mechanism and construction mode, breaking China's existing administrative model, realized the member units that belong to different government departments, with different management mechanism, to build cooperation and to effectively activate various types of decades of accumulated information resources of these units, and promote the country's scientific information resources allocation to optimize and improve efficiency in the use of state funds[4].

2 National Scientific Information Support Capabilities Strengthened

Since its establishment, by implementation of concept innovation, mechanisms innovation, technology innovation and service innovation, NSTL has built an integrated sci-tech document and information service platform based on internet at the internationally advanced level, and set up a document and information service sharing system which is consistent with network information environment and the market economy mechanism.

2.1 A Sci-tech Information Service System Has Been Built

As an important part of national science and technology information infrastructure, NSTL online service system, initially providing service on December 26, 2000, built with the broadband fiber optic network of 220 Mbps export bandwidth, 1000Mbps bandwidth among the member units, as well as established 100 Mbps connection to National Library, China Education and Research Network (CERNET), China Science and Technology Network (CSTNET) respectively, provides the sci-tech institutions all over the country with various document and information services via internet.

With the increase of its document and information resources, NSTL built a national strategic information supporting system which is now one of the largest sci-tech document and information service platforms in China. Users from scientific research

institutions, universities, government agencies, industrial companies, and other groups or individual users, as long as they can access to the internet, can enjoy the equal treatment of document and information services. The networked services, jointly provided by NSTL member institutions, have pioneered a very convenient way for Chinese sci-tech communities to acquire their needed information. Figure 3 is the homepage of NSTL service platform.

Figure 3．Homepage of NSTL service platform

Relying on sci-tech libraries and information institutions throughout the country, NSTL has actively promoted the development of national sci-tech information service system. On the basis of its service platform, NSTL established 41 service stations (See Figure 4), 31 user management platforms in provinces (major cities or districts), as well as 32 thematic mirror data set in the major user local systems in different areas or provinces of the country. The establishment of NSTL national service system has played a significant role in promoting NSTL information services, as well as effectively enhanced the local sci-tech information service capabilities throughout the country.

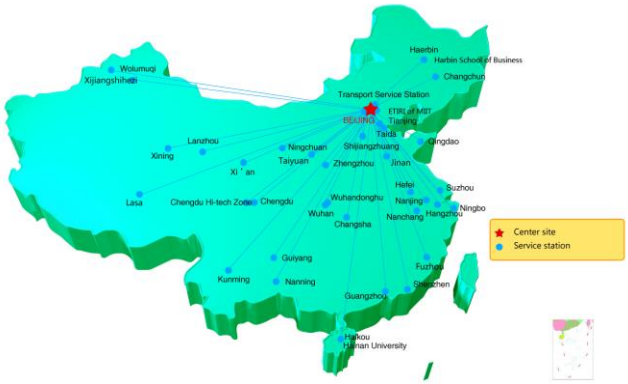

Figure 4．Sketch map of service stations established by NSTL

2.2 Cooperation among the Information Institutions Expanded

Towards the target to make more effective use of information resource, NSTL has also promoted the development of joint construction and information sharing in a greater scope, to advance the construction of sci-tech document and information service system at national level by coordinating with China Academic Library & Information System (CALIS), National Library of China, the Shanghai Library and other information organizations and units. NSTL has played an important role on drafting the standards for digital library construction, researching long-term preservation of digital information resource, investigating the development and utilization of information under network environment, as well as studying the issues on intellectual properties, etc.

Based on the service platform of NSTL, there were 26 open interfaces connected to other service systems, for example, through CALIS interfaces, NSTL services embedded into hundreds of universities. Through this system, professional resources have been embedded into the internal private network of varied units, into the user's local information environments, the personalized services being delivered to the individual desktops of the researchers.

3 National Information Resource Support Capabilities Enhanced

As a comprehensive sci-tech document and information support institution in China, NSTL has subscribed four areas of documents, covering natural sciences, engineering, agricultural science and technology, medicine and health care, involving more than 100 disciplines or research fields. Having been profited from the advantage of the increase of country's funding, the number of foreign document and information resource has kept growing. Based on this sharing management model, the large stock of document and information resources accumulated for several

decades by all member institutions has been effectively activated, which has greatly enhanced China's support capabilities of sci-tech document and information resources.

