

A new service model of document and information sharing among consortium members: The collaborative innovation practice of the NSLC and PASs*

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Abstract

Purpose: This paper documents an exploration of an innovative approach to the sharing of documents and information among the members of the National Alliance of Academies of Sciences (NAAS) in China, based on the practice initiated by the National Science Library of the Chinese Academy of Sciences (NSLC).

Design/methodology/approach: Through interviews and user surveys, we analyzed the general information demands of users from provincial academies of sciences (PASs) and problems of their document and information service teams. Based on our findings, we designed targeted services to help Alliance members support their document resources, information services for science and technology (S&T) decisions, and their knowledge transfer achievements. Furthermore, we offered training courses for provincial service teams, researchers, and administrators, to improve their information skills. These activities represent a new collaborative model for professional library consortia.

Findings: To date, our service has been extended to all Alliance members, covering 19 provinces in China, and the NSLC service covers all aspects of knowledge services of Alliance members, from basic document delivery services to subject information analyses.

Research limitations: Different PASs have different understandings of the role of the document and information services in the process of scientific research. These differences limit information service sharing of the NSLC with the PASs, and affect the service performance. For the sake of convenience, the original survey was conducted in only three provinces, which may not fully reflect the information needs of users in each Alliance institution. In addition, quantitative and qualitative analyses have been limited by the coverage of the sample.



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Practical implications: Document and information sharing has not only taken advantage of the NSLC knowledge service system and cooperation model, it has also enhanced the range of services of the NAAS in China.

Originality/value: Based on knowledge service enhancements, the NAAS in China has formed a new kind of library consortium, which has broken the traditional library alliance model that was based mainly on the sharing of resources and services.

Keywords Library consortium; Collaborative innovation; Document and information service sharing; Knowledge service; National Science Library (NSL); Chinese Academy of Sciences (CAS); National Alliance of Academies of Sciences (NAAS)

1 Introduction

Collaboration across regions, disciplines, and institutions has become an inexorable trend in the development of science, and it has become an important feature of scientific research. In the future, research work will be completed through cooperation by different research communities located in different regions^[1]; therefore, efficient in-depth knowledge sharing and collaboration is now a prerequisite to the success of scientific research^[2].

Collaborative innovation is a comprehensive approach to innovation covering all areas, such as knowledge, technology, industry, services, and so on. Collaborative innovation provides an effective way to integrate innovation resources and innovation management mechanisms, and makes the innovation efficient^[3].

In Microsoft's report, *The fourth paradigm*^[4], scientific research is described to change from traditional scientific research paradigms to data-intensive discovery. Digital research, based on knowledge sharing, communication, and networks, and also on collaboration^[5], places new demands on today's scientific research environment.

With the deepening of specialization, traditional literature services cannot meet the scientific research needs; new types of information services therefore appear. The report *Libraries and museums in an era of participatory culture*^[6] suggests that libraries and museums should be involved in scientific research and education, providing participatory tools, facilities, and services to meet the needs of users and their organizations.

In 2011, the International Federation of Library Associations and Institutions (IFLA) held an annual convention with the theme of *Libraries beyond libraries: Integration, innovation and information for all*[®], and the IFLA is responding to the



[®] Retrieved on February 28, 2014, from <http://conference.ifla.org/past-ifla-conferences-and-ifla-presidents>.

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coming of the library transformation. Meanwhile, the continuous development of information technology has provided good conditions for a revolution in libraries. Library consortia have emerged as a kind of cooperation structure, offering resource sharing, technical support, and knowledge services. Different types of alliances, services, and sharing mechanisms are being developed at different scales, all over the world.

Initiatives, such as main-branch library models, library purchasing consortia, digital library alliances, professional library alliances, and regional library consortia^[8], all illustrate a burgeoning diversification in library alliances. Collaborative service innovation is happening due to construction of new library spaces^[9], which provides nationwide access to collaboration and communication facilities.

Systematic construction of cloud service facilities is opening a new and rich platform for libraries and industry^[10], making it possible to cooperate among different organizations. New personalized services are promoting collaborative innovation: Professional libraries are integrating blogs and embedding them in the research communication platform, then providing a virtual reference service through SNS, RSS, and mobile location services^[11].

