Research and Prospect on National Scientific and Technical Literature Development Strategy in an Open Science Environment (Postprint)

Authors: Sun Tan, Huang Yongwen, Zhang Jianyong, Zhao Ruixue, Xian Guojian, Li Jiao

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Abstract

[Purpose/Significance] Scientific and technical literature constitutes an indispensable instrument for scientific research and serves as the support and guarantee for enhancing scientific and technological innovation capabilities. By investigating the development of scientific and technical literature resources both domestically and internationally, this study provides preliminary strategic research for the formulation of national medium- and long-term scientific and technological development plans. [Method/Process] This research examines the current status and existing problems in the development of China's scientific and technical literature resources, analyzes international experiences in scientific and technical literature development, summarizes the development trends and emerging needs of scientific and technical literature in the open science environment, and proposes future layouts and development plans for China's scientific and technical literature resources. [Results/Conclusion] This paper proposes key directions for the future development of China's national scientific and technical literature resources: establishing a world-class new-generation national scientific and technical literature infrastructure and a long-term preservation system to ensure sustainable supply and strategic security of China's scientific and technical literature; constructing a national scientific and technological innovation open knowledge service system to break through bottlenecks in the independent supply of key technologies and products for new-generation intelligent knowledge services of scientific and technical literature; establishing a national scientific and technical literature collaborative support service system covering all types of innovation entities to form a new ecosystem of open intelligent knowledge services; actively leading the policy and development direction of scientific and technical literature to enhance China's influence on the international academic stage. Additionally, safeguard measures for China's national scientific and technical literature development are proposed from five aspects.

Full Text

Preamble

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Research and Prospects on the Development Strategy of National Scientific and Technical Literature in an Open Science Environment

Sun Tan[1,2], Huang Yongwen[1], Zhang Jianyong[3], Zhao Ruixue[1,2], Xian Guojian[1,2], Li Jiao[1]

[1]Agricultural Information Institute, Chinese Academy of Agricultural Sciences, Beijing 100081
[2]Key Laboratory of Agricultural Big Data, Ministry of Agriculture and Rural Affairs, Beijing 100081
[3]National Science Library, Chinese Academy of Sciences, Beijing 100190

Abstract: [Purpose/Significance] Scientific and technical literature is an indispensable means of scientific research and a support and guarantee for enhancing scientific and technological innovation capacity. By studying the construction of scientific and technical literature both domestically and internationally, this paper provides strategic research for the formulation of national medium- and long-term science and technology development plans. [Method/Process] This study examines the current status and existing problems in the development of China's scientific and technical literature construction, analyzes foreign experiences, summarizes development trends and new demands under the open science environment, and proposes future layouts and development plans for China's scientific and technical literature construction. [Result/Conclusion] The paper proposes key future directions for China's national scientific and technical literature construction: building a world-class new-generation national scientific and technical literature infrastructure and long-term preservation system to ensure sustainable supply and strategic security; constructing a national scientific and technological innovation open knowledge service system to break through bottlenecks in the independent supply of key technologies and products for new-generation intelligent knowledge services; establishing a national collaborative support service system covering all types of innovation entities to form a new open intelligent knowledge service industry; and actively leading the development policies and directions of scientific and technical literature to enhance China's influence on the international academic stage. Additionally, five guarantee measures are proposed for China's national scientific and technical literature construction.

Keywords: scientific and technical literature; development strategy; scientific and technological innovation; knowledge service; open science
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Scientific and technical literature serves as an important foundational condition

for scientific research and constitutes an essential supporting element for implementing innovation-driven development strategies and building an innovative country. In recent years, as China's scientific and technological innovation capabilities have steadily improved and investment has continuously increased, the supporting and guaranteeing role of scientific literature in scientific and technological innovation activities has become increasingly prominent, and its function within the scientific and technological innovation system has grown ever more critical, becoming a vital support for comprehensively enhancing scientific and technological innovation capacity.

Under the guidance of national medium- and long-term science and technology development plans and related programs, China has established a national scientific and technical literature support system and various levels of scientific literature sharing networks covering the entire country, thereby enhancing support capabilities for scientific and technological development and innovation. However, China's scientific and technical literature construction started relatively late and has developed slowly. In particular, the importance of literature construction for research development has not received sufficient attention from management departments. Compared with overall research investment, investment in scientific literature remains insufficient and lacks continuity, while specialized construction is fragmented and repetitive, resulting in low overall efficiency of scientific literature. The established scientific literature service platforms are segmented, lacking mechanisms for mutual integration, association, and interoperability.

Meanwhile, with the rapid development of information technology and widespread 普及 of information networks, scientific and technical information in various carrier forms has exploded in volume. Research users' demands for information resource access continue to rise, scientific research and academic exchanges have become more collaborative, a data-intensive scientific research paradigm based on big data mining and analysis has gradually taken shape, and open science has triggered transformative changes in scientific research paradigms and knowledge exchange ecosystems, bringing disruptive impacts to scientific literature services [1]. Under the backdrop of open access, open data, and open science, scientific literature services require repositioning in resource construction management, resource allocation structures, user services, partnership models, and development strategies. All these factors pose new demands for the construction of national scientific literature platforms. Therefore, this study primarily investigates the current status, trends, and demands of scientific literature development, explores future directions and priorities under the open science environment, and conducts forward-looking research for China's national scientific conditions construction planning.

