An Integrated Model for Regional Collaborative Innovation Platforms Based on "Internet Plus" (Postprint)

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Abstract

[Objective/Significance] Regional scientific and technological collaborative innovation is a complex systems engineering endeavor that requires the joint participation of various innovation entities. Researching and constructing a cooperation platform based on the participation of these innovation entities holds practical significance for promoting cooperation and interaction based on resource sharing. [Method/Process] Based on research regarding the connotation of collaborative innovation platforms, subject demand positioning, and organizational forms, this study provides a theoretical definition of such platforms, and further analyzes the basic functions that regional collaborative innovation service platforms should achieve and the supporting role of "Internet Plus" related technologies for these platforms. [Results/Conclusions] The system architecture design of the collaborative innovation service platform is completed, and an integrated operational model for the collaborative innovation platform based on "Internet Plus" is constructed. As the information sharing subsystem constitutes the core component of the platform, the specific construction of its four modules requires further in-depth research.

Full Text

Integrated Model of Regional Collaborative Innovation Platform Based on "Internet Plus"

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Abstract

[**Purpose/Significance**] Regional science and technology collaborative innovation is a complex systematic engineering endeavor that requires the participation of multiple innovation entities. Researching and constructing a cooperation

platform based on the participation of various innovation entities holds practical significance for promoting cooperation and interaction founded on resource sharing.

[**Method/Process**] Based on research regarding the connotation of collaborative innovation platforms, subject demand positioning, and organizational forms, this paper provides a theoretical definition of the platform. It then analyzes the basic functions that regional collaborative innovation service platforms should implement and examines how "Internet Plus" related technologies support the platform.

[**Result/Conclusion**] The architecture design of the collaborative innovation service platform system is completed, and an integrated operation model for the collaborative innovation platform based on "Internet Plus" is constructed. However, the specific construction of the four modules comprising the information sharing subsystem—the core component of the platform—requires further in-depth research.

Keywords: Internet Plus; regional collaborative innovation; service platform; integration

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1. Connotation and Definition of "Regional Collaborative Innovation Service Platform"

1.1 Basic Connotation of Collaborative Innovation Service Platform

Addressing the fundamental questions of "what is collaborative innovation," "what is a platform," and "what is a collaborative innovation service platform" is essential for understanding the platform' s connotation. In recent years, experts have elaborated on these concepts from various perspectives, with representative viewpoints as follows: First, regarding collaborative innovation, it is defined as an innovative behavior in which multiple innovation entities or elements cooperate and complement each other to achieve common innovation goals. Alternatively, it can be described as a nonlinear new network platform organizational model that takes industry-university-research collaboration as the main body, relies on government science and technology functional departments, and aims at resource sharing. The "region" in this study refers to a province or municipal administrative area as the research object. Regional science and technology collaborative innovation involves collaboration among multiple entities such as government, industry, universities, and research institutes, characterized by three features: "holistic," "open," and "non-equilibrium,"

and manifests in three innovation models: "government-led," "enterprise-led," and "university-led."

Second, regarding the platform, also called a cooperation platform, it generally refers to the environment or conditions required for certain work. It is an organization that serves as a medium, bridge, aggregator, and leader. Third, the collaborative innovation service platform represents a new type of cooperation platform from the perspective of integrating "government-industry-university-research-application." By integrating collaborative innovation information resources from universities, research institutions, enterprises, government, and certain third-party organizations, it achieves a networked innovation model for major scientific and technological achievements from research and development to transformation and eventual industrialization. It serves as an essential condition in every link of scientific and technological innovation, reduces cooperation costs and transaction risks through resource sharing, and directly serves national and local economic and social development strategies with final innovation outcomes. Therefore, the collaborative innovation service platform is necessarily a high-level innovation service platform based on the interaction and collaboration of government, industry, universities, and research institutes. In terms of the relationship between "collaborative innovation" and "cooperation platform," the platform construction serves as the basic goal, while subject (element) cooperation constitutes the fundamental requirement. Macroscopically, service platform construction is a systematic project requiring collaboration among various innovation entities or elements; microscopically, it requires these subjects (elements) to interact and promote talent, information, capital, technology, and other resources through platform functions to generate synergistic effects and achieve optimal scientific and technological innovation outcomes.

