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## Digital services of regional centers for scientific and technical information in China

### Цифрові послуги регіональних центрів науково-технічної інформації Китаю

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Written by:

**Guo Zhiliang**<sup>143</sup><https://orcid.org/0000-0002-0939-0530>**Alla Solianyk**<sup>144</sup><https://orcid.org/0000-0002-7167-6695>**Olena Karpenko**<sup>145</sup><https://orcid.org/0000-0002-9922-165X>

#### Abstract

The article aims to study the current level of digital services of the regional subsystem of the National System of Scientific and Technical Information of the People's Republic of China and to determine its optimization directions.

A content analysis of 28 provincial institutes of scientific and technical information's official sites was carried out; the most powerful of them were identified in terms of resource and service potential, the level of organization of corporate cooperation based on consolidated digital platforms of multifunctional user service. It is proved that the level of efficiency of digital services of regional scientific and technical information systems directly depends on the level of the province's economic development and the ability of its government to finance and technologically equip information industry centers activities, and to establish sustainable interaction of all subjects of the information market. Summarizing the results of the content analysis made it possible to identify reserves for improving the service capabilities of the Chinese information industry's regional clusters, to design vectors for diversifying consulting, expert-analytical, cognitive services of provincial institutes of scientific and technical information, the development of integrated innovation-oriented intelligent service platforms operating based on artificial intelligence technologies.

#### Анотація

Метою статті є дослідження сучасного рівня цифрових сервісів регіональної підсистеми Національної системи науково-технічної інформації КНР та визначення напрямів її оптимізації.

Здійснено контент-аналіз офіційних сайтів 28 провінційних інститутів науково-технічної інформації, виявлено найпотужніші з точки зору ресурсного та сервісного потенціалу, рівня організації корпоративної співпраці на базі консолідованих цифрових платформ реалізації мультифункціонального обслуговування користувачів. Доведено, що рівень ефективності цифрових сервісів регіональних систем науково-технічної інформації напряму залежить від рівня економічного розвитку провінції, спроможності її уряду фінансувати та технологічно оснащувати діяльність центрів інформаційної індустрії, налагоджувати сталу взаємодію усіх суб'єктів інформаційного ринку. Узагальнення результатів контент-аналізу дозволило виявити резерви вдосконалення сервісних можливостей регіональних кластерів інформаційної індустрії Китаю, розробити вектори диверсифікації консалтингових, експертно-аналітичних, когнітивних послуг провінційних інститутів науково-технічної інформації, розвитку інтегрованих інноваційно-орієнтованих інтелектуальних сервісних платформ, що

<sup>143</sup> Postgraduate student, Department of Information, Library and Archival Affairs, Kharkiv State Academy of Culture, Kharkiv, Ukraine.

<sup>144</sup> Doctor of Pedagogical Sciences, Professor, Kharkiv State Academy of Culture, Kharkiv, Ukraine.

<sup>145</sup> PhD in Pedagogy, Associate Professor, M. Ye. Zhukovskiy National Aerospace University "Kharkiv Aviation Institute", Kharkiv, Ukraine.



**Keywords:** regional institutes for scientific and technical information, digital information services, artificial intelligence technologies, consulting services, innovation transfer.

## Introduction

In the conditions of digitization of all spheres of society's life, China is rebuilding the National System of Scientific and Technical Information like the best world models. Based on the study of the experience of creating scientific and technical and analytical centers in the USA, Germany and Great Britain, the study of the organizational principles of the functioning of such powerful institutions as the Information Technology and Innovation Foundation of the USA Gold Association (Information, Technology and Innovation Foundation (ITIF), the British Science Policy Research Unit, SPRU, Korea Science and Technology Policy Institute (STEPI), Indian Science Congress Association (ISCA), etc., the People's Republic of China is transforming the information service system of specialists into a digital knowledge industry, which relies on artificial intelligence technologies capable of extracting knowledge as a result of analytical processing of large volumes of scientific and technical information. This large-scale task requires an analysis of the existing information and infrastructural potential of the regional component of the National System of Scientific and Technical Information of the People's Republic of China, which is the resource core of information service for users throughout the country.

To realize the aim of the study concerning the peculiarities of the current level of digitizing Chinese society and transforming the regional subsystems of the National System of Scientific and Technical Information to determine its optimization directions the relevant literature was analyzed and systematic, classification, comparative, and socio-communication approaches were used. Works by Baiyang et al., (2020), Chzhylan (2022), Defang (2007), Jialin & Zhang (2007), Jianxun(2019), Li & Guang (2017), Li et al., (2021), Xin. (2022) were chosen as the theoretical base of analyzing the study problem. And as the main methods for studying the current state and potential of 28 Institutes of Scientific and Technical Information in different regions of China were content analysis, the statistical method and the ranking method. Using

працюють на основі технологій штучного інтелекту.