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Authors: Sun Tan (ORCID: 0000-0002-8257-5064), Vice President, Re-

searcher, PhD; Huang Yongwen (ORCID: 0000-0001-8912-0698), Associate Research Librarian, PhD, Corresponding Author, E-mail: huangyongwen@caas.cn; Zhang Jianyong (ORCID: 0000-0001-7533-1726), Research Librarian, Master; Zhao Ruixue (ORCID: 0000-0002-1406-8562), Deputy Director, Researcher, PhD; Xian Guojian (ORCID: 0000-0003-4332-1958), Researcher, PhD; Li Jiao (ORCID: 0000-0002-8876-3728), Librarian, PhD
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2. Development History and Current Status of China's Scientific and Technical Literature Construction

2.1 Development Status and Progress Achievements

(1) Multiple large-scale scientific literature resource systems have been established, forming stable national scientific literature support capabilities. Currently, China has built several large-scale collaborative scientific literature resource support systems, forming multiple cross-domain and cross-regional scientific literature sharing platforms and long-term preservation systems that provide scientific literature services to scientific personnel nationwide and offer specialized literature intelligence services for major strategies, key projects, and significant research tasks. These 主要包括: National scientific literature resource systems. The National Science and Technology Library (NSTL) collects core foreign scientific and technical literature resources through joint construction and sharing, establishing a national strategic support service system for scientific literature that effectively meets China's basic literature needs for scientific and technological innovation. University alliance-based systems. The China Academic Library & Information System (CALIS) has over 1,800 member libraries, integrating various collection resources from more than 2,700 libraries to provide literature support services for university faculty and students. Professional system-based systems. The Chinese Academy of Sciences (CAS) system and the Chinese Academy of Agricultural Sciences system have carried out collaborative resource construction and sharing within their systems, focusing on establishing specialized scientific literature resource systems in science and engineering, agriculture, and other fields. Commercial systems. CNKI, Wanfang, and VIP integrate publisher resources to provide commercial scientific literature services, accelerating the dissemination of scientific literature and knowledge through comprehensive services. Additionally, the National Science Library of CAS has pioneered research and practice in digital resource long-term preservation in China, while NSTL has organized and promoted the construction of a national long-term preservation system for digital scientific and technical literature information resources, initially establishing such a system [2].

(2) A scientific literature information collaborative support service

system has been basically established. NSTL has established a nationwide scientific literature sharing service system that provides universal literature information services to scientific personnel across the country, while also offering industry-specific services and intelligence services for key industries, enterprises, and small and medium-sized enterprises. National-level information institutions, research institutions, and university systems have also formed scientific literature information support service mechanisms. Digital literature services have become popular in most universities, research institutions, and major public libraries, with the National Library and CALIS becoming major service supports in public cultural literature services and higher education information resource services. Meanwhile, major domestic scientific literature institutions have actively developed specialized and personalized information services and knowledge services, with regional and industry-specific scientific and technical information institutions also actively carrying out various forms of thematic information services targeting government and enterprise needs. Concurrently, various social entities have entered the scientific literature information service field in multiple ways, forming a diversified scientific information service system.

(3) A technical system for scientific literature organization, analysis, and utilization has been preliminarily established. During the 12th Five-Year Plan period, led by NSTL and organized with 35 research institutions, universities, and enterprises including the National Science Library of CAS and the Institute of Scientific and Technical Information of China, key technologies were breakthrough such as knowledge organization system construction, multi-source heterogeneous scientific literature big data knowledge representation, and deep integration. Platforms for scientific knowledge organization system construction and sharing services, as well as tools for large-scale semantic computing and scientific literature semantic annotation, were developed, forming demonstration systems for intelligent retrieval, scientific monitoring, and domain-specific research information environments, laying a solid technical foundation for knowledge services.

(4) Active participation in open access policy implementation and promotion has achieved initial results. Open access has become a scientific achievement dissemination method actively promoted by the international scientific community, with profound significance for scientific literature construction and services. China has carried out multifaceted work in participating in international open access movements and promoting open access to scientific information in China, playing a leading, exemplary, and driving role. In 2003, Academician Lu Yongxiang became the first Chinese scientist to sign the Berlin Declaration on Open Access. In 2004, NSFC Director Chen Yiyu and CAS President Lu Yongxiang signed the Berlin Declaration on behalf of their institutions [3]. In 2009, China began large-scale construction of institutional repositories. By the end of 2013, NSTL represented China in joining the Sponsoring Consortium for Open Access Publishing in Particle Physics (SCOAP3) to support open access to high-energy physics research results in China [4]. In May 2014, CAS and NSFC successively issued their open access policies and organized the third

Global Research Council Beijing Meeting [5]. At the 14th Berlin Open Access Conference in 2018, representatives from NSFC, NSTL, and CAS explicitly expressed support for OA2020 and Plan S, with NSTL leading multiple domestic information institutions and university libraries to sign the OA2020 Initiative Letter of Intent, promoting and demonstrating open access development [6].