However, the strategic objectives and tasks of library consortia should align with changes in the information environment. In December 2012, the Chinese Academy of Sciences (CAS) and the other 19 PASs established an NAAS to promote their complementary advantages, and to build research and development (R&D) and technology transformation^[12]. In 2013, the NSLC initiated a move to establish a branch association of provincial academies for documents and information, and set up a sharing platform to reinforce the development of document and information services in PASs.

2 Demand analysis

PASs are important scientific research institutions. By August 2015, the NSLC has signed cooperative agreements with all PASs. To date, the CAS has opened its research infrastructure, experimental facilities, and document and information resources and services, to provide service support for the scientific and technological innovation of PASs.

All provincial research institutions have established different research foci in consideration of local and regional economic development^[13]. Since these subjects and industry directions are diverse and dispersed, the research institutions must offer multi-domain and -mode information services.

In order to provide targeted information services, we have carried out qualitative and quantitative analyses of provincial academies information needs. First, we



conducted on-site investigations^② with researchers, R&D administrators by interviews; second, we carried out a questionnaire survey of three provincial academies. Two combined the foundation for our work.

2.1 Latest developments of PASs

Because of funding shortages, the document and information services of PASs have been in a under-developed state for many years. Most of the information services are focused on Chinese documents, which cannot meet the need of scientific research and innovation. Also lagging are network conditions, awareness of modern document and information services. The basic situation of the PASs is summarized in Appendix I.

2.2 Characteristics of document demands

Three selected demand surveys were implemented at Henan, Jiangxi, and Guizhou Provincial Academies of Sciences, which include 29 institutes located in central, eastern, and southern China. During the visits, we distributed 439 questionnaires, with 432 valid responses returned. Among all the investigated participants, researchers accounted for 66.50%; management staff for 4.6%; engineers, 14%; and laboratory assistants, 10.3%.

The questionnaire covered six factors: 1) methods of information acquisition; 2) main resource types; 3) research project information requirements; 4) specific problems in information utilization; 5) specific demands on information service; and 6) the kinds of information retrieval skills need to be improved. The results are shown in Table 1.

Users with different work responsibilities, such as researchers, project leaders, R&D administrators, and PASs leaders, have different information needs. As shown in Fig. 1, researchers are major participants in both scientific research and information request, while R&D administrators are responsible for research management, project evaluation, and business administration. PASs leaders are decision-makers on research, research development, and R&D planning.

2.3 Service design

Information needs of researchers vary by subject areas in PASs. Our survey showed that these needs are either driven by research and development, or based on research



^② During 2012–2013, our investigations were conducted in 12 province academies, which includes Shanxi, Gansu, Guizhou, Jiangxi, Henan, Hebei, Heilongjiang, Shandong, Beijing, Liaoning, Shanghai, and Guangxi Autonomous Administrative Region.

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Table 1 Survey results of document and information needs in PASs

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Investigation content	Results
Channel of information acquisition	Search engines (such as Google and Baidu), free Internet and network community, professional forums, personal homepages and blogs
Main resource type	Chinese academic journals database, e-books, foreign language databases, preprint databases, market information and yearbooks
Information requirements in research project	Some researchers have greater demands on technology information; some want more on market dynamics, business information (competitors, vendors and products), academic papers, industry development reports (industry development status and future trends), national standards and industrial policies (project planning and national statistics)
Information utilization problems	Information acquisition methods, timeliness of the information services, information retrieval techniques and costs
Information service needs	Focusing on research achievements, especially leading-edge information needs, such as documents, subject document search, S&T searches, and subject tracking services
Information retrieval training	Three scientific institutes have greater training demands on using databases and library services (such as sci-tech novelty retrieval and document delivery)

