Construction of an Information Support System and Operational Model for Comprehensive National Science Centers: A Case Study of Hefei (Postprint)

Authors: Chu Jiewang, Cao Zhenxiang

Date: 2023-08-26T00:00:00+00:00

Abstract

[Purpose/Significance] This study investigates the intelligence support system for the construction of comprehensive national science centers, offering recommendations for scientific and technological innovation development and providing reference for the construction of domestic science centers. [Method/Process] First, it briefly outlines the characteristics of intelligence requirements and intelligence support systems for comprehensive national science centers, analyzes the role of intelligence support for such centers, identifies three orientations for constructing intelligence support systems, and finally examines the core system construction and operational model of intelligence support for the Hefei Comprehensive National Science Center. [Results/Conclusion] The intelligence support system for comprehensive national science centers should serve the innovation-driven development strategy, with broader and more comprehensive support content and scope. The framework of the intelligence support system is collaboratively constructed by multiple entities to serve the planning, management, and various spheres of the national science center. The intelligence support system should focus on the construction of intelligence platforms, intelligence talent teams, information infrastructure, and intelligence management systems. The operational model of the intelligence support system is a process of interconnection, exchange, and interaction between government-led initiatives and internal intelligence platforms as well as external intelligence cooperation, and it is also a process of creating and realizing intelligence resources, thereby serving innovation-driven development.

Full Text

Preamble

Journal of Library and Information Science, Vol. 62, No. 8, April 2018
Construction of Intelligence Support System and Operation Mode for Comprehensive National Science Centers—A Case Study of Hefei
Chu Jiewang, Cao Zhenxiang
School of Management, Anhui University, Hefei 230000

Abstract

[**Purpose/Significance**] This paper examines the intelligence support system for comprehensive national science centers, offering recommendations for scientific and technological innovation development while providing reference for domestic science center construction. [**Method/Process**] The study first outlines the characteristics of intelligence needs and intelligence support systems for comprehensive national science centers, analyzes the functions of intelligence support, identifies three orientations for system construction, and finally investigates the core system construction and operation mode for Hefei Comprehensive National Science Center. [**Result/Conclusion**] The intelligence support system for comprehensive national science centers should serve the innovation-driven development strategy with broader and more comprehensive coverage. The framework involves multi-agent collaborative construction to support planning, management, and multi-level services for national science centers. The system must focus on building intelligence platforms, talent teams, information infrastructure, and management institutions. Its operation mode is a government-led process of interconnection and interaction with internal intelligence platforms and external intelligence cooperation, representing both the creation and realization of intelligence resources to serve innovation-driven development.

Classification Number: G306
Keywords: Comprehensive National Science Center; Intelligence Support System; Intelligence Support Platform; Intelligence Talent Team Construction; Hefei City

---

1. Introduction

In January 2017, China's National Development and Reform Commission issued the *13th Five-Year Plan for National Major Science and Technology Infrastructure*, which designated regions with concentrated scientific infrastructure such as Beijing, Shanghai, and Hefei to build comprehensive national science centers serving national strategic priorities. These centers would feature advanced infrastructure, deep integration of multidisciplinary and interdisciplinary research,

concentration of scientific talent and teams, and open, flexible research environments [1]. The State Council' s approval of Shanghai' s plan to build a globally influential science and technology innovation center positioned national science centers as foundational platforms for the national innovation system, capable of enhancing China' s basic research, strengthening original innovation capacity, overcoming key core technologies, and increasing international scientific competitiveness [2]. In March 2016, the National Development and Reform Commission and Ministry of Science and Technology approved the Shanghai Zhangjiang Comprehensive National Science Center, focusing on promoting major science and technology infrastructure clusters and their deep integration with cutting-edge interdisciplinary research [3]. Subsequently, Beijing Huairou Comprehensive National Science Center was also approved [4].

The *Hefei Comprehensive National Science Center Implementation Plan (2017-2020)* (hereinafter referred to as the *Hefei Plan*) outlines a "2+8+N+3" multi-level innovation system centered on information, energy, health, and environmental sciences. The plan involves establishing national laboratories, promoting science and technology infrastructure clusters, building interdisciplinary frontier research and industrial innovation platforms, and developing "Double First-Class" universities and research institutions [5]. The center aims to advance the application and transformation of scientific and technological achievements, enhance international influence, and construct a full-chain innovation system from "source innovation—technology development—achievement transformation —emerging industries" [5-6]. The fundamental purpose of building comprehensive national science centers is to implement the innovation-driven development strategy, deepen scientific and technological system reform, and transform innovation achievements into the most powerful engine for economic growth [7].