**Ключові слова:** регіональні інститути науково-технічної інформації, цифрові інформаційні сервіси, технології штучного інтелекту, консалтингові послуги, трансфер інновацій.

the methodological tools allowed us not only to study the current state of digitalizing regional subsystems of the National System of Scientific and Technical Information but also to determine their directions as to forming regional science and technology clusters, increasing generation productivity, and introducing scientific and technological innovations, which is badly important for developing the economies of China's poor provinces.

## Literature Review

The analysis of publications by Chinese librarians and computer scientists devoted to the evolutionary changes of the National System of Scientific and Technical Information of the People's Republic of China made it possible to determine the regularities of its development and diversification of service functions under the influence of sociopolitical, economic, technical, technological and cultural factors. The works by Chzhylan (2022), Defang (2007), Jialin & Zhang (2007), Xisheng (2022), Yan (2022) and others were particularly significant in this context. The study of the main historical stages of the state's development of regional institutes of scientific and technical information and the legal basis of their coordinated functioning developed by Zhou et al., (2019) is fundamental, as well as the results of the research by Shilin et al., (2022) in the context of forming state policy to ensure national security is of great interest.

The author's classification of scientific and technological services of regional institutions of the information industry of China was developed by experts of the Information Resources Research Center of Wuhan University such as Baiyang et al. (2020). They emphasized the objective regularity of the transition from a resource to a service model of proactive information service for users, which is due to the modern pace of mastering the latest technologies of the global digital society based on cloud computing, big data, 5G, and blockchain. The trend of diversifying the range of information services under the influence of Internet 3.0

technologies is confirmed in their publications by Hannas & Chang (2022), Huld, A. (2022), Shelestova et al., (2021), and others. The effectiveness of implementing digital platforms for providing intelligent services in the regional system of scientific and technical information is evidenced by the results of the research by Li et al., (2021) who are specialists of the Documentation and Information Center of the Chinese Academy of Sciences. Yi et al., (2022) as experts in the field of automation of modern information services by using the example of the integrated service platform of scientific and technical information of Shaanxi province, reveal the possibilities of building innovation-oriented intelligent service systems of the new generation. The peculiarities of the System Function of the Science and Technology Service Industry were researched by Jing et al., (2006). The results of the research by Chen et al., (2017) devoted to implementing Chinese innovation-driving factors including regional structure, innovation effect, and economic development data contributed to the policy measures to implement innovation-driven strategies. For improving the information support system of regional innovations.

### Methodology

A complex of scientific approaches and methods, which complement each other's heuristic capabilities, was used to achieve the goal and objectives of the research. The systematic approach made it possible to establish the structure and functional features of regional components of the National System of Scientific and Technical Industry of China, to determine their connections and contribution to the formation of integrated information resources and to provide remote access to them for collective and individual users. The classification approach made it possible to organize various digital services of the regional Institutes of Scientific and Technical Information of the People's Republic of China; the comparative approach allowed defining advanced information institutions that implement actual competitive intelligence services and semantic methods of searching for hidden knowledge and develop analytical brain centers with expert services for evaluating the prospects of innovative projects.

Combining the possibilities of information and socio-communication approaches with historical, genetic and socio-cultural ones made it possible to prove the importance of the aggregation of consolidated information resources at the national and interregional levels, their unification

with the help of network communications into a single system of multifunctional information centers that can level the digital and economic inequality of the rich and the poor provinces of the People's Republic of China by providing high-quality scientific and technical service to their industrial enterprises.

Based on the application of content analysis and the statistical method, the sites of 28 Institutes of Scientific and Technical Information in different regions of China were surveyed, the ranking method helped to determine the most powerful of them, with a developed system of digital products and services.

### Results and Discussion

The evolution stage of China's digital information industry began in 1997, when Wanfang, the first professional database manufacturing company, was established in the country. Its activity stimulated the development of other high-tech database aggregators — Tsinghua Tongfang and Chongqing VIP, etc. The next important step in forming a powerful resource base for the production of digital products and services by regional NTI Institutes is the creation of the National Map of Science and Technology in June 2000, which, under the auspices of the National Science and Technology Library (NSTL), united all branch databases created by the Chinese Academy of Sciences, the Chinese Institute of Chemistry and Metallurgy, the Chinese Academy of Medical Sciences, the Chinese Academy of Agricultural Sciences and other branch scientific centers into a single network to exchange of scientific and technical information. Based on them, the Consortium of Information Resources was created, the access points to which were designated at the regional level by regional NTI Institutes. Currently, on their official websites, subscribers are offered to search for information in such authoritative databases of Chinese scientific and technical literature as CNKI, Wanfang Data, VIP Information, Guoyan, numerous databases of regulatory, patent, periodical, and other scientific and technical publications in foreign languages.