3.1 Subscription of Hardcopy Publications

In 2012, the subscription number of the foreign sci-tech documents in hardcopy had reached 28,306 titles（See Table 1）, including 17,996 titles of journals, which was 5 times larger than that before joint construction, while other 10,310 titles of publication were foreign conference proceedings etc, which was 3 times of the number of pre-joint construction. According to statistical data，the number of sci-tech journals and conference proceedings ordered by NSTL has accounted for more than 60% of the number of the relevant publications of whole country imported, which can basically meet the domestic primary information needs.

Table 1．Numbers of foreign printed publications ordered by NSTL from 2000 to 2012

Year	Foreign Journals （Title）	Foreign Conference Proceedings etc. （Title）	Total （Title）
2000	7, 673	2, 519	10, 192
2001	7, 768	2, 431	10, 199
2002	8, 242	2, 431	10, 673
2003	10, 242	2, 431	12, 673
2004	11, 542	2, 451	13, 993
2005	11, 542	2, 451	13, 993
2006	14, 543	2, 953	17, 496
2007	16, 331	6, 946	23, 277
2008	17, 531	8, 886	26, 417
2009	17, 350	7, 696	25, 046
2010	17, 797	8, 091	25, 888
2011	17, 901	8, 955	26, 856
2012	17, 996	10, 310	28, 306

The discipline distribution of foreign printed publications ordered by NSTL in 2012 is shown in Figure 5.

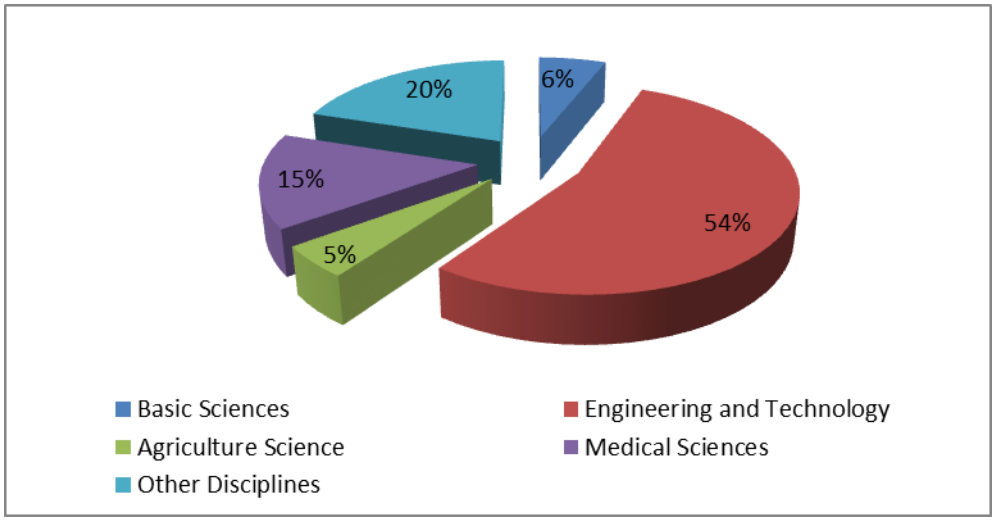

Figure 5．Discipline distribution of foreign printed documents ordered by NSTL in 2012

The document type distribution of foreign printed publications ordered by NSTL in 2012 is shown in Figure 6.