Currently, China' s comprehensive national science center construction remains in its initial stage, not yet matching national innovation-driven development requirements and still showing clear gaps with world-leading science and technology centers. Challenges include nascent exploration of innovation circle systems, functional settings for various circles, and innovation carriers, as well as evident shortages in talent, funding, resources, and international exchange and cooperation. Since 2014, research on science and technology innovation centers has become a hot topic among scholars worldwide, covering definitions, connotations, characteristics [8], industry-university-research cooperation mechanisms and resource allocation [9], functions and features of innovation centers [10], and their diversity [11]. While these studies differ in scope from comprehensive national science centers, they reflect spatial heterogeneity and new trends in global innovation activities, providing theoretical and practical foundations.

Academic research on comprehensive national science centers remains limited. Representative studies include Wang Zhiyuan' s discussion on the significance, challenges, and international experiences for Hefei's construction [12], and Zhang Yaofang's definition of comprehensive national science centers'connotations, four major functions (knowledge innovation, technological innovation, management

innovation, and cultural leadership), and their scientific research foundations and future layouts [13].

Research on intelligence support systems for innovation is also scarce. Wang Yanfei et al. argue that theoretical and practical studies on innovation-driven strategy intelligence support require interpretation of three key concepts: innovation, intelligence support, and evaluation. Intelligence support encompasses information security, decision support, and forward-looking assessment, with emphasis on data foundations and analysis [14]. Fan Mingming et al. propose that intelligence support systems mainly include intelligence indicators, acquisition, processing, analysis, and distribution [15]. Deng Qizheng et al. identify components such as intelligence management systems, acquisition systems, information protection systems, sharing systems, and support systems [16]. Huang Xiaobin suggests focusing on digital information resource construction, resource integration, and institutional transformation, elevating information management to "knowledge management" [17]. While these studies address system composition and functions, they lack in-depth discussion of operation modes.

---

2. Characteristics of Intelligence Support for Comprehensive National Science Centers

2.1 Characteristics of Intelligence Needs and Support Systems

2.1.1 Characteristics of Intelligence Needs

(1) Diversity and Comprehensiveness. The construction of comprehensive national science centers is a complex, comprehensive process requiring diverse intelligence types, including market information, policy information, technical information, standardization information, and patent information [18]. Innovation platforms cover multiple aspects and fields, making single-type intelligence insufficient for innovation entities' needs.

(2) Dynamism and Predictability. The technological innovation process requires rapid information transmission to enable quick intelligence flow within circles and dynamic exchange among innovation entities, promoting rational resource allocation. As comprehensive national science centers represent domestic innovation pinnacles, their intelligence needs must reflect cutting-edge information. Moreover, gaining market advantages requires predictive and forward-looking intelligence to help innovation entities understand future market trends and make scientific decisions.

(3) Multi-level and Cross-system Nature. Traditional enterprises, universities, or governments promoted innovation through internal resources with internal intelligence needs. National science centers, however, consist of four interconnected circles forming an integrated whole for collaboration, with intelligence needs shared across circles. Innovation activities are shifting from

system/department-based to open, social, market-oriented, and collaborative models, creating cross-system information needs [19].

(4) Aggregation and Re-divisibility. While intelligence needs possess the above characteristics, intelligence utilization targets specific problems and fields. Intelligence collected from various channels and in various types and forms must be aggregated and then re-divided according to different support objects, purposes, and scopes, using different service methods and models for intended users.

2.1.2 Characteristics of Intelligence Support Systems. A system is a global issue [20]. Intelligence support systems permeate the entire process of scientific research, production, and innovation achievement transformation, preventing R&D waste, avoiding redundant investment, saving funds, and helping researchers identify research directions and absorb new knowledge. Traditional intelligence support systems tend to serve single entities with relatively simple content, methods, and scope. In contrast, comprehensive national science center intelligence support systems serve multi-agent collaborative innovation development with broader and more comprehensive content and scope, as shown in Table 1 .

Table 1. Comparison Between Comprehensive National Science Center Intelligence Support Systems and Traditional Intelligence Support Systems [21]

Feature	Comprehensive National Science Center Intelligence Support System	Traditional Intelligence Support System
Support Object	Multi-level, multi-agent within comprehensive national science center	Single agent (enterprise, government, research institution)
Support Content	Information technology, intelligence management, intelligence talent, information law, service innovation	Informatization, intelligence services
Support Purpose	Knowledge/technology innovation, regional innovation	Single-chain innovation
Support Method	Unified, specialized intelligence support platform	Single intelligence expert work
Support Scope	Source innovation—technology development—achievement transformation—emerging industries	Data-intensive
Support Mode	Multi-agent expert collaboration (industry-university-research)	Knowledge-intensive