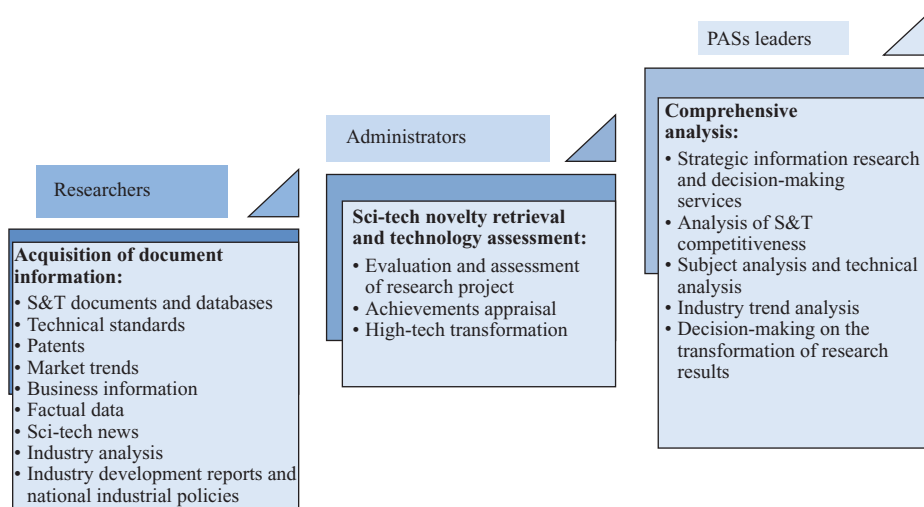


Fig. 1. Different responsibilities of different users and their document and information service needs

processes or industrial transformation under consideration, so our information services offered to users must meet the following demands:

- Being research-driven. Research innovation is a key driving force of research institutions; S&T documents are the dominant information need of PASs.

- Fitting research process. Different research stages (such as approval-operations-completion) have different information needs. The embedded information services must meet the information needs of different project phases.
- Meeting field differences. Each PAS has its own strategic development objectives, so the document service should be designed to meet them.
- Providing multi-level information services. We need to provide multi-level services, such as embedded technical analysis, industrial technology analysis, and product technical analysis.
- Promoting resource sharing. By sharing services with updated information resources among Alliance members, barriers to scientific research must be broken. Only in this way, research and innovation can be effectively promoted.

2.4 NSLC advantages

Since 2002, the NSLC has gradually integrated tools and resources (such as periodicals, abstracts, and books) into its digital document resource system. Multi-level, -type, and -organization collaborations in information research constitute the basis of document and information sharing for PASs^[13].

In 2012, the NSLC initiated a “Document and Information Sharing Services” Project, to support document resource and service sharing. Base on this, we provide sci-tech novelty analyses, thematic information, technical analyses, decision-making reports, and industry trends tracking for the NAAS. The service framework is shown in Fig. 2.

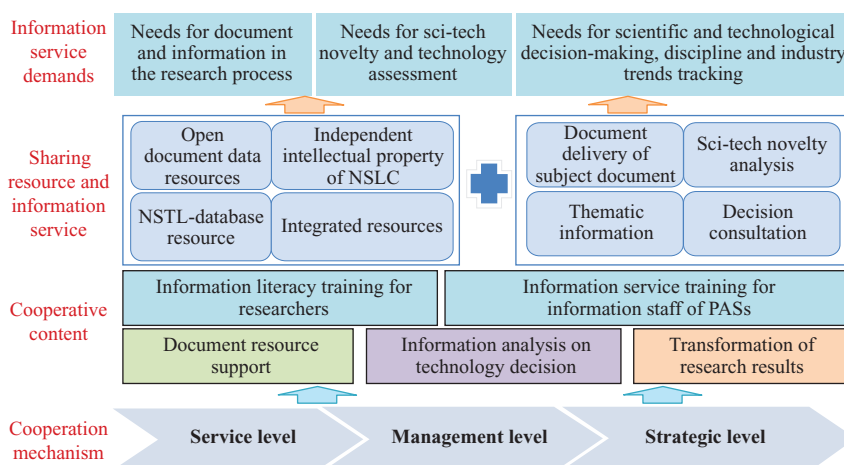


Fig. 2. Framework of document and information services of the NAAS



3 Supporting mechanisms

3.1 Full-spectrum knowledge services of the NSLC

Based on our digital document resource system, the service team of the NSLC provides different services, corresponding to different phases of user projects.

