Scenario Extension: From Scientific and Technical Intelligence to Postprint Scientific and Technical Services

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Abstract

[Purpose/Significance] By examining the extension of science and technology intelligence service scenarios, this study provides targeted pathways and methods for the development of science and technology intelligence and its integration into science and technology services. [Method/Process] The research proposes a science and technology intelligence scenario triplet, utilizes case analysis methodology to investigate the extension of this scenario triplet, and employs the case of comprehensive science and technology services in the middle reaches of the Yangtze River urban agglomeration to explore approaches for conducting science and technology services. [Results/Conclusion] The study identifies two fundamental pathways for implementing science and technology services in new scenarios: first, resource integration, and second, service synergy.

Full Text

Abstract

[Purpose/Significance] This study examines the scenario extension of sci-tech intelligence services to provide targeted pathways and methods for the development of sci-tech intelligence and its integration into sci-tech services. **[Method/Process]** We propose a sci-tech intelligence scenario triad and analyze its extension through case studies, investigating how to conduct sci-tech services using the case of integrated sci-tech services for the middle reaches of the Yangtze River urban agglomeration. **[Result/Conclusion]** The research identifies two fundamental approaches for delivering sci-tech services under new scenarios: resource integration and service coordination.

Keywords: sci-tech intelligence; sci-tech services; scenario

Sci-tech intelligence plays a foundational, strategic, and guiding role in scientific and technological innovation activities, and all major technological powers attach great importance to it. China's sci-tech intelligence enterprise has evolved alongside important scientific research and engineering projects since the founding of the People's Republic, consistently serving national sci-tech innovation and making outstanding contributions. However, with successive waves of information technology revolutions, the scenarios for sci-tech innovation continue to extend, and intelligence service paradigms keep evolving. Research on how to adapt sci-tech intelligence services to national sci-tech development under new scenarios has become a new challenge facing intelligence professionals.

President Xi Jinping [1] describes the current scenario for sci-tech development as "a great transformation unseen in a century, with emerging markets and developing countries rising at an unprecedented pace, and a new round of sci-tech revolution and industrial transformation bringing unprecedented metabolism and fierce competition." He further emphasizes that "scientific and technological workers must write their papers on the land of the motherland and apply their achievements to the great cause of modernization." This points the way forward for sci-tech intelligence in the new era: sci-tech must address real problems in national development, and intelligence must meet the needs of innovation activities.

1. Deconstructing the Sci-Tech Intelligence Service Scenario

Management scholars have extensively studied service scenarios. M. Bitner et al. [2] first proposed the concept of "servicescape," defining it as "the environment in which services exist," encompassing location, atmosphere, and the service relationship between providers and consumers. E. Arnould et al. [3] identified physical places as fundamental elements of service scenarios, including service spaces and facilities. A. Mattila and J. Wirtz [4] noted that service relationships—covering provider behavior and user feedback—exist between physical space and service atmosphere. E. Nilsson and D. Ballantyne [5] further conceptualized the service scenario as a co-created service environment between providers and consumers, comprising both traditional physical places and intangible service experiences. M. Rosenbaum and C. Massiah [6] expanded the service scenario model to include physical, social, social-symbolic, and natural dimensions.

As digital space [7] increasingly merges with physical reality, the contemporary world exhibits highly ternary characteristics. Sci-tech intelligence and its operations also rely on the ternary world (Cyber-Physical-Society, CPSS) [8] across information, physical, and social dimensions. Within this framework, and considering the characteristics of sci-tech intelligence service activities, we can describe the sci-tech intelligence scenario as a triad of space, activity, and agent: *f(Space, Activity, Agent).*

Space generally refers to the location or physical space where sci-tech intelligence services occur. *Activity* can be expressed through business operations and relationships. *Agent* describes the social network of subjects and objects involved in services. Comparing intelligence work with library work illustrates this concept: both share core literature and intelligence services, but library service scenarios follow a relatively simple triad *f(Space, Activity, Agent)*, whereas intelligence work involves more diverse and complex places, activities, and agents. In other words, differences in the triad distinguish intelligence work from library work.