The construction of comprehensive national science centers includes: (1) leveraging advantages of innovative universities, research institutions, and enterprises to build interdisciplinary, cross-field industry-university-research collaborative

innovation networks to optimize resource allocation and promote scientific innovation; (2) establishing intelligence support systems connecting enterprises, universities, research institutions, and governments to reduce costs of searching, storing, and processing innovation information resources; (3) promoting internal sharing and circulation of information resources, rational allocation, integration of complementary resources, and maintaining innovation resource security to tighten government-industry-university-research connections and support collaborative innovation networks; (4) providing precise intelligence for different types and levels of innovation entities and comprehensive intelligence support services for innovation activities to improve overall innovation performance; and (5) optimizing innovation resource allocation, rationally planning innovation industry layouts, stimulating social innovation vitality, improving innovation product practicality, and enhancing innovation benefits to drive social development [27].

2.2 Functions of Intelligence Support for Comprehensive National Science Centers

2.2.1 Reducing Innovation Costs and Improving Innovation Decision-Making. Innovation-driven development is the core concept of comprehensive national science centers, and innovation cannot proceed without intelligence support and promotion. Innovation forecasting relies on intelligence research and analysis. R.S. Campbell considers patent analysis an effective tool for innovative technology forecasting [22], playing an important role in predicting new technologies and promoting existing technology innovation. Patent analysis guides innovation technology forecasting through patent citation analysis, keyword patent mapping, key technology analysis, patent legal status analysis, and technology life cycle analysis.

Intelligence support provides basis for government policy-making and support for enterprise technological innovation. At the national level, scientific and technological intelligence serves as a bridge to transform foreign scientific achievements into domestic productive forces, avoiding unnecessary waste and redundant R&D—key to seizing technological commanding heights [23]. At the enterprise level, the same effect applies. Practice shows that in addressing major issues, traditional decision-making forms, methods, and mechanisms can no longer independently handle complex decision-making affairs, making governments dependent on "intelligence products" and "knowledge essence" for policy advice [24].

2.2.2 Optimizing Resource Allocation and Supporting Collaborative Innovation. Collaborative innovation essentially integrates innovation elements and enables unobstructed flow of innovation resources within the system, optimizing innovation agents and enabling cooperative innovation [25]. The U.S. Defense Intelligence Agency' s 2014 national intelligence strategy objectives stated that new information requires both sharing and protection, and technological progress must enhance cross-intelligence discipline collaboration while eliminating organizational and cultural barriers [26].

3. Framework and Operation Mode of Hefei Comprehensive National Science Center's Intelligence Support System

3.1 Three Orientations for Intelligence Support System Construction

Based on intelligence service orientation requirements, intelligence services should meet the structural and functional intelligence needs of their service objects. Therefore, Hefei Comprehensive National Science Center' s intelligence support system should satisfy three orientations:

3.1.1 Orientation Toward National Science Center Construction and Management Intelligence Needs. Hefei Comprehensive National Science Center deploys policies around four key aspects: "platform,""talent,""science and technology," and "industry," striving to form a strong policy system supporting comprehensive national science center construction [28]. The center' s construction management undoubtedly includes three components: (1) planning (strategic analysis, policy formulation, implementation, and resource maintenance); (2) management (center construction, system operation, personnel coordination, and education); and (3) evaluation (resource management, supervision, organizational coordination, and innovation improvement). All these tasks require intelligence resource support. Through intelligence work conducting detailed investigation and thorough analysis of external environments, competitors, and internal conditions, correct judgments and reasonable, effective policies can be made amid rapidly changing domestic and international situations [29].

Currently, national science center construction primarily focuses on four circles: core, intermediate, peripheral, and linkage layers (see Figure 1 [Figure 1: see original paper]). The intelligence support system must also serve each circle. The central link of the intelligence support system is core system construction, ultimately serving the intelligence demand subjects of the national science center.

3.1.2 Orientation Toward the Four Circle Functions. Platform construction must center on Hefei National Science Center, be guided by multi-agent intelligence needs across all levels, integrate and optimize information resources and services, build an overall support framework for business systems, and maximize comprehensive, efficient satisfaction of multi-agent intelligence needs with differentiated intelligence selections for different demands, while adapting to potential and future intelligence needs to maximize investment benefits and ensure sustainable development.

(1) Core Layer. The core layer is the center of comprehensive national science center construction, focusing on coordinating major science facilities oriented toward national strategic needs. Intelligence and strategy are inseparable. Core layer intelligence services should analyze national strategic needs, target Hefei' s scientific research directions, and provide precise intelligence services.

Intelligence support should facilitate mutual cooperation and support among innovation units. Major science facility construction and upgrading must make strategic contributions to national economic construction and social development, requiring intelligence research and analysis on global scientific and technological development, large research bases, and national strategic needs to promote resource integration and sharing, and enhance openness.