2.2 Existing Problems and Deficiencies

Through years of accumulation, China's scientific literature support capabilities have initially reached internationally advanced levels, but gaps remain compared with foreign countries. First, core resources and services mainly rely on foreign providers, making us vulnerable to external control and posing challenges to information security and support for China's scientific and technological innovation strategy. Second, China's scientific literature infrastructure construction suffers from insufficient development and service product supply, lacking world-class knowledge products and providing inadequate support for key aspects of scientific and technological innovation and research management. Third, new digital resources such as digital publishing, open access, audio-video, and social media are rapidly developing, while China's strategies for scientific literature construction and support remain inadequate. Specific manifestations include three aspects:

(1) Risks in the use and permanent guarantee of foreign scientific literature resources. The foreign scientific literature market is basically controlled by foreign capital. Digital literature resource subscriptions have shifted from asset purchases to service license purchases, acquiring only "right to use" rather than "ownership," making national ownership and preservation of digital information resources a practical issue. In the event of force majeure such as natural disasters, wars, or international disputes, China's access to and use of foreign scientific literature would suffer major losses or even become blank, representing enormous risks. Additionally, as China's independent innovation capabilities improve, foreign information blockades against China are intensifying. In recent years, important documents such as technical reports from NASA, the Department of Defense, the Department of Commerce, and the Department of Energy in the United States are no longer sold to China, and the European aerospace company reports have significantly strengthened subscription review scopes. The inability to purchase these important foreign scientific and technical documents poses new challenges to the comprehensive guarantee of China's scientific and technical information resources.

(2) Scientific literature information service capabilities struggle to meet the demands of scientific and technological innovation. In today's era of data-intensive scientific research, scientific information is growing rapidly, and researchers urgently need to accurately and conveniently discover and access scientific information, as well as specialized and refined knowledge services. Traditional scientific literature information service methods and capabilities can no longer adapt to the profound changes in scientific and technologi-

cal innovation, research management, and scientific research. Although China's information service institutions are also undergoing service transformation, gaps remain compared with foreign service systems in terms of knowledge processing depth, technical maturity, new technology application, service forms, content, and methods.

(3) Most foreign literature analysis tools and system platforms are dependent on foreign sources. After possessing massive amounts of scientific literature resources, effective mining and analysis tools are needed to truly release their value. Currently, a considerable number of analysis and mining tools based on scientific literature used in China are monopolized by foreign entities, with insufficient supply of original high-end domestic products, creating de facto dependence on these foreign tool platforms. Once these foreign tools and platforms become inaccessible, they could significantly impact China's scientific research activities. In the big data era, relevant foreign institutions could potentially collect and analyze log information of Chinese researchers accessing foreign scientific literature resources, thereby grasping China's research dynamics and directions, and even mining and analyzing national strategic scientific and technological innovation layouts, creating vulnerabilities and risks.

3. Foreign Experience and Enlightenment in Scientific and Technical Literature Construction

3.1 Diversified Foreign Scientific Literature Platform Construction Models

Foreign scientific literature platform construction models are both decentralized and relatively centralized. Taking the United States as an example, its scientific literature information service platforms 主要有四种 types: Government-led platforms, such as the Department of Energy's Office of Scientific and Technical Information (OSTI) portal [7], which integrates important scientific and technical reports including the Energy Technology Virtual Library and government gray literature portal; Alliance organization platforms, such as OhioLINK [8], a library consortium formed by public universities, community/technical colleges, private university libraries, and state libraries through spontaneous organization for resource sharing; Public welfare institution platforms, such as PubMed [9] developed by the U.S. National Library of Medicine (NLM), the world's most authoritative and influential biomedical information service system; Enterprise-led platforms, such as Google Scholar launched by Google and SciFinder by Chemical Abstracts [10].

Other developed countries have different construction models. The United Kingdom builds platforms with libraries as the main body, such as the British Library service platform and the Intute platform [11] built by the UK Higher Education Funding Council. Germany, France, and Japan adopt a model with scientific and technical information institutes as the main body, such as the "STN International" online service product built by the German Karlsruhe Institute of

Technology [12], the ConnectSciences platform built by the French Institute for Scientific and Technical Information [13], and the GeNii academic information portal built by the Japanese National Institute of Informatics [14].

3.2 High Emphasis on Independent Key Technologies for Knowledge Services

Currently, the informatization, correlation, datafication, and computability of scientific and technical resources have become major demands for knowledge innovation [15]. International mainstream scientific literature platforms are accelerating their transformation toward specialization and knowledge orientation, with new-generation knowledge service systems centered on knowledge discovery and computation showing vigorous development momentum. Content mining, semantic search, intelligent Q&A, trend tracking, intelligence and decision analysis based on scientific literature big data have become development priorities for knowledge services. Consequently, the United States, the European Union, and other developed countries have established special projects to support technological innovation in relevant fields, actively promoting the transformation of scientific literature information services from information integration service models to semantic knowledge discovery models.

In terms of key technologies and product development capabilities for digital knowledge representation and organization, Google Inc.'s Knowledge Graph technology has consistently led industry development [16]. Springer Nature's SciGraph [17] integrates various information from the research community and links it with external datasets. The GoPubMed system [18] developed by German Transinsight Company in cooperation with Dresden University of Technology, based on semantic lexicons and ontologies, achieves semantic network, biomedical information retrieval, and visualization analysis of biomedical hotspots. These key technological developments have greatly promoted knowledge resource construction and provided a favorable technical environment for the service functions and product development of scientific literature platforms.