2. The Extension of Sci-Tech Intelligence Scenarios

The extension of China's sci-tech intelligence scenario *f(Space, Activity, Agent)* has progressed through three main phases.

2.1 Early Development of Sci-Tech Intelligence

Before the 1980s, China's sci-tech intelligence service scenario remained relatively stable. In terms of *Space*, services occurred primarily in physical locations such as intelligence institutes and university research centers. Regarding *Activity*, services focused on traditional operations: collecting, processing, transmitting, and utilizing literature and intelligence resources. For *Agent*, providers were mainly intelligence institutions and their staff, while users were sci-tech innovation institutions and their personnel. Under this stable triad, pre-1980s sci-tech intelligence work achieved remarkable success in fulfilling tasks assigned by the Party and state.

Three landmark events characterized this early period. First, the establishment of the Institute of Scientific and Technical Information of China (ISTIC) in 1956 (initially as the Institute of Scientific Information, Chinese Academy of Sciences, renamed in December 1958, and again in 1992) marked the formal launch of China's sci-tech intelligence enterprise [9]. In 1956, under Premier Zhou Enlai's leadership, the central government formulated the "1956-1967 Long-Range Plan for Scientific and Technological Development," proposing 57 key national tasks. Based on Task 57—"rapidly establishing sci-tech intelligence institutions"—China created specialized intelligence service organizations and initially built a national sci-tech intelligence system. Early intelligence work focused on comprehensively and timely collecting, researching, and reporting domestic and international sci-tech developments, particularly from technologically advanced countries, and abstracting papers and reports from global journals to provide literature and intelligence support for national development and engineering projects.

Second, participation in the national "748 Project" earned a National Science and Technology Progress Award, representing a major achievement. In August 1974, under Premier Zhou Enlai's coordination, multiple ministries launched the key national project "Chinese Character Information Processing System Engineering" (the "748 Project"). ISTIC and the Beijing Library (renamed the

National Library in December 1998) jointly developed the *Chinese Thesaurus*, *Chinese Library Classification*, and *Chinese Library Book Classification*, making important contributions to Chinese character information processing. These achievements won first and second prizes in the 1985 National Science and Technology Progress Awards, marking a major breakthrough for sci-tech and library intelligence work.

Third, the Fifth National Sci-Tech Intelligence Work Conference established a new direction: "broaden intelligence sources to serve national economic construction," signaling comprehensive scenario extension. In July 1980, Jiang Ming, then Vice Minister of the State Science and Technology Commission, chaired the conference and discussed the "Opinions on Adjusting and Strengthening Sci-Tech Intelligence Work," which stated that "intelligence work in the new era must closely serve national economic construction and sci-tech development needs… promptly and accurately providing intelligence and analytical materials for all sectors." From this point, sci-tech intelligence began comprehensively serving the "Four Modernizations."

2.2 Expansion Under the Impact of Informatization

After the 1980s, successive waves of informatization dramatically transformed the sci-tech intelligence service triad. First, *Space* changed: before informatization, services occurred mainly in physical spaces, but with the arrival of ICT (Information and Communication Technology) environments, service locations expanded from physical to virtual space. Virtual space's unlimited nature compensated for physical space's limitations, enlarging service areas and blurring business boundaries. This spatial extension increased complexity and raised higher demands for service delivery.

Second, *Activity* began to change. In the early reform period, Deng Xiaoping proposed the guiding principle of "developing information resources to serve the Four Modernizations." Historical analysis shows that informatization and the Four Modernizations developed in parallel with cross-integration. Against this backdrop, sci-tech intelligence *Activity* expanded from traditional services to broader domains serving economic and social development. The extension of *Space* and *Activity* drove *Agent* expansion, diversifying both providers and users.