- Document resource services. The NSLC owns diverse document and information resources, such as an integrated database of open-access documents, an NSLC specialized resource system, ScienceChina platform, and a patent analysis platform. As a member of the National Science and Technology Library (NSTL), the NSLC can use the resources of the NSTL—a national document platform. This can not only help researchers of PASs in knowledge discovery, but also assist them in forming a sustainable mechanism for allowing the PASs to access to more document resources.
- Subject document services. The NSLC offers subject resource access in response to research needs, including patent assessment, technical standards, and retrieval of a wide variety of research information.
- Sci-tech novelty retrieval and technology assessment services. The NSLC provides sci-tech novelty retrieval and technology assessment services for research project approval, research achievement appraisal, and so on. Through coaching researchers and librarians of PASs in sci-tech novelty retrieval and assessment tools, we can provide the PASs objective evaluation for their research.
- Advisory services for regional decision-making. The NSLC offers policy and technology trend monitoring and competitiveness analyses. This can strongly support PASs in their basic decision-making regarding S&T development and innovation. For instance, our reports *Competitiveness analysis of provincial academies of sciences and technology* and *Competitiveness analysis on science and technology of six Central-China provinces* have been well-received, and another report, *The development status and prospects of the powder metallurgy industry*, supported a feasibility analysis for the construction of a local industrial park. These experiences can be models for PASs in supporting regional strategic decisions.
- Information services for industry development. The NSLC supports users in market development, technology introduction, R&D decision-making, early industry incubation, and technology development trends. The industrial technical analysis workflow and reporting guidelines are described in Figs. 3 and 4, respectively. For instance, our *Industry technology trend analysis on industrial hemp* report has contributed to the strategic cooperation between the



Heilongjiang Academy of Sciences and an institution of Canada. The report, *Analysis of 3D printing technology* supported a decision on research of 3D printing consumables for scientific research institutions. Another report, *Emergency technique analysis of sudden events in crowded places*, has played a vital role in decision-making for urban construction.

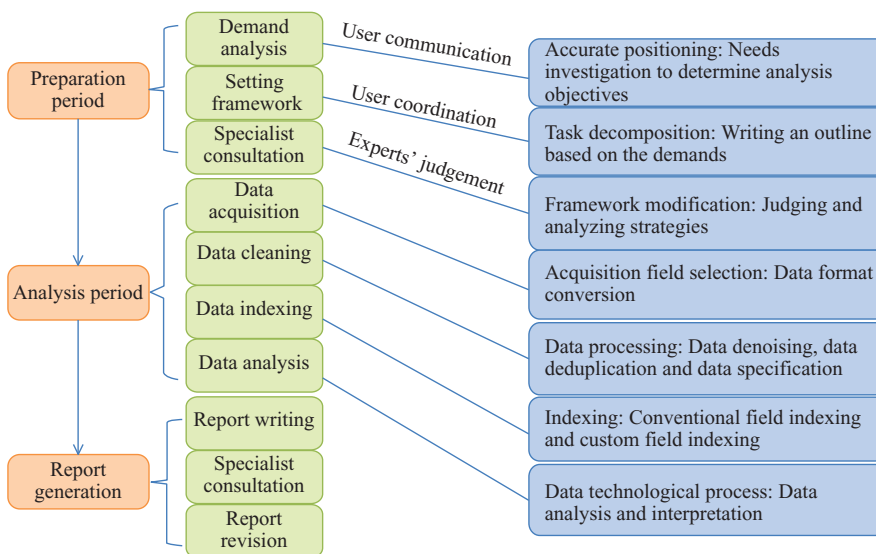


Fig. 3. Workflow of industrial technical analysis

3.2 Further coaching and training

Based on needs of the PASs, we have trained PASs information staff to improve their information skills. For researchers, information literacy training skills include information access, retrieval, management, analysis, and other aspects of benefiting from digital information^[14].

What's more, the NSLC has sent its staff to PASs and their affiliated research institutes, to coach their researchers and librarians to perform literature search for their actual research projects, which has greatly strengthened their abilities.

We have customized training tasks for PASs information staff. PASs librarians are also asked to take tasks during the training in the NSLC. From 2012 to 2015, the NSLC held a total of 45 training sessions, and trained 99 information staff and 3,086 researchers. As shown in Table 2, the training has greatly improved the utilization of the information service.