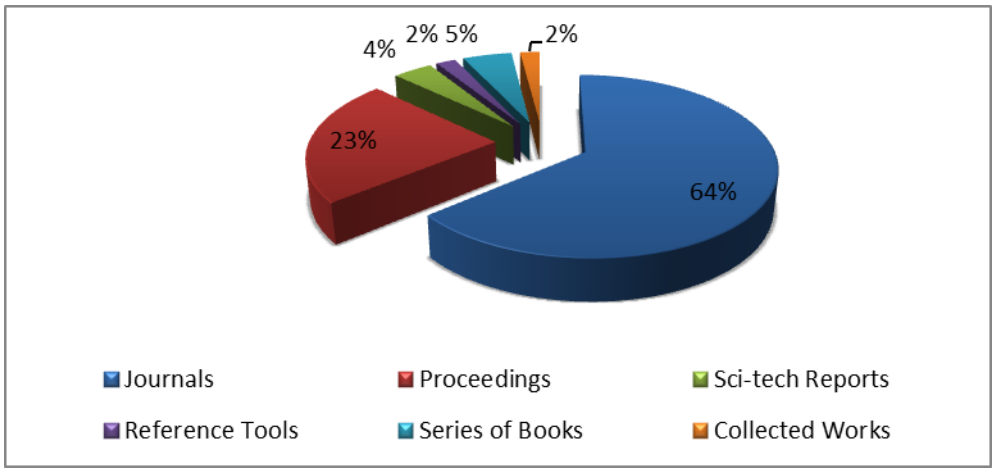

Figure 6．Document type distribution of foreign printed publications ordered by NSTL in 2012

3.2 Subscription of Digital Publications

In recent years，with the influence of the development of digital publishing, the world's information resource construction work is facing new challenges, in order to better meet the increasing usage of the web-based information users from all over China, NSTL has taken various measures to continuously strengthen its building for digital resources, to increase the subscription number of digital Publications.

In 2012, on the basis of national site license, NSTL subscribed 642 foreign full-text online journals, published by more than 50 foreign important society and association publishers, as well as research institutions, to provide services to the

nation's major universities and research institutions. In China, NSTL is the only library that offers full-text online journals service to nationwide STM users. The number distribution of foreign full-text online journals ordered by NSTL from 2001 to 2012 is shown in Figure 7.

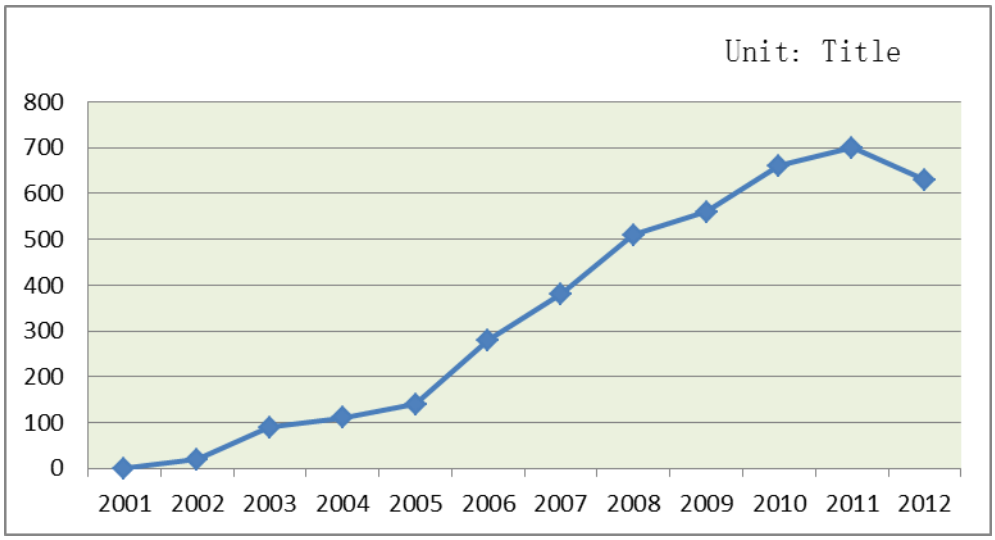

Figure 7．Number distribution of foreign full-text online journals ordered by NSTL from 2001 to 2012

The discipline distribution of foreign full-text online journals ordered by NSTL in 2012 is shown in Figure 8.