In academic search and discovery, Google Scholar, Microsoft Academic Search, NCBI's Entrez, and the Allen Institute for AI's Semantic Scholar [19] have become typical representatives of new-generation academic search systems. Their main characteristic is moving beyond simple keyword search, relying on new-generation technologies such as digital knowledge representation, semantic association, deep machine learning, and cognitive computing to achieve semantic-based knowledge association exploration, computational mining, and deductive reasoning. The BASE-Search open resource academic search engine [20] developed by Bielefeld University Library promotes free retrieval and access services for global heterogeneous academic resources by integrating library catalogs and open access resources.

In terms of professional knowledge service platforms, research and development of domain-specific knowledge service systems oriented toward particular fields

or research questions have yielded fruitful results, providing new tools, methods, or perspectives for scientific research and technological innovation, and supporting the discovery of new information and knowledge that traditional research models struggle to find. The Open Knowledge Maps platform [21] supports literature retrieval services using knowledge maps, providing overviews of specific research fields. The Chem2Bio2RDF Dashboard system from Indiana University provides integrated association services in chemistry, biology, and pharmaceutical fields [22]. Clarivate's Derwent Innovation platform [23] provides global authoritative and reliable patent data and scientific literature retrieval and analysis functions.

3.3 Formulation of National Scientific Literature Platform Construction and Development Strategic Planning

To build reliable scientific literature platforms and long-term preservation infrastructure, developed countries such as the United States, the European Union, and the United Kingdom have incorporated resource construction and long-term preservation into strategic planning priorities, forming stable and sustainable development models. These include ensuring comprehensive collection of publications through deposit legislation, consolidating and enriching characteristic literature resource construction, implementing information resource preservation strategies, and broadening cooperation scopes for information resource construction.

The Library of Congress released its "FY2019-2023 Strategic Plan and Digital Strategy" [24], proposing a user- and data-driven development strategy focused on optimizing resources and enhancing access services, enabling users to access unique collections, expertise, and services anytime and anywhere. NLM has been committed to improving medical research discovery capabilities through data and information transformation, promoting the development of American medical undertakings, and making enhanced discovery capabilities and innovative service models key development priorities in its 2017-2027 strategic development plan [25].

The Association of European Research Libraries released the "LIBER Europe Strategy 2018-2022" [26], proposing three strategic directions for research libraries: innovative scholarly communication platforms, digital skills and services hubs, and interoperable and scalable research infrastructure. It also proposed five development directions: Open access will be mainstream; Research data will be findable, accessible, interoperable, and reusable (FAIR); Digital skills will lay the foundation for a more open and transparent research lifecycle; Provide participatory, customizable, and scalable research infrastructure for different disciplinary needs; Tomorrow's cultural heritage will be built on today's digital information.

The British Library launched a collection globalization strategy, proposing strategic goals from local collections to global services, and actively promoting

the globalization, diversification, and openness of collections. In its metadata strategic roadmap, the British Library proposed preserving and providing digital literature content in various physical formats, striving to support the computability and intelligence of collection resources, and in its "Living Knowledge" 2015-2023 development strategy [27], it pointed out the need to actively respond to the growing challenges of preserving and accessing historical audio and music collections, achieve national collection of born-digital content and ensure its long-term preservation, and use the library's resources and expertise to promote innovation based on large-scale data analysis, bringing broader benefits to British scientific research.

In summary, international scientific literature construction started relatively early, with systematic development plans and innovative development strategies, core key technology research and development capabilities, well-established industry-academia-research cooperation networks, mature product markets, and a de facto monopoly position. The development of international scientific literature is closely integrated with the general trend of scientific research and technological development under the open science environment. Developed countries have deepened development planning, strengthened cooperation, developed innovative products, and formed solid and comprehensive scientific literature service capabilities.

4. Development Trends of Scientific and Technical Literature and New Demands for Literature Construction in an Open Science Environment

4.1 Analysis of Scientific and Technical Literature Development Trends

Openness has become a global consensus, evolving from open scientific papers to open data and then to open science. The open movement characterized by knowledge sharing continues to develop in depth. Open access to publicly funded research results has become a common action worldwide, promoting the construction of global open knowledge infrastructure. The EU Horizon 2020 research and development program [28] requires all project research results to achieve full open access by 2020. Eleven European national research funding agencies and the European Research Council released Plan S [29], and the Max Planck Society in Germany initiated the OA2020 Initiative, which has been signed by global institutions including China's NSTL, calling for the conversion of all subscription journals to open access by 2020. The 2018 STM report indicates that the open access market accounts for approximately 20%-22% of total publishing volume, and this upward trend will continue in the coming years [30].

Initially, the focus of open science promotion was on open papers and data, but it has now expanded beyond papers and data to include mutual utilization of research infrastructure, open and shared research methods, and machine read-

ability. Open science has had an extremely important impact on academic exchange models and scientific literature construction, presenting both challenges and opportunities for scientific literature services. Under the open science background, scientific literature services need to reposition resource construction management, resource allocation structures, user service methods, and development strategies. Corresponding to open science development are intellectual property protection and barriers between nations. In interviews in December 2019, U.S. White House Science Advisor Droegemeier [31-32] mentioned open access, with main viewpoints leaning toward protection, ensuring that open access is consistent with the overall goals of R&D enterprises, and ensuring that open access does not expose national scientific and technological achievements without reservation to prevent others from easily utilizing them. He emphasized the need to take measures to prevent the theft of intellectual property, ideas, publications, and proposals, ensuring that the tremendous value of research and scholars' creativity remains protected. There is a contradiction between open access and knowledge protection (or national interests), and finding a balance remains a challenge. Protection policies from major knowledge-exporting countries may affect the direction and priorities of China's scientific literature construction.