(2) Intermediate Layer. The intermediate layer' s main task is building "Double First-Class" universities, disciplines, and world-class research institutions. This layer' s intelligence services aim to provide intelligence support for innovative universities and R&D institutions. Building first-class innovative universities requires promoting key discipline construction. The University of Science and Technology of China, Hefei University of Technology, and Anhui University should leverage the national science center construction opportunity to identify their positioning, analyze their strengths and weaknesses, and maximize advantages. Intelligence research can help researchers identify new directions and solve research problems [30]. Providing intelligence services for major scientific research projects can comprehensively guarantee literature access, information utilization, and knowledge services for research teams [31], ultimately promoting scientific development and enhancing institutional influence.

(3) Peripheral Layer. The peripheral layer focuses on building world-class industrial clusters oriented toward local economic and social development needs. This layer' s intelligence system enhances regional industrial competitiveness through industrial competitive intelligence services. Research shows that over 50% of enterprises have significant needs for technical competitive intelligence, market intelligence, and competitor analysis [32], and 89.77% of enterprises urgently need industrial technology competitive intelligence service institutions and complete intelligence systems [33]. A unified intelligence support platform should monitor regional economic and social development needs and industrial technology dynamics through resource integration and collaboration, providing industrial competitive intelligence for enterprises across the innovation industry chain to form internationally competitive industrial clusters.

(4) Linkage Layer. The linkage layer focuses on planning and implementing large-scale science and technology programs [34]. By grasping technology innovation directions, it provides guidance for large-scale science and technology action plans. The process of selecting priority areas for science and technology planning is essentially dynamic intelligence acquisition, integration, research, service, and user interaction [35]. This layer' s intelligence work collects, selects, evaluates, analyzes, and synthesizes technical intelligence, predicts technology development trends, and forms novel, value-added intelligence products to provide basis for technological innovation strategies and methods [36].

3.1.3 Orientation Toward Intelligence Users to Meet Personalized Needs. Personalized and humanized platform construction aims for "one-stop acquisition, rapid response, real-time interaction, and dynamic development." Design must align with different users' habits and characteristics, optimize sup-

port procedures, and organically integrate the process from analyzing user needs to providing intelligence support. The system should innovate support modes, improve work efficiency, communicate comprehensively with support subjects, respond promptly to environmental changes, and develop dynamically. Particularly, big data must be integrated with intelligence platforms to promote co-construction and sharing of intelligence resources. Big data technology enables more diversified, intelligent, convenient, and low-cost data acquisition, greatly improving management efficiency [37]. Co-construction and sharing of information resources effectively addresses the contradiction between information explosion across media and limited funding for single government, enterprise, or university entities, adapting to changing intelligence resource demands from innovation subjects.

3.2 Core System Construction of Intelligence Support System

Hefei Comprehensive National Science Center' s intelligence support system should involve multi-agent collaboration among government information centers (providing policy, legal, standard, and macro-analysis intelligence), intelligence research institutes (providing standard and scientific intelligence), enterprise information departments (providing scientific and market intelligence), university libraries (providing literature intelligence), and data service providers (providing multi-type data and extracting intelligence through data mining). The core comprises four subsystems: intelligence support platform, intelligence talent team, information infrastructure, and intelligence management system, providing differentiated support services for Hefei National Science Center' s planning, management, and circle construction through websites, forums, lectures, columns, and training (see Figure 1). Among the four core subsystems, platform construction and talent development are particularly critical.

3.2.1 Intelligence Support Platform Framework Construction. Hefei Comprehensive National Science Center' s intelligence platform can be divided into intelligence, management, service, and application layers (see Figure 2 [Figure 2: see original paper]).

(1) Intelligence Layer includes four aspects: (a) Intelligence channels, including acquisition systems (information retrieval and data collection), analysis systems (information mining and analysis), management systems, and monitoring (early warning) systems. Different departments, fields, and entities serve as intelligence sources through both open and secret channels. (b) Intelligence types, including open intelligence, grey intelligence, and secret intelligence; or enterprise, government, education, science and technology, and social intelligence; or human and literature intelligence. (c) Intelligence circles refer to intelligence generated and used by the four circles of the national science center. (d) Intelligence methods include manual and automated approaches, with automated collection and analysis becoming a major feature in the big data era.