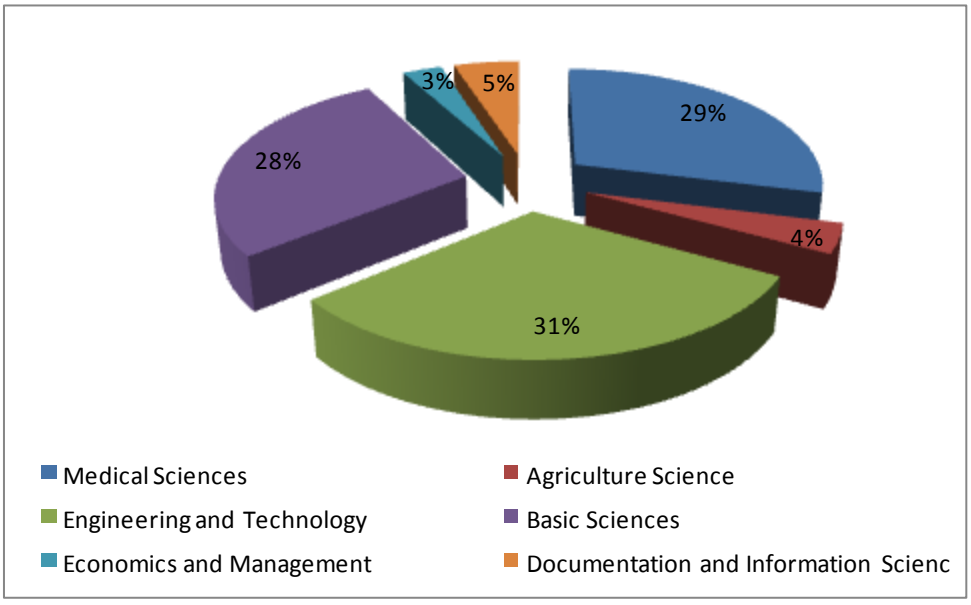

Figure 8．Discipline distribution of foreign full-text online journals ordered by NSTL in 2012

Adhere to the principle of "long-term ownership, permanent use, and to meet the knowledge service", NSTL has actively and exclusively promoted foreign sci-tech journal retrospective database construction. By the end of 2012, there were 14

foreign journal backfile databases, involving 1,629 journals, having been purchased (See Table 2), which effectively made up the country's historical lack of resource construction in the correspondent subject fields. NSTL establishes foreign journal backfile databases locally and provides services to nationwide STM users.

Table 2．Foreign journal backfile databases purchased by NSTL in national license

Publisher	Retrospective Journals		
	Titles	Pub-year	Articles
Springer	968	1854–1996	2, 055, 552
OUP	142	1849–1995	813, 324
IOP	37	1874–2002	191, 901
Turpion	6	1958–2002	30, 190
Nature	1	1869–1986	380, 000
LWW	248	1846–2003	1, 138, 623
CSHL	2	A 1933–2003 B 1970–2009	5, 856
RSC	66	1841–2004	241, 618
IDL	77	1872–1993	91, 685
BMJ	23	Create year–2006	366, 929
AIP	11	Create year–1998	330, 000
ADIS	39	Create year–2005	159, 059
IWA	9	Create year–2010	226, 061
Total	1, 629		5, 880, 798

Meanwhile, relied on the foreign hardcopy journals ordered by NSTL, through copies bundling, the member institutions of NSTL have subscribed more than 7,000 titles of foreign online journals, providing services locally. NSTL also supports the Chinese Academy of Sciences Library, Chinese Academy of Medical Sciences Library and other member units to purchase 68 full-text online database containing more than 13,000 full-text journals serving for more than 160 national key research institutions. Through the above measures, NSTL comprehensive support capabilities for digital information resources have been improved significantly.

4 Diversified Web-based Information Services

At the launch of the network service system, its services mainly covered free document abstract retrieval and full-text delivery services. In order to meet the multi-level of information needs, in recent years, NSTL has continuously enriched its

services, expanded the way of service, strengthened the content of service, and launched new service programs, etc. For example, subject information service, real-time online and offline reference service, internet information navigation, Chinese preprints database, sci-tech hot subject portals, and the international sci-tech citation retrieval system, etc. have successively been initiated by NSTL. Diversified means of services and the rich contents of databases have facilitated convenient access approaches and ensure that users can fully utilize all types of document and information resources of NSTL.

4.1 The Amount of Data Provided by the System Increased Dramatically

NSTL has paid great attention to the construction of its network service system, the number of web-based databases and scale of each database kept increasing. A large-scale integrated document and information service system has been formed that pooled a lot types of sci-tech resources, such as sci-tech journals, monographs, conference papers, Chinese dissertations, sci-tech reports, patents, standards and metrology norms.