In 2017, the United States released the "2016-2045 Emerging Science and Technology Trends Report," proposing 20 most noteworthy science and technology development trends [33]. Gartner Vice President D. Cearley believes that ten strategic technology trends will bring disruptive innovation in the next five years [34]. In such an intelligent space of digital life, various types of data are continuously aggregated and computed to generate new knowledge—insights—making data-intensive scientific discovery truly possible. People, devices, content, services, and transactions will connect into an ever-expanding network, and future ubiquitous intelligent devices will provide various personalized services based on big data. From the strategic development plans of major foreign information institutions, it is evident that they will closely integrate with the general trend of scientific and technological development, building an omnipresent and timeless intelligent and knowledge-based support service ecosystem, strengthening technological innovations such as computational analysis and knowledge association based on scientific literature, and enhancing knowledge discovery capabilities.

Through the above trend analysis, the main enlightenment for China's scientific literature development is: continue to promote open access development while considering knowledge barriers from certain countries to find a balance between openness and protection; continue to strengthen localized strategic security guarantees for scientific literature while enhancing deep knowledge processing, organization, analysis, mining, and development and utilization; fully utilize big data and intelligent era technologies to associate, integrate, and comprehensively develop and utilize scientific literature, scientific data, analysis tools, and other scientific and technological resources closely related to the entire lifecycle of scientific and technological innovation, achieving comprehensive collaborative support.

4.2 New Demands for Scientific and Technical Literature Construction

(1) The development of open science and changes in scientific research paradigms require the construction of new digital resource infrastructure. Open science is an open scientific research and communication model based on the Internet, a product combining the concept of open access to academic resources with modern information and communication technologies. Its purpose is to promote the disclosure, openness, and reuse of academic achievements using modern scientific and technological means, forming a research environment conducive to knowledge sharing, mass innovation, and economic development [35]. Open science has ushered in a new era of scientific research with unprecedented openness, emphasizing that the public can directly or indirectly participate in scientific research processes across time and space constraints, and can freely and openly access various scientific research achievements, thereby achieving intelligent openness of scientific research content, processes, and infrastructure—simultaneously possessing accessibility, understandability, assessability, and usability [36].

In promoting open science, establishing and improving digital resource infrastructure covering scientific literature and scientific data is an urgent task for scientific and technological innovation. Building integrated digital resource infrastructure not only helps overcome data silos, enhance information exchange, enable more people to participate in scientific research, and create a favorable environment for jointly tackling key problems, but also promotes the sharing of scientific research achievements during the research process and improves the efficiency of scientific research and its transformation. The European Union, the United States, the United Kingdom, and other countries worldwide are actively promoting digital resource infrastructure construction at the policy level. The EU has successively launched the European Grid Infrastructure (EGI), the European Open Science Cloud (EOSC) [37], and the Open Access Infrastructure for Research in Europe (OpenAIRE) [38]. EOSC will integrate Europe's existing distributed scientific data infrastructure to create an open, seamless virtual environment providing cross-border and cross-domain scientific data storage, management, analysis, and reuse services for European researchers and professionals in various fields [37]. OpenAIRE aims to build infrastructure supporting EU open science by aggregating and linking all types of resources including literature, scientific data, software, workflows/portals, experiments, and educational resources to promote openness in scientific research and usability of scientific achievements [38]. China is no exception. The 19th Central Political Bureau's second collective study proposed accelerating the improvement of digital infrastructure, promoting data resource integration and open sharing, and laying an important foundation for digital China construction through the integration and sharing of society-wide data resources.

To address the unprecedented complexity of problems facing various disciplinary research fields, it is necessary to utilize new-generation network technologies and

computing environments to establish new digital resource infrastructure, gradually enabling researchers to conveniently utilize scientific literature, scientific data, and analysis tools under the open science environment, and making scientific research develop in a more open and collaborative direction.

(2) Diversified strategic demands for scientific and technological innovation place higher requirements on scientific literature support capability construction. Scientific literature support service capability has become an important component of scientific and technological innovation capacity building and a key factor for nations to maintain scientific leadership and enhance international scientific and technological competitiveness. Therefore, almost all countries and regions regard the research and construction of scientific literature as an important field of high concern and full investment. The implementation of innovation-driven development strategies and the building of an innovative country cannot be separated from scientific literature support, which has been entrusted with a new historical mission. As China's scientific and technological strength has significantly enhanced, some research fields have entered "deep water zones," requiring strengthened original innovation capabilities in basic and emerging strategic fields, as well as greater absorption and reference to foreign advanced experiences and grasp of international research frontiers and innovation sprouts. This requires enhancing scientific literature support capabilities through national power to ensure China's future scientific and technological innovation development needs. Therefore, it is necessary to grasp national scientific and technological innovation development trends, adhere to national top-level design and overall layout, and comprehensively promote scientific literature construction.