(2) Management Layer generally includes: (a) Intelligence planning system,

which formulates research plans based on needs of various Hefei Comprehensive National Science Center levels, determines target architecture and specific content, and establishes research teams. (b) Intelligence collection system, where research teams combine traditional retrieval with big data research methods to monitor and collect real-time, extensive internal and external data, then deduplicate, filter, and identify data [38] to form high-quality intelligence resources. (c) Intelligence analysis system, which uses data mining methods (classification, regression analysis, clustering, association rules, deviation analysis) [39] to analyze and interpret data, forming comprehensive analysis reports or decision-making solutions. (d) Intelligence management system, which manages, stores, transmits, optimizes, uses, and controls intelligence research products. (e) Intelligence monitoring system, which monitors and provides early warnings on activities of important targets (major research institutions, other national science centers, major science and technology initiatives) to support intelligence research.

(3) Service Layer. Intelligence services include providing relevant intelligence through WeChat and websites, publishing research reports for specific groups, organizing forums and lectures, and offering customized intelligence services.

(4) Application Layer. Intelligence services must be application-oriented, serving industrial clusters, national laboratories, major science facilities, large-scale science and technology programs, enterprise technology centers, interdisciplinary frontier research platforms, industrial innovation transformation platforms, innovative universities (Double First-Class universities), R&D institutions, and relevant government departments.

3.2.2 Intelligence Talent Team Construction. Hefei faces several challenges: few intelligence practitioners, low quality, lack of relevant knowledge and skills, insufficient professional training, low salary levels, and difficulty attracting high-end talent due to compensation, social status, and development environment. Enterprise employment mechanisms don' t match intelligence talent management, with inadequate attention, incomplete incentive mechanisms, and mismatched talent placement.

Currently, intelligence education focuses primarily on formal degree programs. Hefei' s top universities (University of Science and Technology of China, Hefei University of Technology, Anhui University) lack complete intelligence talent training systems. Only Anhui University and Anhui University of Finance and Economics offer graduate degrees in intelligence studies, with obvious problems: (a) Students have incomplete comprehensive qualities and knowledge structures, emphasizing theory over information technology and literature intelligence while neglecting economic and scientific intelligence theory and practice; (b) Training approaches are single, relying on single agents like universities with insufficient enterprise and research institute participation; (c) Teaching is emphasized over research, with limited academic vision; (d) Lack of practice makes it difficult to integrate theory with reality, and educational content doesn' t match R&D institution needs, leaving intelligence talent ill-equipped to solve practical prob-

lems.

To address these issues and build Hefei's intelligence talent team, two approaches are needed:

(1) Intelligence Talent Training. To cultivate market-satisfying intelligence talent, training models must be integrated with Hefei' s development environment through multi-agent collaborative training. Collaborative talent development involves multiple stakeholders jointly educating talent on the same platform, driven by market demand, creating cooperative, complementary, and synchronized synergies [40]. Using universities (University of Science and Technology of China, Hefei University of Technology, Anhui University) as the main body, supplemented by science and technology intelligence institutes, enterprises, and data service providers, collaborative training should involve domestic and foreign intelligence institutions when necessary (e.g., School of Information Management at Wuhan University, Nanjing University, Peking University, and Chinese Academy of Sciences Documentation and Information Center).

Intelligence education should emphasize innovative professional talent cultivation. Talent serving innovation-driven development and Hefei Comprehensive National Science Center must possess innovative spirit and capability to explore new knowledge and solutions using professional intelligence knowledge and skills when facing new problems. Intelligence teaching should address broader information professions, including information management careers in public, scientific, social science, university, professional, administrative, industrial, and health fields, cultivating research-oriented, interdisciplinary, and leading talent who can lead traditional information institutions through cultural transformation [41].

Training comprehensive, interdisciplinary talent requires not only research-oriented degree education but also market-oriented continuing education that understands relevant enterprises. Only through full integration can its role be realized. Teaching methods should abandon single classroom lectures in favor of multi-faceted, effective, and humanized approaches: "theory mastery—practice testing—theory sublimation—service innovation." Teaching should emphasize group learning, individual presentations, and seminars to strengthen practical operation, expression, and application abilities [42], providing internship and practice venues for intelligence research students to develop intelligence collection and usage capabilities, ultimately cultivating talent serving Hefei Comprehensive National Science Center.

To ensure talent advancement and applicability, continuing education for intelligence talent must be perfected, and learning organizations established to provide job training and quality improvement for existing staff. A sound lifelong education system for talent must be established to continuously improve comprehensive qualities.

(2) Intelligence Talent Introduction. To adapt to Hefei Comprehensive National Science Center construction, Hefei has established a "top-to-bottom—

tailor-made—all-encompassing" talent policy system. "Top-to-bottom" refers to high-level innovation and entrepreneurship talent, "tailor-made" to specialized policies for the science center, and "all-encompassing" to various peripheral foundational talents serving the center [43]. On May 9, 2017, the *Opinions on Talent Work for Hefei Comprehensive National Science Center Construction (Trial)* was issued, covering ten aspects including increased recruitment incentives, visa and residence facilitation, strengthened knowledge value incentives, personal income tax preferences, professional title green channels, innovative establishment and position management, optimized living support services, advanced model rewards, special handling for special talent, and strengthened coordination [44]. Intelligence talent, as mid-to-high-end technical talent, should be included in this policy system, with enterprises and research institutes strengthening attention, establishing reasonable management systems, perfecting incentive mechanisms, and placing intelligence talent in suitable positions.