By the end of 2012, the number of databases that can be accessed to via the networked service system had been over 40, which was more than 7 times larger than that at the launch of the system. The amount of data provided by the system reached 220 million, of which about 30 million of abstract data and more than 120 million of citation data were processed by NSTL member institutions. NSTL owns the intellectual property of these data. The amount of data provided in NSTL service platform from 2000 to 2012 is shown in Table 3.

Table 3．The amount of data provided in NSTL service platform from 2000 to 2012

Year	Amount of Data (Million)	Year	Amount of Data (Million)
2000	1. 77	2007	63. 85
2001	6. 13	2008	84. 86
2002	12. 00	2009	117. 79
2003	27. 23	2010	142. 52
2004	29. 95	2011	180. 28
2005	34. 86	2012	220. 72
2006	40. 00		

The distribution of data amount provided in NSTL service platform from 2000 to 2012 is shown in Figure 9.

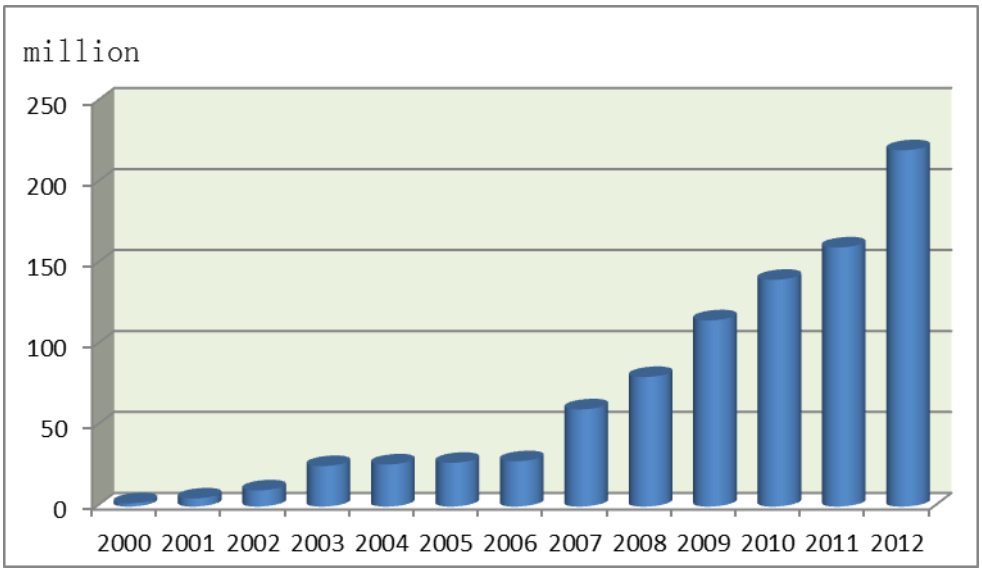

Figure 9．The distribution of data amount provided in NSTL service platform from 2000 to 2012

4.2 The Service Platform Being Widely Accepted by STM Users

NSTL has adhered to the "User-oriented, Honest services" as its service principle, continuously investigating the ever-changing information needs of users, developed new types of services and exploring specialized, personalized and knowledgeable information services. With the substantial increase in total amount of resources and the continual strengthening of its service functions, NSTL service platform has been widely accepted by Chinese STM users [5].

In 2012, there were 166,570,000 access clicks to NSTL's web-based document and information retrieval system, and there were 3,357,236 abstract records from more than 40 databases offered in the service platform being viewed or downloaded by internet users from all over the Country. Numbers of access clicks to NSTL service system from 2001 to 2012 are shown in Table 4.

Table 4．Numbers of access clicks to NSTL service system from 2001 to 2012

Year	Access Clicks	Year	Access Clicks
2001	4, 750, 000	2007	60, 460, 000
2002	11, 500, 000	2008	61, 370, 000
2003	16, 000, 000	2009	48, 060, 000
2004	19, 190, 000	2010	317, 020, 000
2005	28, 250, 000	2011	540, 390, 000
2006	41, 680, 000	2012	166, 570, 000
		Total	1, 315, 240, 000

5 The Significant Effectiveness of Document and Information Services

Through its distributed, joint-supported service system, NSTL has effectively provided document and information services to China's sci-tech users, and which has made contributions to the enhancement Chinese sci-tech innovation capability and international competitiveness.