1.2 Subject Demand Positioning of Collaborative Innovation Service Platform From the perspective of cooperative subjects or participating elements of the systematic innovation service platform, universities, research institutes, enterprises, and government are the main participants. Their relationships are established based on mutual needs, and each should have clear demand positioning.

(1) University Demand Positioning. For universities, talent cultivation, scientific research, and social service constitute the main value propositions for their survival and development. Practice at home and abroad has proven that universities have always been major components of the scientific and technological innovation system and reliable "engines" for regional innovation-driven development. However, university talent cultivation and scientific research activities require government policy support; cultivated talents need social recognition and absorption; and universities' cutting-edge technological innovation achievements require enterprise implementation for improvement and value realization. Thus, universities are intrinsically linked with enterprises and government: without government research funding support, university scientific research would

become a sourceless water and rootless tree; without enterprise transformation of research outcomes, university achievements would be shelved and lose their deserved value. Therefore, universities occupy an intermediate zone between government and enterprises in the scientific and technological innovation value chain.

(2) Research Institute Demand Positioning. Research institutes may originate from universities or be independently established social organizations; this study refers to the latter. It is evident that for the innovation value chain, research institutes share the same characteristics as university research institutions, so their functions and demand positioning are basically similar or close to those of universities.

(3) Enterprise Demand Positioning. Facts prove that for an enterprise to sustain competitive advantages in fierce market environments, it must continuously enhance innovation capabilities, develop new products, and industrialize scientific and technological innovation achievements. However, any enterprise' s resources, especially scientific research resources, are always limited, making it difficult to cope with and satisfy unlimited demands for technological innovation. Therefore, enterprises must obtain new knowledge and technology through cooperation with external parties, particularly with universities and research institutes. Undoubtedly, under government guidance, alliances and cooperation with relevant universities and research institutes to jointly develop the latest technologies represent their optimal cooperation choice.

(4) Government Demand Positioning. The government hopes to generate new employment opportunities, promote regional economic growth, enhance economic benefits, and improve national welfare and people' s livelihood through enterprise scientific and technological innovation and industrial upgrading. Therefore, the government has the responsibility and obligation to provide high-quality public services such as policy support, legal environment, and intermediary consulting to promote university-enterprise cooperation, ensuring that cooperation occurs in an environment with sound regulations and orderly, efficient operations.

Thus, these four subject elements—universities, research institutes, enterprises, and government—are interrelated, interdependent, and mutually needed in the innovation platform. All are indispensable and collectively constitute the platform' s architecture, jointly undertaking regional collaborative innovation responsibilities. Their relationship is illustrated in Figure 1 [Figure 1: see original paper].

1.3 Organizational Forms of Collaborative Innovation Service Platform Currently, China' s regional collaborative innovation service platforms present diversified organizational forms, mainly appearing as "activity carriers" and "functional divisions." Regarding activity carriers, they can be divided into virtual platforms and physical platforms. Virtual platforms are supported by

network-related technologies, using centralized or random release forms to publish information resources of various innovation entities, including enterprise technical problem information and technology demand information, scientific and technological achievement information from universities and research institutes, and government policy and regulation information. Simultaneously, information exchange, access, sharing, and negotiation can be conducted online in virtual negotiation rooms, achieving seamless docking among parties. Physical platforms utilize face-to-face forms, mainly realized through carriers such as achievement expositions, trade fairs, and promotion meetings.