Among the basic digital services of regional institutes of scientific and technical information to individual and collective subscribers, which they produce based on powerful digital platforms of NSTL, the following are the most popular:

- implementing collection, comparison and analysis of scientific and technical data, forming information resources of the

province, in particular scientific and technical archives, integrating profile databases of scientific and technical direction, providing services for searching scientific and technical literature, scientific and technological novelties, international patent online searching and consulting on copyright for all segments of society;

- supporting science and technology departments of their provinces in project management, such as research and development plans in key sectors of the economy, the opening of research institutes and scientific and technical associations, etc.;
- analyzing the effectiveness of introducing innovations, collection and provision of statistical indicators of the development of science and technology in the region; advertising of scientific and technical achievements through the preparation and publication of annual statistical directories; reporting on realizing plans for the scientific and technical development of the province and the market of its technologies, as well as popular science magazines that form an attractive economic image of the region.

Under the influence of the development of the digital economy and knowledge society in China, there is a diversification of digital services of regional NTI Institutes as consulting centers and technology transfer centers, and information brokerage agencies.

Thus, nowadays the leading regional NTI Institutes already offer:

- providing decision-making consulting services, such as the study of the development strategy and economic policy of the region, planning of innovations and creating a technical road map for their implementation, participating in tenders for technological projects and competitive intelligence for business structures and government departments at all levels and in all sectors of the national economy;
- industrial cluster research, regional planning, development of business incubation strategies, intelligence analysis and operational economic planning for provincial governments, science and technology parks, business incubators, manufacturing enterprises, and transfer of their technologies.

One of the key tasks of regional scientific and technical institutes as information intelligence

agencies is to help the government and enterprises to make innovative decisions, substantiate forecasts and development strategies, and evaluate production and management technologies. They perform the function of a strategic intelligence service and a think tank, which are an important basis for making timely and effective management decisions. For example, the Guangdong Institute of Scientific and Technological Information provides the provincial government with high-quality consultations on the strategic directions of regional planning and conducts research to assess the economic efficiency of Guangdong's industrial and regional development. The information resource center of this institute is one of the most powerful platforms of the network created by the National Science and Technology Library (NSTL) for the exchange of scientific and technical information and access points to such authoritative databases of Chinese scientific and technical literature as CNKI, Wanfang Data, VIP Information, Guoyan, databases of periodicals and other scientific and technical publications in foreign languages. Awards for the high level of information service for users of scientific and technical literature and documentation were received from NSTL in different years by NTI institutes of the provinces of Gansu, Guangdong, Tianjin, Fujian, Hubei, etc.

The most powerful institutes of NTI, in particular the Institute of Gansu province, create Systems of cloud services for searching scientific and technological information and Intelligent information systems for search management for scientific and technological novelties (SNRMIS). These high-tech systems of the new generation apply cloud computing, intelligent data analysis, text messages on mobile phones, and WeChat to realize the effective management of business processes, such as the search, collection, analysis, and introduction of scientific and technological innovations, assessment of intellectual property protection and the prospects of scientific and technical achievements.

In recent years, the Science and Technology Information Research Institute of Hubei Province has implemented about 300 projects above the regional and ministerial levels, received about 10 provincial-level awards for promoting scientific and technological progress, and issued about 100 intellectual property rights, such as invention patents, useful models, software, has provided users with more than 3,000 informational advice for decision making. The effective activity of the Institute made it possible to create social and

economic benefits in the amount of more than 3.5 billion yuan, to satisfy the information needs of about 3.5 million users; produce more than 800 scientific and technical television films, videos, feature films, documentaries, and news films, including on CCTV and Hubei TV. According to the analysis of the Institute's powerful information resources, its employees discovered 40,000 scientific and technological innovations, acted as mediators in more than 200 successful technological projects with a new initial value of nearly 400 million yuan; completed more than 600 research projects in the field of soft sciences at various levels; provided more than 3,000 pieces of information for the adoption of management decisions by state bodies. The business philosophy of the Institute's service to universities, research enterprises and investors is based on "building a green bridge between technology and capital", integrating the information market and technology transfer market and promoting the transformation of scientific and technical achievements into real productivity. In addition, Hubei NDINTI publishes China's most influential academic journal "Scientific and Technical Progress and Countermeasures", which is indexed in the authoritative scientometric databases of CSSCI. In 2019, this publication was included in the "List of the Impact Index of World Academic Journals" in the field of humanities and social sciences.