Throughout the informatization wave, the constant thread in sci-tech intelligence work remained resource-based intelligence services. Intelligence workers and institutions extensively explored which resources could support what services. For example, in resource construction, new forms emerged such as specialized sci-tech resources, dedicated sci-tech networks, and information resource sharing. In specialized services, institutions leveraged resource advantages to develop competitive intelligence, thematic research, and information consulting. In service methods, new forms like cloud services and embedded services appeared [10]. Overall, China's sci-tech intelligence enterprise effectively ex-

plored new development pathways and strongly supported national economic and social development.

2.3 Comprehensive Extension in the New Era

Entering the new era, China has embarked on building a modern socialist society. In the ternary world where physical, human, and information spaces merge, the sci-tech intelligence service triad *f(Space, Activity, Agent)* continues to expand unevenly, with increasingly loose relationships. Digital *Space* exhibits ubiquitous characteristics combining virtual and physical elements, moving services from offline to online-offline integration. *Activity* encompasses comprehensively renewed service content and forms. This expansion pulls more stakeholders into *Agent*, including not only traditional providers and users but also professional service firms and enterprises that participate in and transform sci-tech intelligence business forms [11].

Intelligence engineering [12] represents the development path for sci-tech intelligence work in response to new scenarios. Under the expanded triad, intelligence engineering practice 主要包括数据、工具、服务三个方面 [13]: data exhibits multi-source, multi-dimensional, and heterogeneous characteristics, requiring big data thinking for integration; tools become more automated, intelligent, and standardized, demanding human-machine collaboration; services feature cross-institutional, cross-regional, and cross-domain characteristics, requiring multi-institutional coordination. In the new era, sci-tech intelligence institutions actively respond to scenario transformations by exploring intelligence engineering practices.

3. Conceptualizing Sci-Tech Services Under New Scenarios

Against the backdrop of comprehensive scenario extension, sci-tech intelligence is rapidly integrating into sci-tech services, with scenarios further expanding:

f(Space+, Activity+, Agent+)

Space+ refers to new places: sci-tech service locations have more blurred temporal and spatial boundaries, existing everywhere from physical venues to virtual clouds. *Activity+* refers to new business activities: service integration and coordination oriented toward industrial development. *Agent+* refers to new stakeholders: pulled by *Space+* and *Activity+*, new service objects emerge and providers become more diversified. These changes in the new scenario triad provide implementation pathways for sci-tech intelligence services to expand and integrate into sci-tech services.

3.1 Expansion of Sci-Tech Intelligence Services Under New Scenarios

(1) **Dual-Driven Expansion by Technology and Demand**. Technology-driven and demand-pull factors are two basic elements driving scenario extension. Technology-driven changes, represented by cloud computing, big data, 5G, and blockchain, have transformed sci-tech intelligence service

tools and methods, making services cross-temporal, cross-institutional, and cross-modal. In the new scenario of building a modern socialist society, comprehensive economic and social development creates richer and higher demands for sci-tech intelligence, driving changes in business content and service forms.

(2) **Expansion of Service Objects Under New Scenarios**. Service objects, as crucial stakeholders in *Agent*, are the source of sci-tech service demand. Early intelligence services targeted sci-tech workers and innovation institutions, later expanding to governments, enterprises, and industrial innovation activities. With government-led industrial parks, regional industrial clusters emerged, and intelligence work began serving regional sci-tech innovation and economic development. Sci-tech intelligence services for regional innovation development face significantly increased scenario complexity. From the demand side, regional intelligence needs for industrial development are diverse and heterogeneous. From the supply side, intelligence products and technologies must adapt to regional industrial development needs. From the environmental perspective, intelligence institutions must deeply participate in regional sci-tech policy formulation and analysis.

(3) **Expansion of Service Providers Under New Scenarios**. As primary *Agent* stakeholders, service providers' subjects and roles are changing. In terms of roles, intelligence institutes are no longer just direct service providers but also offer intermediary support and regional sci-tech resource integration. In terms of subjects, besides professional intelligence institutions, specialized service firms, enterprises, and universities have become supplementary forces, making providers more diversified.