1. Industry introduction	3. Patent technology analysis
1.1 Concepts related to industry	3.1 Year distribution
1.2 Present situation and trends of industrial development	3.2 Country/region distribution
1.3 Industry chain analysis	3.3 Patent technology distribution
2. Basic research analysis	3.4 Analysis of major applicants
2.1. Analysis of overall situation	(1) Year distribution
(1) Age distribution	(2) Country/region distribution
(2) National and regional distribution	(3) Technology market distribution
(3) Agency distribution	(4) Technology subject distribution
(4) Journal distribution	(5) Cooperative relationship distribution
2.2 Citation frequency analysis by country/region	3.5 Patent technology subject distribution
2.3 Research on technology subject analysis	(1) IPC theme distribution
(1) Overall distribution of the research area	(2) Hot technology distribution
(2) Analysis of a technical subject	4. Market analysis
• Time distribution	4.1 Key country analysis
• Country/region distribution	4.2 Key enterprise analysis
• Agency distribution	5. Industry policy analysis
(3) Specific technical analysis	6. Conclusions and recommendations

Fig. 4. Industry technical analysis reporting guidelines

Table 2 Statistics of service types during 2012–2015 (Up to September 1, 2015)

Year	Registered users	Document delivery	Subject literature	Sci-tech novelty assessment	Thematic information	Industrial technology information push
2012	62	285	9	3	2	0
2013	692	1,735	30	10	18	8
2014	566	2,824	41	4	18	24
2015	270	5,436	24	26	8	12
Total	1,590	10,280	104	43	46	44

3.3 Service sharing network

The cooperative platform of the NAAS gathers all available literature resources and services and makes them available for scientific research and management. The platform structure is shown in Fig. 5. The main content of the platform includes:

- Information service. It includes 1) document search, access, and delivery from the NSLC and other domestic and foreign libraries; 2) sci-tech novelty assessment services; and 3) services for thematic information analysis.
- Training services. Our training services include 1) offering coaching sessions and training courseware for communication, conference information, and reports; 2) helping researchers well-informed of document and data retrieval



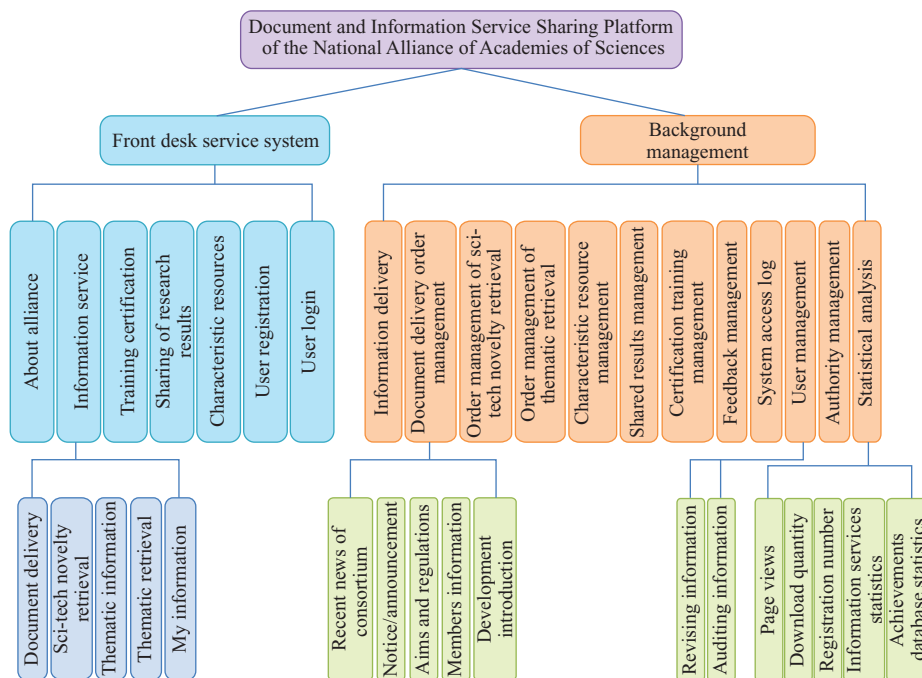


Fig. 5. Structure of information and service sharing platform of the NAAS

methods; and 3) assisting information staff in using new tools of competitiveness analyses and technical situation analyses for patents, etc.