In one of the most powerful provincial Institutes, the Guangdong Institute of NTI, the Industrial Technology Research Center has been opened, which provides services for the management of the full process of scientific and technological projects in the key sectors of the economic plan of research and development of Guangdong Province, and also conducts promising interdisciplinary research on the main strategic issues of industrial development region. The service of integrated management of scientific and technical projects assists in preliminary analysis and strategic evaluation of research results, preparation of plans for its implementation, project approval, signing of the task log, management of project launch, assessment of allocations at the second stage, evaluation of effectiveness and acceptance of project completion results. It is important to emphasize that problems of scientific and technical projects, which are realized by the Guangdong INTI, are devoted to the development of such extremely complex industries as the technologies of artificial intelligence of the new generation; chips, software and computing; laser and additive

manufacturing; virtual reality and information security networks; production of intelligent robots and equipment, cars running on new energy. The center provides information and consulting support for the research of innovations in the field of industrial technologies of Guangdong Province through the provision of information on industrial technologies and development strategies, a support system for innovations in the field of industrial technologies, technology transfer; research on the formation and development of industrial and innovation clusters in Guangdong Province, including the development of traditional industries and characteristic industry clusters, the development of new industry clusters, industrial technological innovation policy, industrial development strategy and planning, as well as strategic planning and management of corporate technology.

One of the mandatory services of provincial NTIs is forming digital scientific and technical archives of science and technology departments of their provinces to provide services for managing the implementation of innovative technologies and realizing strategic research. In the 2000s, most of the regional NTI institutes transferred the work of the archives to a digital format, organizing the reception, processing, safe storage, daily management, and maintenance of a large number of files of scientific and technological documents of the provincial departments of science and technology. On average, about 20,000 files are processed and stored annually in such archives, and about 1,000 services are provided for searching scientific and technical archival documents, which provides effective information support for the introduction of technological innovations.

An important area of activity of provincial INTIs is the popularization of the scientific and technical achievements of their provinces and the promotion of their scientific and economic development through publishing monthly magazines in the field of science and technology. Leading institutes of NTI, such as Guangdong, can support publishing two magazines, such as "Science and Technology" and "Research on the strategy of scientific and technical innovative development". The purpose of these publications is to provide intellectual support for innovative development strategies realized by the regions of the People's Republic of China.

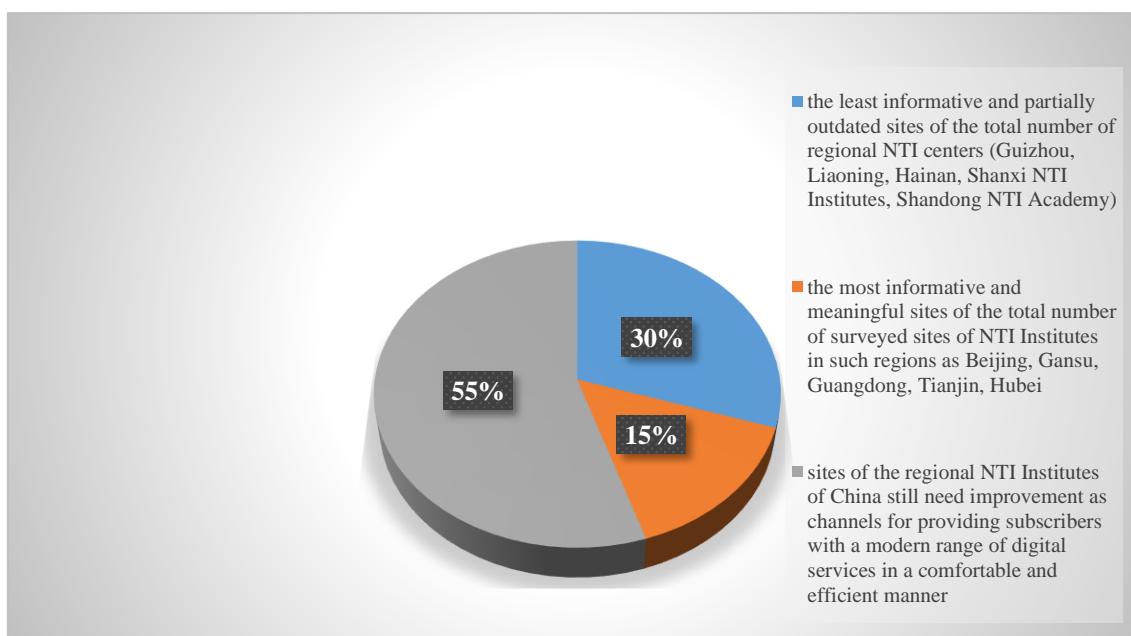
The experience of building digital e-commerce platforms in the field of science and technology, operating in O2O mode, by Chinese regional NTI

institutes is also effective. These platforms are a link that brings together scientific instruments and equipment, scientific databases, intellectual property rights, research and development, business incubation, scientific and technical consulting, scientific and technical financing, technology transfer, and other scientific and technical resources and services. Thanks to the functioning of such platforms, an organic combination of scientific and technical resources and services, public procurement and financial support for innovations of small and medium-sized enterprises is carried out.