5.1 The Service Effectiveness of Hardcopy Resources

In 2012, a total of 1,170,000 full text papers from hardcopy publications were offered by NSTL and its member institutions by means of document delivery, interlibrary loan or replication services within the library (See Figure 10).

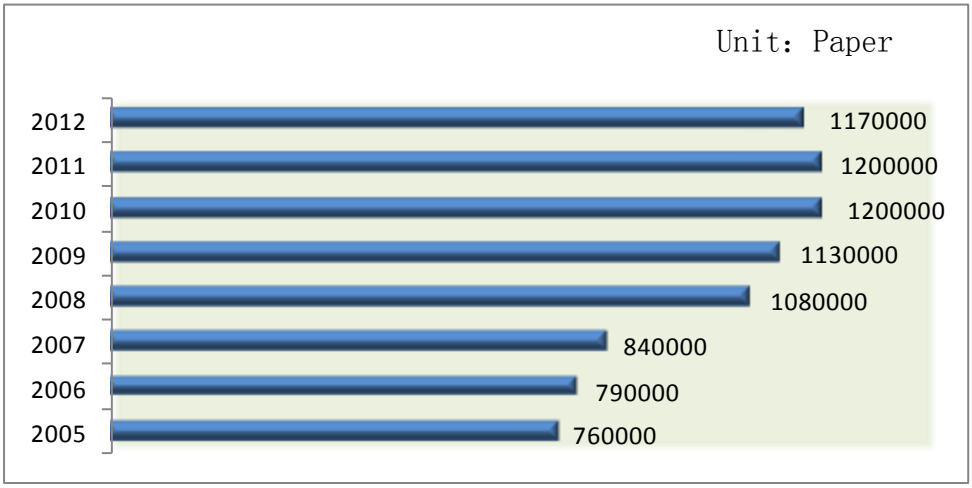

Figure 10．Full text services for hardcopy publications offered by NSTL and its member institutions from 2005～2012

Among these services there were 359,607 full text papers offered through NSTL service platform via the mean of document delivery in 2012, and all the services were completed within 24 hours. The numbers of full text delivery service offered through NSTL service platform from 2001 to 2012 are shown in Table 5.

Table 5．Numbers of full text delivery service offered through NSTL service platform from 2001 to 2012

Year	Piece of paper	Year	Piece of paper
2001	25, 414	2007	259, 516
2002	122, 068	2008	337, 285
2003	113, 448	2009	366, 225
2004	109, 575	2010	403, 005
2005	125, 942	2011	434, 786
2006	152, 157	2012	359, 607
		Total	2, 449, 421

The number distribution of full text delivery service offered through NSTL service platform from 2001 to 2012 is shown Figure 11.