- **Characteristic resources.** Resources provided for users of PASSs include: both the online patent analysis system^⑤ and the document service system of the CAS^⑥; free resources of NSTL; the institutional repository of the CAS^⑦; the united directory database of the National Journal^⑧, Chinese Scientists Online—iAuthor^⑨; a one-stop platform of open access—GOOA^⑩, and other resources.
- **Achievements presentation.** This includes the latest research results of the PASSs, special information analysis reports, research papers, patents, standards, and other publicly accessible scientific and technological achievements and resources. A statistic of the information sharing since the establishment of the NAAS is presented in Table 3.

^⑤ Patent online analysis system of CAS. Retrieved on August 5, 2015, from <http://patent.casip.ac.cn/pat2/view/m05/A0500.xhtml?csrftoken=95fab4e5f5e94236b2190d4482f4c4cf>.

^⑥ ScienceChina. Available at <http://sciencechina.cn/?csrftoken=95fab4e5f5e94236b2190d4482f4c4cf>.

^⑦ Available at <http://www.irgrid.ac.cn/?csrftoken=95fab4e5f5e94236b2190d4482f4c4cf>.

^⑧ Available at <http://union.csd.l.ac.cn/?csrftoken=95fab4e5f5e94236b2190d4482f4c4cf>.

^⑨ Chinese scientists online: iAuthor. Available at <http://iauthor.cn/welcome/index.xhtml>.

^⑩ Available at <http://gooa.las.ac.cn/external/index.jsp?csrftoken=95fab4e5f5e94236b2190d4482f4c4cf>.



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Table 3. Statistics of document and information sharing of the NAAS (2014–2015)

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Type	Quantity	Type	Quantity
Registered platform users	1,590	Sci-tech novelty assessments	60
Integrated open access journals	1,766	Thematic search services	14
Open resources offered for the national scientific research institutions by NSTL	655	Industry technical information reports	43
Available document entries	60 million	Research articles	37
Document delivery services	6,348	Open characteristic resource links	12

3.4 Service mechanism

Figure 6 illustrates the service mechanism that supports our platform through a three-level structure. To implement the Alliance service, we first established a Document and Information Branch of the NAAS and subsequently the Alliance of the PASs, with clear missions and working plans. All 19 PASs members signed the cooperation agreement, which clarified the duties and restrictions.

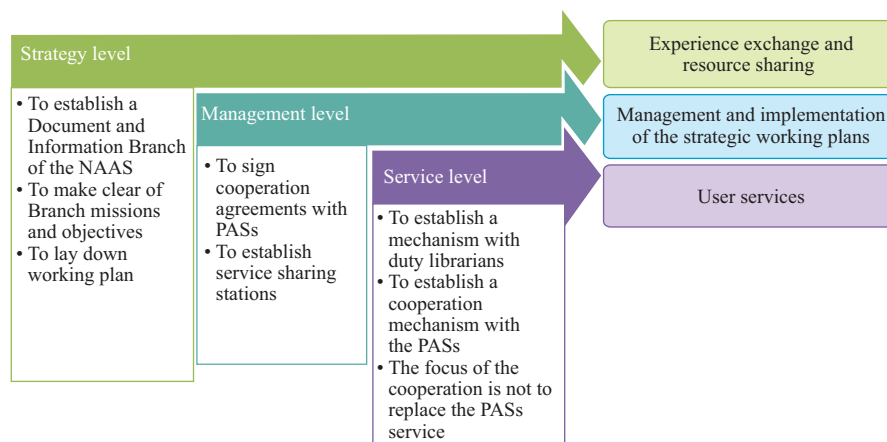


Fig. 6. Three-level service mechanism structure and its main functions

4. Initial service features

4.1 A shift from unilateral service provider to bilateral channel

The cooperation between the NSLC and the PASs provides a unilateral benefit—that is, the NSLC gives support to PASs in information literacy skills, supplies S&T information resources to the PASs, and offers full-spectrum S&T services for the entire scientific research process. But the strategic goal of the NAAS is to reinforce the document and information services of different PASs, instead of replacing them



by the NSLC. In the process of cooperation, the S&T resources of the PASs are maintained, and the information service abilities and information skills have been promoted through the export of documents and information service abilities of the NSLC. Now, the Alliance gives powerful support for technology decision-making and promotes the development of the local economy. At the same time, the NSLC is benefiting from being able to offer resource access to the PASs. The Alliance is changing from being a one-way service provider to a participant in a bilateral arrangement.