For example, since 2008, the Beijing Institute of Scientific and Technical Information has significantly expanded the range of free services, providing in particular competitive intelligence services that improve users' understanding of the competitive environment and reduce decision-making risks. Such services are especially important for high-tech enterprises, investors, state institutions, and branch authorities. In Beijing and other powerful regional centers of scientific and technical information, specialized laboratories of "competitive intelligence and evaluation of innovations" have been created, which serve the needs of business groups engaged in the production of high-quality equipment, intelligent transport, IT technologies, and other innovative projects. Carrying out professional competitive intelligence, regional intelligence agencies monitor internal and external factors affecting the development of science and technology, and propose to state governing bodies several action plans built according to possible financial and other economic risks. An important service of NTI regional institutes should be realizing the functions of think tanks, the task of which is to collect, sort and analyze information and its intellectual screening, as well as further processing for decision-making. Thus, since 2015, the Center for Documentation and Information of the Chinese Academy of Sciences has been implementing a strategic plan of transformation into a scientific, technological and analytical center with innovation assessment and competitive intelligence services. Similar tasks are set before the regional institutes of NTI. Their expansion of the range of free services

through the provision of competitive intelligence services improves users' understanding of the competitive environment and reduces the risks of their decision-making regarding the opening of high-tech enterprises in the region and communication with investors and industry authorities.

However, the level of service and participation of scientific and technical analytical centers in the development of each province is different. It depends on the ability of the governing bodies of the province to finance and technologically equip the activities of such centers. In total, China has 34 provincial-level administrative regions, including 23 provinces, 5 autonomous regions, 4 municipalities directly under the central government (Beijing, Tianjin, Shanghai, and Chongqing), and 2 special administrative regions (Hong Kong and Macau). To establish the presence of regional NTI Institutes in these administrative areas and the level of digitization of their services, a content analysis of their official sites was conducted as a basic channel for providing digital products and services. According to the results of the content analysis, problems with the stability of work, prompt updating, and the quality of the content of the sites of NTI Institutes of remote autonomous regions: Inner Mongolia, Guangxi-Zhuang, Tibet, Ningxia-Huei and Xinjiang-Uygur were revealed. Among provincial institutions, the sites of Guizhou, Liaoning, Hainan, Shanxi NTI Institutes, and Shandong NTI Academy, which make up 30% of the total number of regional NTI centers, are the least informative and partially outdated. The sites of NTI Institutes in such regions as Beijing, Gansu, Guangdong, Tianjin, and Hubei were recognized as the most informative and meaningful from the point of view of the presence of advanced intellectual management systems for the search for scientific and technical innovations, which is 15% of the total number of surveyed sites. The established ratio of the degree of informativeness of the sites of the regional institutes of the NTI of the KRN is illustrated in Figure 1. It clearly shows that 55% of the sites of the regional NTI Institutes of China still need improvement as channels for providing subscribers with a modern range of digital services comfortably and efficiently.



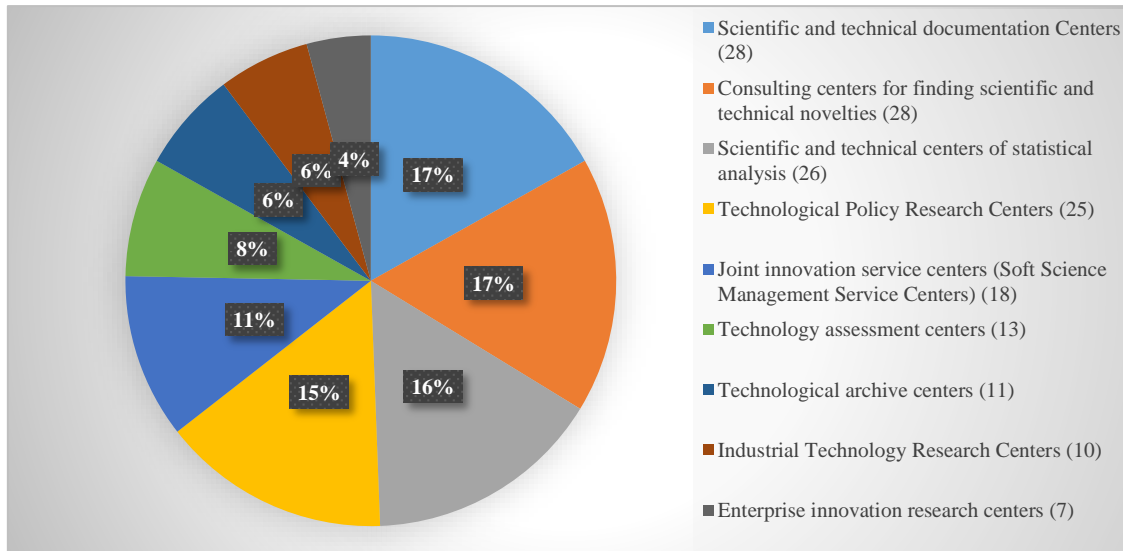
**Fig. 1.** Degree of informativeness of sites of regional institutes of scientific and technical information of the People's Republic of China