The demands of scientific and technological innovation are increasingly prominent. Transitional research connecting basic research, applied research, technology development, and market innovation, as well as industry-academia-research integration, have become mainstream forms of scientific and technological innovation. These changes pose new demands for scientific literature support, requiring strengthened information support for interdisciplinary and emerging disciplines, organic integration of information support and services for basic research, applied research, and technology-market integration, and deepened information services for enterprises, innovation clusters, small and micro innovative enterprises, and markets as the main battlefields for innovation and development. Therefore, there is an urgent need to break through traditional thinking, introduce new ideas, methods, and technologies, elevate scientific literature support capabilities to a new development stage, and build scientific literature service platforms oriented toward major research tasks and scientific and technological innovation, flexibly organizing and customizing scientific literature resources and services according to the personalized needs of research users and embedding them into researchers' working environments to effectively support their scientific and technological innovation activities.

(3) The development of new-generation information technology re-

quires the construction of intelligent knowledge service systems. The development of new-generation information technology has provided unprecedented opportunities for the deep mining and intelligent service of scientific literature. The deep integration of artificial intelligence technology with scientific literature services will become an important direction for the development of scientific literature services. The development of new technologies such as knowledge computing engines and knowledge service automatic response systems will promote the knowledge service of scientific literature to develop in depth, forming an intelligent knowledge service system that deeply integrates literature, data, and intelligence analysis.

5. Considerations for the Future Layout of China's National Scientific and Technical Literature Construction in an Open Science Environment

In an open science environment, to address the imbalances and inadequacies between scientific literature demands and services, it is necessary to continuously improve national scientific literature support capabilities that match China's new-era scientific and technological innovation strategy, innovation demands, innovation strength, and international status, avoid the risk of "bottleneck" issues in scientific literature resources and service products, comprehensively support China's and even global scientific and technological innovation development, and fully establish an advanced, intelligent, secure, and reliable scientific literature support and sharing service system that supports the improvement of national scientific and technological innovation capabilities. The following recommendations are proposed for the future layout of China's national scientific literature construction:

5.1 Construct a New-Generation National Scientific and Technical Literature Infrastructure and Long-Term Preservation System

On the premise of core foreign scientific literature resource support, overall demands for basic research, application development, and industrial innovation should be coordinated, with simultaneous attention to the collection and storage of academic and industrial resources. Comprehensively promote digital resource construction based on metadata and centered on local full-text preservation, and strengthen the construction of scientific literature big data systems characterized by datafication, computability, and analyzability. Establish a resource guarantee pattern of collaborative construction of print and electronic literature, subscription literature, and open access resources, achieving 100% local preservation and service for foreign literature resources frequently used and indispensable in the scientific and technological innovation process. Strengthen the construction of resources such as research project databases, patent analysis databases, basic lexicons, authority files, and software tools, and build centralized databases for research project outputs at national and provincial/ministerial levels. Construct a unified scientific literature big data platform to achieve interconnectiv-

ity between scientific literature and other research condition platforms such as scientific data. Actively promote the construction of a national long-term preservation system for digital literature resources, organize and coordinate division of labor among major domestic scientific literature institutions to preserve digital scientific literature resources, and build a world-class new-generation localized national scientific and technical literature infrastructure and long-term preservation system to ensure sustainable supply and absolute strategic security of China's scientific literature.

5.2 Construct an Open Knowledge Service System Supporting National Scientific and Technological Innovation

Establish an independent innovation technology system for scientific literature development and utilization, break through bottlenecks in the independent supply of key technologies and products for new-generation intelligent knowledge services, and provide comprehensive support for the intelligent and knowledge-oriented services of China's scientific literature. Through the complementary advantages and deep integration of artificial intelligence technology and semantic knowledge organization, breakthrough key technologies such as metadata integrated organization, digital knowledge representation, semantic organization and association, and user cognitive model construction, as well as large-scale semantic knowledge base automatic construction, knowledge computation and reasoning, and knowledge services. Develop generalizable knowledge learning and computation tool engines to drive the upgrade of the national scientific literature platform to an intelligent knowledge service platform, achieving independent supply of key technologies and products for new-generation intelligent knowledge services, providing ubiquitous platform support for precise knowledge discovery and acquisition for different innovation demands and scenarios, and forming reliable sustainable strategic security supply capabilities for scientific literature. According to new demands for scientific literature support systems posed by new scientific research paradigms and open knowledge exchange ecosystems, build intelligent open scientific literature infrastructure and support platforms adapted to innovation demands, creating a green ecological information support environment integrating storage, management, analysis, and reuse for various scientific and technological innovation groups in China, and providing support conditions for significantly improving scientific and technological innovation efficiency.