3.2.3 Information Infrastructure Construction. Information infrastructure and industries are becoming core drivers of economic development and key to industrial transformation and upgrading [45]. Building Hefei Comprehensive National Science Center, constructing world-class comprehensive innovation platforms, and building intelligence support platforms all generate strong demand for deep information resource development and utilization, requiring robust information infrastructure support (big data, cloud computing, Internet of Things). The *Anhui Provincial Information Network Infrastructure Development Special Plan (2017-2021)* issued on May 31, 2017, identifies main tasks including accelerating high-speed fiber optic network improvement, building mobile broadband networks, deploying high-level application infrastructure, and strengthening network and information security [46]. Specific measures such as coordinating cloud computing and big data infrastructure construction and promoting a "one center, two bases, multiple parks" cloud computing and big data industry layout provide solid foundations for Hefei Comprehensive National Science Center and its intelligence support system.

Information infrastructure should adopt Public-Private Partnership (PPP) models to break state capital monopolies and address potential information infrastructure backwardness caused by continuous construction. Platform information technology should accelerate establishment of personalized service network structures adapted to Web 3.0, distributed databases for massive data storage, advanced technologies and equipment for big data processing and application, and resource discovery systems [47].

3.2.4 Intelligence Management System. Intelligence management systems regulate various institutional rules for intelligence collection, coding, organization, analysis, auditing, confidentiality, release, and personnel incentives across departments, entities, and platforms. Due to extensive content and space limitations, this section is omitted.

3.3 Construction of Intelligence Support System Operation Mode

The *Hefei Comprehensive National Science Center Implementation Plan (2017-2020)* states that promoting scientific and technological achievement transformation and application, enhancing international influence, and building a full-chain innovation system from "source innovation—technology development—achievement transformation—emerging industries" [48] requires the intelligence support system to cover every step of the full-chain innovation system, as shown in Figure 3 [Figure 3: see original paper].

The operation mode is a government-led process of interconnection and interaction with internal intelligence platforms and external intelligence cooperation, as well as a process of creating and realizing intelligence resources to serve innovation. Internal intelligence support primarily involves internal intelligence platforms formed by high-tech enterprises in Anhui, universities (University of Science and Technology of China, Hefei University of Technology, Anhui University), and research institutes (Hefei Institutes of Physical Science, Chinese Academy of Sciences), serving innovation industry chains with goals of innovation benefits, capacity, and culture. External intelligence support seeks cooperation based on national policy compliance, precise market demand, and competition/cooperation with Beijing and Shanghai Zhangjiang national science centers. The core value lies in establishing systems through internal intelligence alliances and external cooperation, forming deep cooperative relationships, building mutually beneficial intelligence networks, and continuously transforming internal and external intelligence resources across innovation chain stages to provide intelligence for the innovation process.

Hefei Comprehensive National Science Center construction demonstrates Anhui' s leading position in China' s innovation landscape, representing national participation in global scientific and technological innovation competition and cooperation at high levels [49]. Intelligence support systems permeate the entire process of scientific research, production, and innovation achievement transformation, playing a crucial supporting and promoting role for Hefei Comprehensive National Science Center construction. Due to data collection limitations and personal subjective factors, this article inevitably has shortcomings, with many valuable issues regarding intelligence support systems not thoroughly explored, which future research should address.

References

[1] *Notice on Issuing the 13th Five-Year Plan for National Major Science and Technology Infrastructure* [EB/OL]. [2017-09-10]. http://www.ndrc.gov.cn/zcfb/zcfbgh/201701/t20170111_{83

[2] *Notice of the State Council on Issuing the Shanghai Systematic Innovation Reform Pilot Plan for Accelerating Construction of a Globally Influential Science and Technology Innovation Center* [EB/OL]. [2017-09-12].

http://www.gov.cn/zhengce/content/2016-04/15/content_{5064434}.htm.

[3] Shanghai Zhangjiang Comprehensive National Science Center Approved [EB/OL]. [2017-09-12]. http://www.most.gov.cn/dfkj/sh/tpxw/201603/t20160307_{124522}.htm.

[4] Beijing Huairou Comprehensive National Science Center Approved [EB/OL]. [2017-09-12]. http://scitech.people.com.cn/n1/2017/0617/c1007-29345464.html.