Thus, the actual trend today is that the NTI Institutes of economically developed provinces significantly deepened their analytical activities in the early 2010s, which allowed them to move to a qualitatively new level of user service by creating consulting divisions. Thus, in 2012, relying on the support of the Department of Science and Technology of its province, the Research Institute of Science and Technology Information of Zhejiang established a consultative committee for the development of science and technology in its province. This Advisory Committee on the development of a Regional Innovation System and Scientific and Technical Activities currently plays an important supporting role in creating and implementing development strategies for the economic growth of Zhejiang Province.

Currently, the key trend in the transformation of regional NTI centers is to change them into centers for promoting the development of science and technology in their provinces. Their functions include not only scientific and technical information services but also strategic research, scientific and technological consulting,

innovation evaluation and competitive intelligence.

For generalizing the nomenclature of basic digital services of regional Institutes of Scientific and Technical Information of China, an analysis of the organizational structure of 28 institutions of the following administrative regions at the provincial level such as Zhejiang, Fujian, Jiangsu, Shanghai, Anhui, Jiangxi, Guangdong, Guangxi, Hainan, Henan, Hunan, Hubei, Beijing, Tianjin, Hebei, Shanxi, Inner Mongolia, Qinghai, Shaanxi, Gansu, Xinjiang, Sichuan, Guizhou, Yunnan, Chongqing, Liaoning, Jilin, Heilongjiang was carried out. Figure 2 illustrates the 100% availability of documentation, search and consulting services in regional NTI Institutes. Regarding the degree of development of high-tech information services related to the evaluation of innovative technologies and enterprises, the examination of scientific projects and competitive intelligence, they are systematically provided only by 65% of the provincial institutes of scientific and technical information of the provinces, in which specialized units have been created for this purpose.



**Fig. 2.** Organizational structure of provincial institutions of scientific and technical information of the People's Republic of China

The analysis of the organizational structure of the regional institutes of NTI allows us to determine the main functions of these institutions: implementation of information support for the scientific and technical development of their provinces based on the formation of local databases reflecting the industrial profile of the territories, as well as databases of scientific, statistical, patent, expert-analytical, scientometric, archival, marketing information. Thus, the majority of NTI Institutes of the provinces play an important supporting role in the creation of regional innovation systems, providing informational and mediating support to subjects of production and the introduction of technical and technological innovations.

But in the conditions of the exponential rate of increasing flows of digital scientific and technical information and the economic backwardness of China's poor regions, there is a need to reorganize the NTI network of the PRC by integrating it into the National Scientific and Technological Platform for the Management of Scientific Research Projects and Innovations at all levels — from national to regional and local. The model of this platform proposed by the specialists of the National Institute of NTI of China is open, integrated with the latest big data processing technologies, which is capable of information monitoring of all processes of a scientific and technical project's life cycle: from planning, realizing, evaluating effectiveness, advertising of results, and implementing and distributing through transfer technologies. The service potential of the system should be aimed at scientific research institutions and their employees, project managers and decision-

making subjects in the entire digital environment of scientific research.

The reorientation of the regional component of the National NTI system from scientific and technical business to scientific and technical management will allow engineering thinking to be built into every link of the process of information support for the discovery and implementation of innovations, and the introduction of artificial intelligence tools into decision-making support processes. The construction of a unified and open national scientific and technological management platform aims to increase the efficiency and effectiveness of the implementation of scientific projects through the unification of information resources, avoidance of duplication, and optimization of scientific and technological planning management systems at the interregional, interdepartmental, interbranch and interdisciplinary levels. This will make it possible to implement integrated management of science and technology at the state level, integrate the industrial chain, the chain of innovation and capital, and form an open, secure, unified, interactive, fully functional, and effective platform for information support and innovation support.

On the way to building this integrated platform, Hubei Research Institute of NTI plans to provide comprehensive and multi-level information support for technological innovation, producing services for the provincial government, various research and business structures, and focus on creating an effective business support system that will combine the source the cultivation of



modern scientific and technical thinking, a scientific and technical center for public service, a center for the promotion of industrial innovations, and a center for scientific and technical communication.