5.3 Construct a National Scientific and Technical Literature Collaborative Support Service System Covering All Types of Innovation Entities

Focus on resolving the contradictions of imbalance and inadequacy between scientific literature demands and supply services, comprehensively build a new scientific literature strategic collaborative support system supporting the new paradigm of data-intensive scientific research and the new demands of an inno-

vative country, and actively cultivate a new open intelligent knowledge service industry. Deepen horizontal cooperation and collaboration between national-level literature service support systems such as NSTL and CALIS, and jointly build a multi-level and multi-dimensional national scientific literature support service system at national, regional, and domain/industry levels with information service providers and Internet innovation enterprises, based on national scientific literature infrastructure and technology innovation platforms. Promote association, interoperability, and integrated sharing with national innovation platforms and infrastructure such as scientific data, research reagents, experimental animals, and instrument development, forming a new collaborative service guarantee pattern with other scientific and technical information resources, and achieving ubiquitous, equitable, and barrier-free discovery, acquisition, and open sharing of scientific literature and other information resources for the whole society. Build an intelligent knowledge service collaborative support system for public welfare purposes, encourage innovative companies in big data, artificial intelligence, and other fields to actively participate in the development of national open scientific literature innovation service platforms through market demand-driven, multi-party collaborative innovation, and industrialization development models, achieve integrated development of public welfare and market-oriented commercial operations of scientific literature, and form a collaborative service guarantee system that comprehensively supports national mass entrepreneurship and innovation.

5.4 Actively Lead the Formulation of Scientific and Technical Literature Development Policies

Comprehensively enhance the international competitiveness and discourse power of scientific literature innovation services, play a leading role in policies, standards, agreements, and technologies for scientific literature construction, and enhance China's influence on the international academic stage. Actively participate in international open access activities for scientific literature, guide the development direction of open access, and put forward Chinese issues and claims to protect national core interests. Promote global action plans for open access and open science, explore open access solutions beneficial to China's development, and form influence. Propose policy and implementation recommendations to the state for further promoting open access and open science, and coordinate relevant forces to jointly advance open access work. Promote the independent storage and open access of research results produced by publicly funded research projects in China, and improve the openness and influence of China's research achievements. Closely monitor knowledge over-protection issues caused by inter-country barriers and seek balanced solutions between openness and protection. On the international stage of scientific literature services, voice Chinese perspectives and contribute Chinese wisdom. In the formulation of new standard specifications, intellectual property rules, and indicator systems for scientific literature, actively initiate advocacy and compete for international discourse power, actively lead or participate and

contribute in areas such as co-construction and sharing and innovation communities, achieve breakthroughs in key technologies and develop corresponding knowledge service products in China's advantageous fields first, rank among the world's top tier, and serve global scientific and technological innovation.

6. Guarantee Measures for China's National Scientific and Technical Literature Construction

The construction of national scientific literature support capabilities is a long-term, foundational strategic initiative that will provide continuous and solid scientific literature support for China's scientific and technological innovation development. In an open science environment, global scientific and technological innovation competition is intensifying, innovation investment continues to increase, and scientific and technological innovation paradigms and research activity methods have undergone tremendous changes, making the connotation of scientific literature richer and requiring an upgrade of scientific literature support functions. Focusing on the demands of scientific and technological innovation under the open science environment, new models of academic exchange, and the strategic demands and overall objectives of China's national innovation platform and condition construction, the following five measures are recommended to promote the sustainable construction and development of China's scientific literature support capabilities:

(1) Continue to establish national key special projects for scientific literature. To avoid the risk of being controlled by others and "bottleneck" issues in resource construction, technology development, platform construction, and service support of scientific literature, it is recommended to leverage China's institutional advantage of concentrating resources to accomplish major tasks. In national major scientific and technological innovation projects and key special projects, establish major special projects for scientific literature innovation development to support a series of core key technologies and product independent innovations in the process of scientific literature construction, ensuring the innovation capability and independent security environment of China's scientific literature support.

(2) Strengthen research on policies for scientific literature innovation development. Innovation development policies play an important guiding role in scientific literature construction. Therefore, it is necessary to issue guiding policy documents for scientific literature innovation development, clarify future key development directions, and formulate policies to support and encourage scientific literature innovation development, such as establishing deposit systems and open access policies for scientific papers and other research results produced by publicly funded projects at the national level. Establish strategies and measures for the integrated development of national scientific literature platforms, enhance the market competitiveness of national scientific literature products through anti-monopoly regulations for scientific literature products, and gradually form a comprehensive domestically produced scientific literature

support service capability.

(3) Stabilize and continuously increase special funding for national scientific literature construction. Scientific literature construction is a foundational support work that requires stable and continuous special funding investment to support the sustainable development of existing scientific literature construction. Currently, investment in China's scientific literature support system construction is still insufficient. For a long time, literature funding has mainly been used for purchasing and delivering original literature full texts in print, electronic, and database formats. Under the new situation, scientific literature resource procurement prices continue to rise, and the forms, connotation, and functions of scientific literature have undergone tremendous changes, requiring strengthened technological innovation and independent product development in literature content deep processing organization, semantic retrieval, and knowledge discovery. It is recommended to stabilize and continuously increase special funding for national scientific literature platform construction, strengthen independent research and development of scientific literature technology systems and service system construction on the basis of further consolidating literature resource content construction. Continue to invest in building a batch of regional, industry-specific, and domain-specific literature support subcenters, comprehensively constructing a digital resource long-term preservation system and a strategic collaborative support system combining centralized and distributed models to achieve sustainable acquisition and utilization of scientific literature resources.