4.2 Users are both clients and collaborative partners

In our services, users have different levels of participation, ranging from use of basic services to deep services. For instance, in the process of customizing industrial technology analysis reports, the NSLC is grasping users' real purpose through repeated communication between service suppliers and users. Interactions between users and libraries make the user-driven knowledge service an essential aspect of a scientific innovation environment.

4.3 Construction of knowledge services abilities

The cooperation between the NSLC and PASs has broken through old patterns in terms of resource sharing and construction, and is constructing a true knowledge service ability. Thus, the NSLC helps Alliance members with access both to its scientific information and to its services and research abilities.

4.4 Integration of user resources over regions

Internet technology has made resource sharing easier in an intellectual property framework. Members of the Alliance have been across North-, East-, South-, West-, and Central-China. This has broken through the regional limitations that used to characterize these activities, and spread scientific resources and information services all over the country. Different from the library consortium pattern in the past, the Branch of Document and Information of the NAAS has achieved cooperation between one library and a number of scientific institutions, and realized sharing of scientific information resources, which highlights strengths of the heterogeneity of the library consortium.

5 Discussions and expectations

5.1 Demand changes

Since the Alliance was founded two years ago, the basic service content and service mode have been in place. The successful use of the consortium services has pointed out areas that need to be improved.



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- Scientific research institutions need to improve the cognitive level of the document and information service. Different PASs leaders have different understandings of the function of documents and information in scientific research, which has not only restricted sharing with the information service of the CAS, but also affected the service and its development.
- Demand for strategic decision-making support has significantly increased. Managers and decision makers of PASs are paying more and more attention to the S&T competitiveness of the PASs, and to their focus on research areas and advantages of each industrial development direction. In the future, information service support for strategic decision-making will be one of the main tasks of the consortium.
- Needs for document types and services vary. Different PASs have different strategic research roles, and therefore have different needs in terms of types of documents and services, and timeliness and accuracy requirements. Training for researchers will focus more on dealing with issues specific to different users.
- The role of the Document and Information Branch of the NAAS needs to be clarified. Unilateral service provision is not effective. If the consortium is to have long-term growth, it must establish a document and information team, and cooperation must take the form of a bilateral “win-win” relationship.

5.2 Additional service development considerations

5.2.1 At the consortium level

- In order to enhance cooperation efficiency, the Alliance needs to take a more important role in organizing, planning, coordinating, and promoting provincial awareness of the document and information service.
- It is necessary to establish an “industry intelligence research center” between PASs. The strategic consulting services must be based on support for decision-making, enterprise strategy counsel, and intelligence research services. In addition, through establishing a retrieval service network, it will be easy for the Alliance to offer industry information services.
- With the concept of collaborative innovation, we can share the document and information service over the seven professional branches of the NAAS, which will play an important role in scientific research and industrial development.

5.2.2 At the service level

- On the one hand, we need to enhance the knowledge service abilities of the PASs document information staff through training and practice, to “export” service analysis approaches of the NSLC to local academies of sciences.



- On the other hand, we need to establish new patterns and mechanisms that enable the local academies of sciences to play an important role in information and knowledge services for science and industry research.

5.2.3 At the Internet level

- We should make full use of the Internet and data mining technologies to develop tracking services in key areas.
- Virtual scientific communication spaces should be used to promote collaborative innovation between researchers, and help them with the exchange of scientific research.

The sharing of information, documents, and services of the NAAS is a requirement not only for developing regional economies and local science and technology, but also for collaborative innovation and for transformation in the library consortium service pattern. Through the sharing of information and document services of the NAAS, old patterns have been broken through and a new pattern is being shaped, one that focuses on knowledge services and construction of new collaborative abilities.