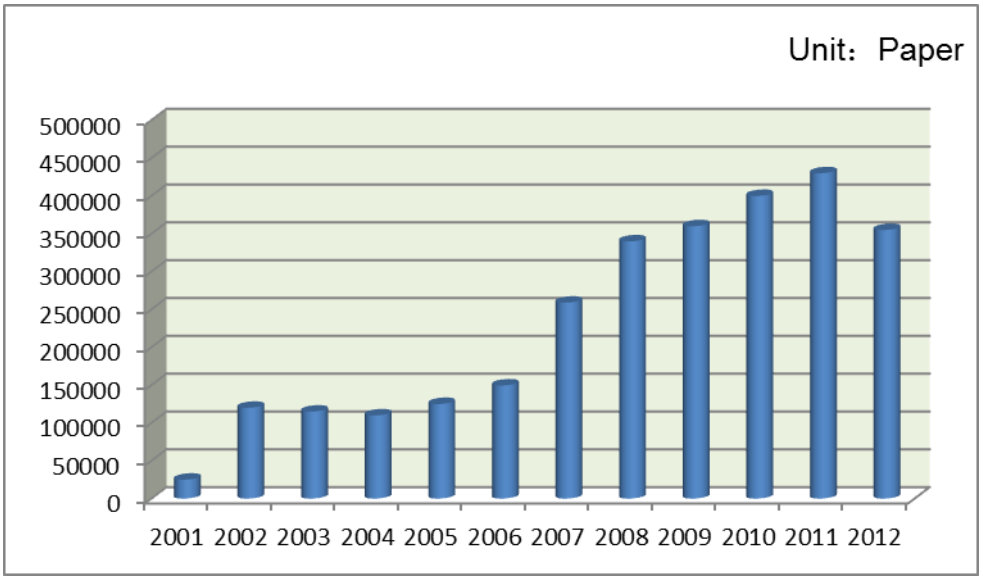

Figure 11．Full text delivery services offered through NSTL service platform from 2001 to 2012

The document type distribution of full text services offered through NSTL service platform in 2012 is shown in Figure 12.

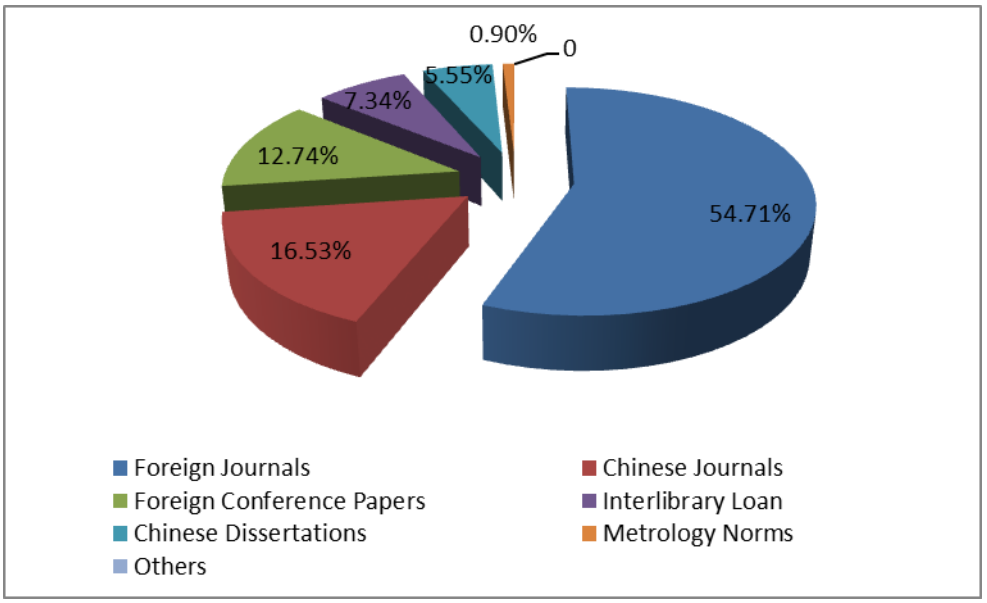

Figure 12．Document type distribution of full text service offered through NSTL service platform in 2012

5.2 The Service Effectiveness of Digital Resources

The various network versions of full text database subscribed or order supported by NSTL played a significant role in providing information supporting environments to the academic users of the country. In 2012, there were 49 million full text papers being browsed or downloaded based on all types of electronic resources order supported by NSTL, the number was increased 19.47% over the previous year. Among the numbers 8.7 million came from national licensing full-text foreign periodical databases, 24.9 million from the online full-text foreign periodicals of consortia ordered by NSTL and other academic libraries of information institutions, and 15.4 million from 68 online full-text databases subscribed by NSTL member institutions (See Table 6).

Table 6．Numbers of papers browsed of downloaded from online databases supported by NSTL in 2012

	From national licensing full-text periodicals	From online full-text periodicals of consortia ordered	From full-text databases subscribed by NSTL member units	Total
Numbers of papers browsed of downloaded	8, 720, 000	24, 900, 000	15, 400, 000	49, 020, 000

5.3 The Effectiveness of Networked Reference Services

In 2012, a total of 2,356 network reference services were offered by NSTL, among them 1,947 real-time references, 409 non-real-time references with responding time of less than 2 days. NSTL virtual reference service initiated since 2003[6], which is a networked joint service system, has already provided more than 25,000 reference consultations up to now (See Table7).