Compared with sci-tech intelligence services, sci-tech services must address the entire process of sci-tech innovation, requiring providers to comprehensively understand upstream and downstream industrial chains, key innovation nodes, all processes, and both individual and common needs of innovation activities. This enables diverse providers to collaborate in forming service chains that match industrial chain demands.

3.2 Classification of Sci-Tech Services Under New Scenarios

Sci-tech services constitute a core component of modern services [14], referring to emerging industries that use modern scientific knowledge, technology, and analytical methods, along with experience and information, to provide intellectual services to society. According to the State Council's "Opinions on Accelerating the Development of Sci-Tech Services" (October 2014), sci-tech services include eight specialized areas: R&D, inspection and testing certification, entrepreneurship incubation, intellectual property, sci-tech consulting, sci-tech finance, technology transfer, and science popularization. Different services rely on different scenario triads *f(Space+, Activity+, Agent+)*. Based on this, we classify sci-tech

services into three categories (see [Figure 1: see original paper]).

(1) **General-Purpose Sci-Tech Services**. These 主要包括科普服务和创业孵化服务. In *Space*, they require physical venues like science museums, libraries, and incubators. In *Activity*, their service content and methods are more universal, integrating capital, equipment, and other resources through teaching and publicity. In *Agent*, science popularization mainly serves the public, while incubation targets individuals and SMEs.

(2) **Broad-Spectrum Sci-Tech Services**. These refer to professional services spanning wide fields and industries, including technology transfer, sci-tech finance, sci-tech consulting, and intellectual property services. Their *Space+* is rich, encompassing all relevant offline institutions and online platforms. In *Activity+*, they center on highly integrated professional intermediary services. In *Agent+*, providers include technology transfer agencies, financial institutions, and patent agencies, serving diverse sci-tech innovation institutions across industries, sectors, and regions.

(3) **Targeted Sci-Tech Services**. These refer to precision services for specialized fields and high-tech areas, including R&D services and inspection and testing certification. Their *Space+* is deeply embedded in industrial and sectoral innovation venues. In *Activity+*, they provide highly specialized and technical services. In *Agent+*, providers must integrate technical resources to serve high-tech R&D users.

4. Implementation Pathways for Sci-Tech Services Under New Scenarios

4.1 New Scenarios Under Industrial Convergence

Industrial convergence refers to the industrial form and economic growth mode where industry, services, and information sectors mutually penetrate, contain, and integrate within the same industrial and service chain. Its essence is deeply integrating sci-tech services into industrial cluster development. During convergence, *Space* covers all sci-tech innovation institutions with cross-institutional, cross-industrial, and cross-regional characteristics. Facing industrial clusters and chains formed by convergence, *Activity* is no longer single services but service chains containing various sci-tech services. In this fusion of industrial and service chains, *Agent* is highly diversified—all institutions in the service chain are providers, while people, institutions, industries, and innovation regions in the industrial chain become users.

Take the middle reaches of the Yangtze River urban agglomeration [15] as an example. This mega-urban agglomeration comprises the Wuhan metropolitan area, the Changsha-Zhuzhou-Xiangtan city cluster, and the Poyang Lake city cluster. Different industrial models and innovation scenarios have emerged during regional industrial convergence, requiring tailored sci-tech services. The region's advantageous industrial clusters mainly exhibit three patterns: hub-and-

spoke, network, and multi-core. Hub-and-spoke industries feature numerous SMEs collaborating around core enterprises, requiring services that integrate and provide sci-tech resources around core enterprises to radiate to satellite enterprises for coordinated development. Network industries involve multiple similarly-sized enterprises forming regional clusters, requiring aggregated services like inspection and testing, technology transfer, and sci-tech finance to promote parallel development. Multi-core industries involve a few oligopolistic enterprises driving upstream and downstream industrial chains, requiring services that support multi-core-driven clusters and cultivate industrial chains.