(4) Promote the construction of scientific literature support systems. Conduct overall planning and layout to establish a sound national scientific literature support system. Improve the institutional mechanisms for scientific literature collaborative construction, sharing, and collaborative innovation, encourage national scientific literature platforms, professional institutions, and innovative enterprises to establish scientific literature collaborative innovation communities, introduce market-oriented and product-oriented operation mechanisms and service models, and jointly build a collaborative national scientific literature platform strategic support system. Encourage the establishment of various scientific literature alliance organizations, continuously explore and improve long-term cooperation mechanisms among industry, academia, research, and application featuring joint development, complementary advantages, benefit sharing, and risk sharing under market economy conditions. Establish a scientific literature sharing evaluation mechanism and a performance assessment system for scientific literature, comprehensively evaluating the operation and management of scientific literature from aspects such as R&D foundation, facility management, resource allocation, sharing capability, and customer evaluation. Strengthen supervision and performance evaluation mechanisms for special fund usage to improve the input-output efficiency of national fiscal funds.

(5) Strengthen talent and research team building in the scientific literature field. Enhance the construction of scientific literature talent teams,

cultivate and establish a stable, professional, and interdisciplinary talent echelon, fully mobilize the enthusiasm, initiative, and creativity of practitioners, and lead the sustainable innovation development of China's scientific literature in the new era. Increase support for personnel participating in international organization affairs and international cooperation. Reform the talent cultivation model in the scientific literature field, introduce and gather high-end leading talents. Strengthen international exchanges to achieve cooperative win-win outcomes. Actively carry out research cooperation on core technologies in key fields, conduct joint research activities with developed countries, and jointly initiate international cooperation plans for key technology breakthroughs. Focus not only on the introduction of core technologies but also on talent introduction to build innovative research teams.

From the current trends in international open access development and intercountry barriers, China needs to build a new-generation national scientific and technical literature infrastructure and adhere to the bottom line of firmly grasping scientific literature as a basic strategic resource in its own hands. In the construction process, guided by Xi Jinping Thought on Socialism with Chinese Characteristics for a New Era, we should fully implement and carry out General Secretary Xi Jinping's requirements on the new national security concept, focus on the demands of China's innovation-driven development strategy and the development trends of the international innovation environment, conform to the development trend of open science, strengthen top-level design, policy creation, technological innovation, product development, and system construction for national scientific literature, forge a path of strategic support for scientific literature with Chinese characteristics, and form a scientific research innovation environment conducive to knowledge sharing, mass innovation, and economic development.

Scientific literature construction is a foundational support undertaking that requires decades of consistent commitment to continuously create high-quality literature resources and provide high-quality, demand-driven knowledge service products. In scientific literature construction, it is necessary to be oriented by national goals and strategic demands, adhere to the policy of "independent innovation, leapfrogging development, industry advancement, and leading the future," be based on the present while looking to the long term, systematically layout, achieve breakthroughs in key areas, cultivate and develop major directions and projects involving overall situations and requiring key breakthroughs, and achieve the transformation of China's scientific literature from passive response to active support, creating a widely accessible and sustainable open environment for scientific literature resource sharing and reuse to better meet the needs of China's scientific and technological innovation development and independent innovation capacity building.

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Author Contributions

Sun Tan: Proposed the research topic and writing ideas, finalized the manuscript;
Huang Yongwen: Drafted and revised the manuscript;
Zhang Jianyong: Proposed the framework and revised the manuscript;

Zhao Ruixue: Proposed strategic development ideas;
Xian Guojian: Organized literature and proposed strategic development ideas;
Li Jiao: Collected materials, conducted research and literature analysis.

Research and Thinking on the Development Strategy of National Scientific and Technical Literature in an Open Science Environment

Sun Tan[1],[2], Huang Yongwen[1], Zhang Jianyong[3], Zhao Ruixue[1],[2], Xian Guojian[1],[2], Li Jiao[1]

[1]Agricultural Information Institute, Chinese Academy of Agricultural Sciences, Beijing 100081
[2]Key Laboratory of Agricultural Big Data, Ministry of Agriculture and Rural Affairs, Beijing 100081
[3]National Science Library, Chinese Academy of Sciences, Beijing 100190

Abstract: [Purpose/Significance] Scientific and technical literature is an indispensable means of scientific research and a support and guarantee for enhancing scientific and technological innovation capacity. Through studying the current situation of domestic and foreign scientific and technical literature construction, this paper conducts strategic research for the formulation of national medium- and long-term science and technology development plans. [Method/Process] This paper studies the development status and existing problems of China's scientific and technical literature construction, analyzes foreign experiences, summarizes development trends and new demands under the open science environment, and proposes future layouts and development plans for China's scientific and technical literature construction. [Result/Conclusion] The paper proposes key future directions for China's national scientific and technical literature construction: building a world-class new-generation national scientific and technical literature infrastructure and long-term preservation system to ensure sustainable supply and strategic security; constructing a national scientific and technological innovation open knowledge service system to break through bottlenecks in the independent supply of key technologies and products for new-generation intelligent knowledge services; establishing a national collaborative support service system covering all kinds of innovation subjects to form a new open intelligent knowledge service industry; actively guiding the development policy and direction of scientific and technical literature to enhance China's influence on the international academic stage. Additionally, five guarantee measures are proposed for China's national scientific and technical literature construction.

Keywords: scientific and technical literature; development strategy; scientific and technological innovation; knowledge service; open science

Note: Figure translations are in progress. See original paper for figures.