Table 7．Numbers of virtual reference service offered by NSTL from 2003 to 2012

Year	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	Total
real-time service			1, 641	2, 035	2, 431	2, 282	2, 460	2, 767	2, 128	1, 947	17, 691
non-real-time service	1, 066	1, 063	961	861	630	533	433	549	561	409	7, 006

The number distribution of real-time and non-real-time virtual reference services offered by NSTL from 2003 to 2012 is shown in Figure 13.

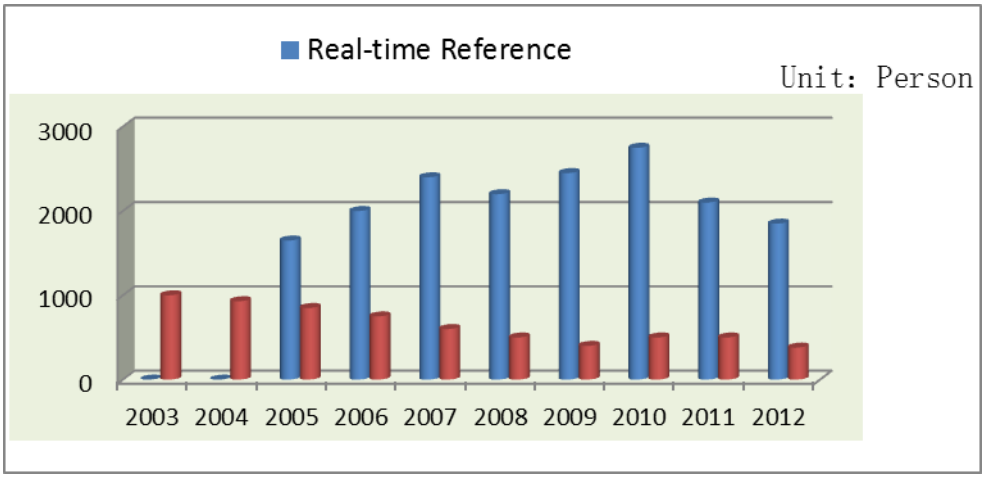

Figure 13．Number distribution of virtual reference services offered by NSTL from 2003 to 2012

5.4 Pay Great Attention to IPR Protection

In the course of the networked information services, NSTL has paid great attentions to IPR protection, organizing thematic research project to understand foreign relative copyright policies, improving document delivery services copyright protection rules, formulating enterprise-oriented service copyright policy, establishing user registration information audit system, making use of electronic watermark protection technology, strengthening the training, inspection, guidance and supervision of all service personnel, and constantly taking all possible measures in its varied document and information services for the adaptation of IPR legal requirement.

6. Play an Important Role in Development of Library and Information Causes in China

Responding to the challenges of the external information environment, meeting the wide range of sci-tech users' needs, in its construction and services, NSTL has actively adopted the relevant technical standards, norms and agreements, and cooperated with relevant organizations to study and formulate professional standards that have been applied to the construction, organization, processing, management and services of digital information resources. At the same time, the issues on utilization and long-term preservation of digital information resources and so on, have been attached importance by NSTL.

Currently, NSTL is organizing the "Scientific & Technological Knowledge Organization Systems" (STKOS) project construction, which is sponsored by the

National Science and Technology Support Program, and is, by far, one of the largest investment funds applied research projects in library and information fields in China. The project adopts the international advanced techniques and methods to build computer applications-oriented knowledge organization system, to provide support for the organization and utilization of digital resources, as the result, to promote the enhancement of sci-tech information service capabilities of the country.

7. Conclusion

After thirteen year of development, NSTL has become one of the most important sci-tech document and information service organizations in China. With the enhancement of its service ability, the status of serious lack of foreign sci-tech information resources has been dramatically changed, the urgent information needs of Chinese sci-tech communities have been basically satisfied, and the country's document and information support capability for sci-tech development has been substantially upgraded.

It has been proved that the concept of information sharing and the model of joint construction represent the development trends of current information service. The innovative management concepts, systems and models, together with the operational mechanism of "Openness, Combination and Sharing", have explored the viable path and provided useful experiences for the development of Chinese sci-tech information careers.

(Note: Most of lists and figures used in this paper were abstracted from *the Annual Development Report of National Science and Technology Library 2012*.)

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