Industrial convergence and different cluster types significantly impact service scenarios. Our sci-tech services must address both individual industry needs and common needs across all industries. In such complex scenarios, single intelligence institutions often struggle to cope, requiring resource integration and service coordination to respond to both individual and common industrial development needs.

4.2 Implementation Pathways for Sci-Tech Services Under New Scenarios

The three types of sci-tech services show that as scenario complexity increases, intelligence institutions face growing challenges. We argue that the pathway for intelligence institutions to enter sci-tech service scenarios is a "resource + service" model: integrating diverse sci-tech resources in response to triad expansion and forming diversified services through online-offline integration.

The core is overcoming cross-regional, cross-domain, and heterogeneous problems in sci-tech resources through resource integration and service coordination to achieve effective integration and utilization for regional innovation development.

(1) **Resource Integration**. The essence is integrating more types and larger scales of innovation resources. Traditionally, intelligence institutions focused on literature and intelligence resources. Under new scenarios, they should further integrate financial, human, physical, and information resources to serve industrial convergence and cluster innovation activities.

Resource integration comprises two modules: first, sharing and integrating general resources—consolidating regional enterprise demand databases, sci-tech achievement databases, scientific instrument databases, expert talent databases, and service institution databases for integrated allocation; second, customizing and integrating personalized resources for different industrial innovation needs, including building specialized databases for regional advantageous industries and customizing resources according to demand.

(2) **Service Coordination**. The core is integrating different types of sci-tech services to form service chains addressing regional innovation needs. Sci-tech service institutions are often small-scale, single-service, and poor

at coordination, making them ill-adapted to industrial convergence scenarios. Therefore, facing new scenario demands, we need coordination mechanisms that are complete in elements, open and collaborative, agile in response, and fully integrated, matching service chains to industrial chain needs and enhancing coordination among different service types.

For example, considering advantageous industries and their services in the middle Yangtze River urban agglomeration: for hub-and-spoke industries' R&D and transfer needs, services should start with technology transfer and integrate comprehensive service chains including R&D, inspection and testing certification, and sci-tech consulting. For network industries, services should start with entrepreneurship incubation and integrate consulting, transfer, and finance. For multi-core industries' chain cultivation needs, services should start with competitive intelligence and consulting, integrating R&D, inspection and testing, and intellectual property services.

From its inception, intelligence studies' unchanging mission has been serving national security and development through research and practice. In the big data era, intelligence research scenarios are broader, methods more diverse, and practical achievements richer. To lead intelligence studies, we must deeply understand the characteristics of the times in sci-tech-economic transformation and social development. Macroscopically, we must accurately grasp national needs for information resources and modern information service systems [16], build disciplinary, academic, and discourse systems with unique characteristics, and actively participate in major national projects. Microscopically, we must focus on innovation and application of intelligence technologies and methods, building method and tool libraries suitable for open scenarios to effectively support intelligence needs in sci-tech, finance, security, and other fields. This study addresses major national needs for regional innovation development, explores the construction of resource pools, systems, and platforms for three advantageous industrial clusters in the middle Yangtze River urban agglomeration, and extends sci-tech intelligence to sci-tech services.

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Author Contributions

Li Baiyang: Developed research framework and wrote the paper; Li Gang: Proposed basic theories and research ideas, wrote the paper; Wang Shiyun: Participated in framework development and case analysis; Chen Hanmei: Conducted case analysis.

Scenario Extension: From Sci-Tech Intelligence to Sci-Tech Services

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Abstract: [Purpose/significance] Through research on scenario extension of sci-tech intelligence services, this article provides targeted pathways and methods for developing sci-tech intelligence and integrating it into sci-tech services. [Method/process] The methodology proposes a sci-tech intelligence scenario triad and analyzes its extension through case studies, further researching how to launch sci-tech services using the case of integrated sci-tech services for city

clusters in the middle reaches of the Yangtze River. [Result/conclusion] The results show two fundamental approaches for launching sci-tech services under the new scenario: resource integration and service coordination.

Keywords: sci-tech intelligence; sci-tech services; scenario

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