Regarding functional division, collaborative innovation service platforms are first considered organizational institutions, such as university-enterprise cooperation innovation platforms. These platforms belong to functional cooperation platforms, generally appearing in organizational forms with common names including industry-university-research cooperation bases, university-enterprise cooperation workstations (studios), and enterprise professor workstations. Second, they also refer to further refinement of the collaborative innovation service platform' s innovation system or organizational structure. Taking university-enterprise cooperation collaborative innovation service platforms as an example, this means constructing several innovation subsystems on this architecture foundation, thereby forming three layers: innovation subjects, market value, and information transmission, along with corresponding innovation environment, innovation service, and innovation investment and financing platforms.

1.4 Main Characteristics of Collaborative Innovation Service Platform The collaborative innovation service platform undoubtedly carries the function of linking university research to enterprise technology demand innovation. Its main function is to provide information exchange and standardized services. Like any platform in any industry, to ensure comprehensive functionality and legal effectiveness of cooperation, collaborative innovation service platforms must possess common characteristics of general platforms such as "replicability, scalability, and achievability." Simultaneously, they should also possess "individual characteristics" including openness, periodicity, and extensibility—features that collaborative innovation service platforms should have and are unique to them. These characteristics can only be fully manifested in today' s "Internet Plus" development era.

Openness means that Internet-based collaborative innovation service platforms can break through spatiotemporal restrictions, completely eliminating geographical and temporal limitations widely existing among participating elements. They not only provide equalized conditions for every participating element and even every individual to initiate various demands but also offer broader possibilities for finding cooperation partners and content. Thus, they constitute all-round, all-region, all-weather cooperation and exchange platforms. Periodicity means that collaborative innovation service platform functions can be regularly activated. Extensibility means that the storage space and exchange space of

collaborative innovation service platforms can continuously expand to meet the requirements of sustainable platform development.

2. Functional Positioning of Regional Collaborative Innovation Service Platform

Innovation development requires established goals, innovation organizations need efficient collaborative teams, and innovation processes highly depend on the environment—especially on innovation platforms. Only through platform support can scientific and technological innovation resources flow rapidly and effectively and continuously increase in value during the collaborative process, achieving optimal and maximum utilization of scientific and technological innovation resources. With the emergence of "Internet Plus," regional collaborative innovation service platforms will effectively promote all-round cooperation among government, industry, universities, and research institutes, becoming the basic guarantee for collaborative innovation. Certainly, to meet scientific and technological development requirements, an ideal collaborative innovation service platform should stimulate cooperation motivation as its foundation, enhance cooperation value as its driving force, deepen cooperation relationships as its path, and improve cooperation efficiency as its goal.

To achieve these objectives, the platform must possess the following main functions:

2.1 Resource Sharing Function for Participating Elements From the current situation of China' s government-industry-university-research cooperation, acquiring resources constitutes the main positioning of each participating subject. Taking university-enterprise cooperation as an example, the primary motivation for university-industry cooperation is often that "enterprises solve innovative technology needs while universities seek sources of research funding," with innovative technology being the core. However, a common phenomenon is that supply and demand information between universities and enterprises is often unknown to each other, creating information barriers, obstacles, or asymmetry that prevents effective sharing of relevant resources among cooperation elements and reduces cooperation effectiveness. Constructing an industry-university-research collaborative innovation service platform based on "Internet Plus" can employ the most advanced information technologies and achievements, enabling all innovation entities joining the platform to interact, communicate, and collaborate through networked methods. This transforms traditional exchange and cooperation models, broadens cooperation fields between scientific and technological innovation achievements and industry and capital, and continuously enhances cooperation efficiency.

2.2 Cost Control Function for Reducing Technology Transaction Costs The construction of collaborative innovation information service platforms means that under an open market environment, competition mechanisms

can be fully introduced to enable one-to-one, one-to-many, and many-to-many two-way selection and cooperation for participating technology and capital elements. The more complete the platform' s operational functions and the more flexible its operational mechanisms, the higher the marketization degree of cooperation methods, the more obvious the diminishing effect of technology transaction costs, and the greater the savings in communication and transaction costs among participating subjects in terms of time, space, and manpower, thereby continuously improving cooperation efficiency.