Among the urgent tasks of all provincial NTI institutes are the unification on a single digital platform and the corporate use of resources for innovation and entrepreneurship to provide services such as the sharing of equipment, innovative ideas and creativity, authoritative expert assessment, and the transformation of scientific and technological achievements into real economically profitable projects. The priority tasks are also creating a system-integrated platform for joint work for all members of the China Science and Technology Association, intensifying data management processes, implementing an integrated work scheme for the Smart Association of Science and Technology and the Smart Society, constructing a digital scientific information platform for the Smart Association for Science and Technology, which will allow more efficient extraction of knowledge based on automated processing of large data sets. This will significantly increase the accuracy and efficiency of the processes of searching, obtaining, analyzing, and using the intellectual resources of the National NTI system of the People's Republic of China.

In the conditions of a complex and tense international political situation, guaranteeing the access of Chinese researchers to big data plays an indispensable role in increasing the efficiency of scientific research and producing innovations, which are the basis of the development of the national economy. The Documentation and Information Center of the Chinese Academy of Sciences, as a national-level institution that provides state guarantees of user access to consolidated resources of scientific and technical information, initiated the creation of a scientific and technological platform of big data based on the aggregation on its basis of strategically important databases from the leading sectors of the economy. Innovative information products and services produced by the Center based on the big data platform should become a new engine of scientific discoveries and innovations in the field of knowledge management.

In the digital society, researchers find an increasing demand for prompt access to relevant research information and active research interaction. Effective and qualified information support is necessary at all stages of the creation of additional value of technological innovations:

from fundamental research and their applied implementation to marketing intelligence on the demand for innovative ideas from consumers. The production of innovations is significantly hampered by scattered and isolated data sets, in which it is difficult to extract new knowledge. This necessitates a fundamental restructuring of the activities of scientific and technical information services based on their use of the latest big data management technologies.

Thus, with the support of the Chinese Academy of Sciences, specialists of its Documentation and Information Center created a series of intelligent service products "Hui" for scientists. These products are developed based on the "Big Data Science and Technology Platform" of the Documentation and Information Center of the Chinese Academy of Sciences under the new model of knowledge discovery and scientific research. This series of products are intended for the category of scientists who embody the modern paradigm of knowledge discovery with the help of artificial intelligence capable of computing big data. Scientists of the Center solve the problem of overcoming the dispersion and isolation of big data in the field of science and technology, which significantly reduces the possibility of objective assessment of the value of knowledge and the effectiveness of scientific research. In the conditions of China's development of the digital economy, the need for radical modernization of the traditional architecture of searching for relevant information, which is currently offered to users by the majority of regional NTI centers, is extremely overdue.

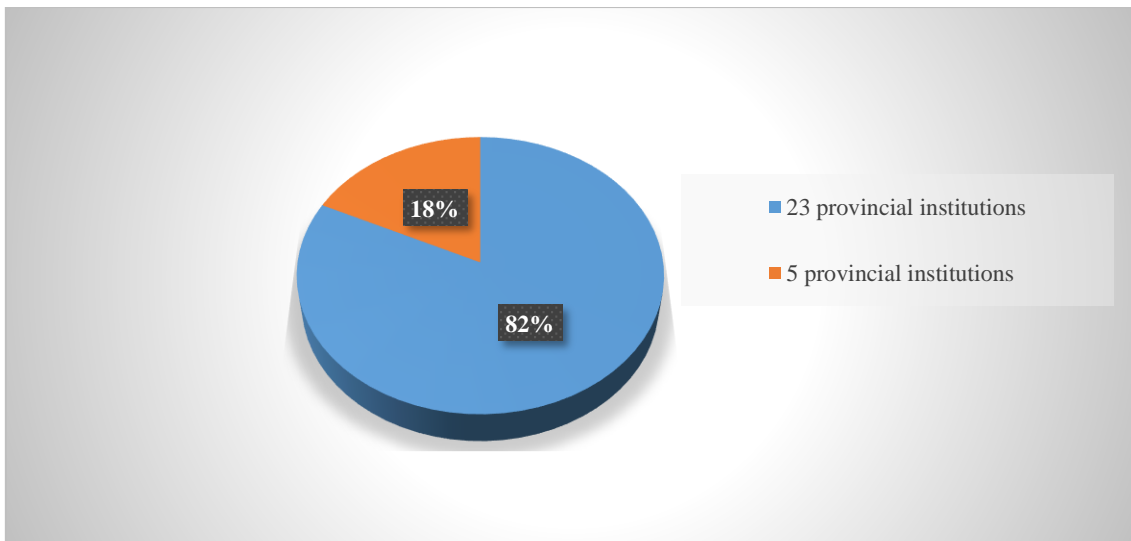
Such modernization is more effective based on corporate cooperation of the subjects of the development of the digital communication space in the field of the state system of scientific and technical information. The National Scientific Library of the Chinese Academy of Sciences, in cooperation with the Central and Regional Institutes of Documentation and Information, including Lanzhou, Wuhan, Chengdu, etc., created a Cloud platform for the monitoring of scientific and technical information (<http://stmcloud.las.ac.cn/>). It is a specialized knowledge service platform designed for advanced research groups, academic library librarians, and strategic intelligence analysts, providing prompt and relevant industry information retrieval. The platform is based on the processing of data generated by specialized Chinese and foreign institutions in various fields of knowledge. The website of the platform automatically collects, evaluates, selects,