[5] Zhang Yali. Hefei Comprehensive National Science Center Constructs "2+8+N+3"Innovation Framework [EB/OL]. [2017-10-03]. http://ah.ifeng.com/a/20170913/5992856_0.shtml.

[6] Zhang Shaochun. Comprehensively Building Comprehensive National Science Center, Striving to Build World-Class Comprehensive Innovation Platform [EB/OL]. [2017-10-03]. http://www.ah.gov.cn/UserData/DocHtml/1/2017/9/13/2904172575970.html.

[7] Cherish the Opportunity and Strive to Blaze New Trails [EB/OL]. [2017-10-17]. http://ah.anhuinews.com/system/2017/03/02/007572143.shtml.

[8] Chen Bo. Preliminary Study on Evaluation Index System of Global Science and Technology Innovation Center [J]. Science Research Management, 2017, 37(S1): 289-295.

[9] Luo Yueling, Gao Xijie, He Wanpeng. Research on Institutional Mechanism Issues for Shanghai to Build Global Science and Technology Innovation Center [J]. Science & Technology Progress and Policy, 2015(18): 28-33.

[10] Du Debin, He Shunhui. Connotation, Function and Organizational Structure of Global Science and Technology Innovation Center [J]. China Science and Technology Forum, 2016(2): 10-15.

[11] Jimenez A, Zheng Y. Tech Hubs, Innovation and Development [J]. Information Technology for Development, 2017(5): 95-118.

[12] Wang Zhiyuan. Thoughts and Suggestions on Hefei' s Construction of Comprehensive National Science Center [J]. Journal of Hefei Municipal Party School, 2016(5): 25-27.

[13] Zhang Yaofang. Connotation, Function and Management Mechanism of Comprehensive National Science Center [J]. China Science and Technology Forum, 2017(6): 5-12.

[14] Wang Yanfei, Zhao Keran, Yu Jie. Analysis of Conceptual Relations in Innovation-Driven Strategy Intelligence Support [J]. Information Studies: Theory & Application, 2016(11): 1-4, 9.

[15] Fan Mingming, Xiao Huan, Tao Xiangjun. Comparison and Enlightenment of U.S. and Russian Anti-Terrorism Early Warning Mechanisms [J]. Journal of Intelligence, 2014, 33(12): 6-9, 14.

[16] Deng Qizheng, Bai Bingquan. Application of System Dynamics in Intelligence Support System Construction [J]. Journal of Intelligence, 2016(9): 16-19, 5.

[17] Huang Xiaobin, Wang Yao. Research Progress on Intelligence Support for China' s Think Tank Construction [J]. Information Studies: Theory & Application, 2017, 40(5): 127-131.

[18] Li Ying. Research on Information Support System Based on Enterprise Technology Innovation Process [J]. Information Science, 2013(7): 46-49, 63.

[19] Hu Jiming. Construction of Information Service System and Information Support System for Innovative Country (2)—Information Service Transformation Based on Innovation Value Chain [J]. Library and Information Service, 2010(6): 10-13, 35.

[20] Zhang Yuzhen, Zhang Hongxuan. Research on Building National Knowledge Innovation Information Support System [J]. Modern Information, 2006(9): 7-9.

[21] Bai Ge, Zhang Daiping, Li Jie. Deeply Exploring Intellectual and Non-Intellectual Factors to Promote Innovative Development of Smart Intelligence Research [J]. Information Studies: Theory & Application, 2016(2): 10-12, 9.

[22] Campbell R S. Patent Trends as a Technological Forecasting Tool [EB/OL]. [2017-10-09]. http://www.sciencedirect.com/science/article/pii/0172219083901345.1983.

[23] Xiang Hong, Cao Ruzhong. Innovative Thinking on Promoting China' s Scientific and Technological Intelligence Work—Based on the Interactive Relationship Between Scientific and Technological Intelligence and Innovation [J]. Science and Technology Management Research, 2012(3): 1-3, 30.

[24] Li Gang, Li Yang. Research on Think Tank Construction from Intelligence Perspective [J]. Library and Information Service, 2015, 59(11): 36-41, 61.

[25] Chen Jin, Yang Yinjuan. Theoretical Basis and Connotation of Collaborative Innovation [J]. Studies in Science of Science, 2012(2): 161-164.

[26] Johnston C, Wright E C J, Bice J, et al. Transforming Defense Analysis [J]. Joint Force Quarterly, 2015, 79(4): 12-19.

[27] Chu Jiewang, Cao Zhenxiang. Research on Patent Intelligence Strategy for Innovation-Driven Development [J]. Modern Information, 2017, 37(9): 9-15.