Authors' contributions

P. Jia (jiap@mail.las.ac.cn) proposed the research question and designed the research framework. She wrote and revised the manuscript and organized the PAS service survey. Y. You (cherryber@163.com) participated in the literature review of library consortium and data analysis. Z. Li (liz@mail.las.ac.cn), W.J. Guo (guowj@mail.las.ac.cn), H.F. Xu (xuhf@mail.las.ac.cn) and W. Y. Zhao (zhaowu@mail.las.a.cn) was responsible for the service organization and implementation for Hebei, Helongjiang, Jiangxi and Beijing Academies, respectively. L. Dong (dongl@mail.las.ac.cn) participated in the practice and framework design for the industrial information process.

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Appendix I Subjects foci of each provincial academy of sciences

PAS name	Number of affiliated institution	Subject/industry direction
Shanghai Academy of Sciences	14	Communication, Computers, New Materials, Kinetics and Electrical Engineering, Ship and Ocean Engineering, Optoelectronics and Lasers, and Mechanical Engineering
Guangxi Academy of Sciences	7	Guangxi Plants, Marine Environment, Mangroves, Marine Aquaculture, Marine Aquatic Products, Microbial Fermentation, and Enzyme Engineering
Anhui Academy of Science and Technology	0	Biological, Medical, Mechanical, Engineering, and Design
Guangdong Academy of Sciences	7	Tropical Oceans, Environment and Biology, Subtropical Plants, Animals, Microorganisms, Southern China Ecology, Pollution Control, Energy, and Biological Medicine



PAS name	Number of affiliated institution	Subject/industry direction
Heilongjiang Academy of Sciences	9	Materials, Adhesives, Chemical, Bast Fiber Crops, Micro-organisms, Automation Control, Volcanic Resources, Resources and Environment, Oil Shale, and Energy
Hunan Academy of Science and Technology	10	New Energy, New Materials, Economic Geography, Internet of Things, Mechanical and Electrical Integration, Information Science, and Engineering Machinery
Shenyang Institute of Science and Technology	0	Research and Development, Intermediate Trial, Industrial Development, and Integrated Organizational and Technological Innovation Services
Beijing Science & Technology Institute	18	Information Technology, Biotechnology, New Energy and Energy Saving, High-End Equipment Manufacturing, New Materials, and Public Safety and Urban Management
Guizhou Academy of Sciences	16	Metallurgy, Materials, Food Safety and Nutrition, Cloud Platform, E-Commerce, Internet of Things (IoT, Engineering, Plant, and Geology and Earth Sciences
Jiangxi Academy of Sciences	6	Biological Engineering, Fine Chemicals, New Materials, Plant Breeding, New Energy and Energy Conservation, Electronic Information, and Ecological and Environmental Protection
Wuhan Engineering Institute	5	Information Technology, Optoelectronic Technology, Biological Technology, Earth Space Physics, and New Materials Technology Research and Development
Chongqing Science and Technology Institute	18	Information and Automation, New Materials, Optical Instruments, Biological Medicine, Electronic Information, Energy-Saving Cars, New Energy and Equipment Manufacturing, and Food
Hebei Academy of Sciences	12	Biology, Microbiology, Geography, Automation, Laser, Applied Mathematics, Energy, and Machine Control
Shandong Academy of Sciences	13	Marine Monitoring Equipment, Environmental Protection Equipment, Raw Materials, Fiber Optic Sensing, Automotive Electronics, High-Performance Computing, Networking and Cloud Computing, Information Security, Advanced Manufacturing and Industrial Control, and Biosensors
Xinjiang Production and Construction Corps	0	Program Management, Science and Technology Awards, Science Popularization, Intellectual Property, and Technology and Markets
Gansu Academy of Sciences	8	Natural Energy, Biological, Geological Disaster Prevention and Control, Sensor Technology, Automatic Control, and Magnetic and Mechanical Engineering
Henan Academy of Sciences	21	Fine Chemicals, Bio-Engineering, Energy, Energy Conservation and New Materials, Remote Sensing, Electronic Information and Automation, Radiation Processing, and Food
Shanxi Academy of Sciences	4	Endangered Animals, Biodiversity, Conservation and Utilization of Biological Resources, Plants, Microorganisms, Bacteria and Enzyme Engineering, and Biochemistry
Xinjiang Academy of Farm Sciences	9	Crops, Animal Husbandry and Veterinary, Mechanical Equipment, Cotton, Irrigation and Soil Fertilizer Science, Agro-Processing, and Biotechnology