describes, systematizes, and publishes significant achievements in the scientific and technical field, scientific research reports, information on funding sources and budgets of leading research projects of scientific institutions, etc. The platform allows for information monitoring of the latest scientific and technical developments in leading fields of knowledge and helps to quickly inform researchers about the emergence of scientific and technological innovations, search for information about partners and competitors, timely identify key achievements and promising vectors of development in a certain field of activity, justify breakthrough scientific and technological solutions.

An important component of the portal is the consolidation of information on the most important industrial projects, including nanotechnology, water pollution control, broadband mobile communication, food and nutrition, prevention of complex diseases, genetically modified organisms, renewable resources, creation of new medicines, air pollution control, etc. Another infrastructure subsystem of the portal is the domain information

platform of the Chinese Academy of Sciences, which combines six of the most powerful networks: the energy information network, materials production information network, biosafety intelligence network, ocean intelligence network, Yangtze River basin information network, optoelectronic industry information network. The convenient interface of the portal allows you to track the latest news in the scientific and technical field, inform specialists about them promptly, and implement the production of personalized and proactive information products and services.

According to the results of the content analysis of the resource content of the websites of the provincial NTI Institutes, it was established that from the point of view of creating corporate platforms that reflect the directions of regional innovative development, only five provinces (Beijing, Tianjin, Hebei, Shaanxi, Zhejiang) implement such projects. Unfortunately, the ratio of the number of such platforms, which allow linking technological and scientific data at the level of several provinces, is still extremely insufficient, which is illustrated in Fig. 3.



**Fig. 3.** Ratio of corporate and regional aggregation information platforms created by provincial institutes of NTI of the People's Republic of China.

In particular, the corporate platform of the cloud service of scientific and technological innovation, created by the Zhejiang Institute of Scientific and Technical Information, combines the information resources of scientific research institutes, and high-tech enterprises and consists of 5 cities and 6 district service platforms. Such cooperation of city and district institutions contributes to the spread of innovations and savings of all types of resource potential of the region. The "Beijing-Tianjin-Hebei" innovative

platform of scientific and technical resources was jointly created to meet the information needs of local enterprises, which contributes to the improvement of the efficiency of industrial development. This platform combined the information and service potential of such powerful institutions as Beijing-Tianjin Research Institute, Jinghe Research Institute, Handan Branch of Beijing Academy of Sciences, Beijing-Tianjin-Hebei Research Institute Alliance, and Beijing-Tianjin-Hebei Research Institute

Intellectual Property Application Alliance to boost technology transfer and generate profits of more than 700 million yuan. The Alliance established scientific and technical cooperation with 329 institutions in 57 countries and regions of the world, launched the Zhongguancun Global Alliance of High-Tech Analytical Centers, created the International Training Center for Scientific and Technical Cooperation "One Belt and Road" and actively integrated into the global innovation network.

## Conclusions

Thus, the analyzing information services of the state system of NTI of the People's Republic of China and the vectors of their transformations allows us to state that at the current stage, this system is being modernized into a digital industry of aggregation of innovative knowledge, production processes of which are based on artificial intelligence technologies capable of extracting knowledge as a result of analytical processing of primary and secondary information resources. Among the breakthrough projects of the development of China's information industry is the development and application of Smart Knowledge Service ecosystems, which function based on big data management, which is carried out by artificial intelligence. In the advanced regional institutes of NTI of the People's Republic of China, service departments have been created, which, with the help of intellectual means of information analysis, acquire explicit and hidden knowledge, which is the basis of the development of technological innovations.

Among the strategic plans for improving the information industry of the People's Republic of China is developing a national research center for designing new-generation artificial intelligence technologies, which should investigate the economic and social consequences of using this innovative phenomenon; acceleration of constructing research centers of breakthrough technologies and their forecasting platforms; creating a national scientific and technical information center of big data, which will allow integrating relevant business resources and big data resources into the chain of management of national plans in the field of science and technology. Priority attention is planned to be paid to improving the quality of information services in the five most promising breakthrough industries of the national economy: biomedicine, cars powered by new types of energy, intelligent manufacturing, the latest materials, and information technologies. At the level of individual provincial NTI Institutes, it is

necessary to intensify the development of corporate platforms that combine information resources and services of powerful industrial enterprises, research institutions, universities, and scientific libraries. This will contribute to the formation of regional science and technology clusters, increase in generation productivity, and the introduction of scientific and technological innovations, which is especially important for the development of the economies of China's poor provinces.

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