[28] Xu Qiuyun. What Policy Support Does Hefei Have for Building Comprehensive National Science Center? [EB/OL]. [2017-10-10]. http://www.cnr.cn/ah/news/20170925/t20170925_{523963242}.shtml.

[29] Yu Yixin, Lü Huaqiao, Shen Zhengzheng. Research Progress on Urban Competitive Intelligence [J]. Library and Information Service, 2014, 58(S1): 130-135.

[30] Deng Fei, Li Hong. Exploration of New Mode of Embedded Scientific Research Intelligence Service [J]. Information Studies: Theory & Application, 2013, 36(7): 10-14.

[31] Wu Ming, Wang Li. Practice of Embedded Subject Intelligence Service —Taking Support for National Major Science and Technology Special Project Innovation as Example [J]. Library and Information Service, 2013, 57(22): 43-48, 36.

[32] Zhao Xiaoyuan, Li Peng. Investigation and Analysis of Industrial Competitive Intelligence Demand [J]. Journal of Intelligence, 2015, 34(4): 27-31, 18.

[33] Zhao Kang. Analysis of Industrial Competitive Intelligence Service for Open Innovation [J]. Information Studies: Theory & Application, 2017, 40(4): 20-25.

[34] Zheng Li. Hefei Comprehensive National Science Center Strengthens Four-Level Construction [EB/OL]. [2017-10-11]. http://ah.anhuinews.com/system/2017/02/20/007564878.shtml.

[35] Wang Haiyan, Leng Fuhai. Research on Strategic Intelligence and Service Framework Supporting Priority Area Selection for Science and Technology Planning [J]. Library and Information Service, 2013, 57(7): 70-74.

[36] Lü Qiongfang. Competitive Intelligence Service for Technology Innovation [J]. Modern Information, 2011, 31(9): 129-131.

[37] Tang Bin. Big Data: "De-islanding" of Information Resources for Ecological Civilization Construction [J]. Xiangtan University Journal (Philosophy and Social Sciences Edition), 2017, 41(1): 67-71.

[38] Liang Chunhua. Development Status and Thoughts on Intelligence Research Platform in Big Data Environment [J]. Information Studies: Theory & Application, 2017(6): 63-66, 50.

[39] Baidu Baike. Data Mining [EB/OL]. [2017-10-11]. https://baike.so.com/doc/3186393-3357840.html.

[40] Liu Kunxiong, Gan Yu. Research on Collaborative Training Mode of Competitive Intelligence Talent for Enterprise Demand [J]. Research on Library Science, 2015(17): 14-21.

[41] Chen Chuanfu, Chen Yi, Si Li, et al. Research on "Four Decades" of Library and Information Science Graduate Degree Authorization in China [J]. Journal of Library Science in China, 2017, 43(1): 17-28.

[42] Wang Xiwei, Guo Yu, Shi Jing, et al. Comparative Study on Curriculum System Construction of Library and Information Science Graduate Programs in China and the U.S. in the Big Data Era [J]. Library and Information Service, 2015, 59(23): 30-37.

[44] General Office of Anhui Provincial Party Committee and Provincial People's Government. *Notice on Issuing Opinions on Talent Work for Hefei Comprehensive National Science Center Construction (Trial)* [EB/OL]. [2017-09-25]. http://xxgk.ah.gov.cn/UserData/DocHtml/731/2017/5/12/406831135791.html.

[45] Du Zhenhua. Vision of Information Infrastructure Construction Under "Internet Plus" Background [J]. Reform, 2015(10): 113-120.

[46] Notice of Anhui Provincial People' s Government General Office on Issuing Anhui Provincial Information Network Infrastructure Development Special Plan (2017-2021) [EB/OL]. [2017-10-03]. http://xxgk.ah.gov.cn/UserData/DocHtml/731/2017/5/31/816497585834.

[47] Li Zhen. Research on Countermeasures for University Library Information Resource Construction in Big Data Era [J]. Journal of Academic Library and Information Science, 2017, 35(1): 36-40.

[48] Zhang Shaochun. Comprehensively Building Comprehensive National Science Center, Striving to Build World-Class Comprehensive Innovation Platform [EB/OL]. [2017-10-05]. http://www.ah.gov.cn/UserData/DocHtml/1/2017/9/13/2904172575970.html.

[49] Zheng Yan. Fully Promoting Hefei Comprehensive National Science Center Construction to Create Powerful Engine for Building Five Major Development Beautiful Anhui [N]. Anhui Daily, 2017-02-28(001).

Author Contributions:
Chu Jiewang: Responsible for overall framework design, paper review, revision, and polishing.
Cao Zhenxiang: Responsible for literature collection and paper writing.

Authors' Addresses:
Chu Jiewang, Cao Zhenxiang, School of Management, Anhui University, Hefei 230000.

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