2.3 Value-Added Function for Technology Transfer When universities and research institutes transfer technology to enterprises, they generally treat technology merely as a product while neglecting its potential application and management attributes, often leading to enterprises' inability to healthily and effectively absorb and transform imported technology, resulting in incompatibility phenomena. Technology transfer based on collaborative innovation service platforms, especially those relying on "Internet Plus" technologies, can endow platforms with more functions since platform construction is technology-oriented. While realizing the economic value of technology, platforms can integrate talent consolidation, technical training, technical consulting, and product upgrading, thereby extending the technology transaction chain and truly achieving a value orientation transformation from pure technology transfer to technology transfer plus management. This enhances added value during the technology transfer process.

2.4 Continuous Deepening Function for Technology Transactions The continuity of technology transactions represents one of the platform' s construction goals. In the government-industry-university-research cooperation chain, universities and industry as main cooperation parties are collaborators. Due to long-term adoption of commitment-based models, their ability to control venture investment risks in technology transactions is relatively poor and requires assistance from third-party organizations to compensate. During platform establishment and operation, third-party organizations can be introduced to provide three-dimensional, all-round services for cooperation parties, such as reasonable pricing issues during technology transactions, feasibility research on venture investment during financing processes, and legal determination during cooperation performance. With third-party support, these issues can be readily solved. This approach fully considers factors such as cooperation credit and risk control; the introduction of social credit overcomes the drawbacks of traditional commitment systems, and defining the entire cooperation process in legal and regulatory forms ensures the rationality and continuity of technology transfer, steering bilateral cooperation toward continuously deepening relationships.

Among these four functions, resource sharing of participating elements is the foundation of platform construction and the necessary means to achieve collaborative innovation goals. Without realizing the resource sharing function, the subsequent three functions cannot be discussed, as they are all extensions and

value additions of the resource sharing function and represent the fundamental purpose of collaborative innovation platform construction. Only by achieving effective control of technology transaction costs can greater space be created for enhancing technology transfer added value; the enhancement of technology transfer added value is the inevitable result of effectively controlling technology transaction costs. The enhancement of technology transfer added value is the prerequisite for continuous and deepening technology transactions; continuous deepening of technology transactions is the fundamental motivation for technology added value transfer. Therefore, these four functions are interrelated, interdependent, and indispensable, collectively constituting the platform' s functional system. Naturally, these four functions can only be comprehensively, efficiently, and systematically realized under the support of "Internet Plus" technologies.

3. Feasibility and Necessity of Applying "Internet Plus" Technology to Collaborative Innovation Platform Construction

The reason why collaborative innovation service platforms can emerge at the current stage is not only due to the strategic needs of China' s innovation system construction but also because "Internet Plus" technologies make the functional realization and mechanism operation of collaborative innovation service platforms possible, with integrated models representing the highest realm of "Internet Plus" application in collaborative innovation service platform construction.

"Internet Plus" refers to the adoption of Internet information technology to combine the Internet with traditional industries. By optimizing production factors, updating business systems, and reconstructing business models, it accomplishes economic transformation and upgrading, representing a new economic form. Currently, "Internet Plus" can be applied not only in economic fields but also in all fields related to economic activities, including scientific and technological collaborative innovation service platform construction, because platform construction also depends on three key elements: "participating subjects, operational system, and operation mode."

Technologies directly related to platform construction include cloud computing and big data. Cloud computing is the product of integrating computer and network technologies such as virtualization, network storage, distributed computing, and parallel computing. It provides a distributed parallel computing mode that expands computing tasks to more computing resources in server clusters and uses redundant resources for fault tolerance, featuring super-strong computing capabilities, low cost, high security, and obvious advantages in network resource sharing. Since cloud computing is a high-speed, large-scale, three-dimensional information processing technology, it can create newer and more favorable conditions for scientific and technological collaborative innovation. Through cloud computing technology, innovation demand information, technology resource information, and service resource information scattered among

various diversified innovation entities can be more effectively integrated, enabling information resources to be shared to the maximum extent, cooperation costs to be minimized, and the effectiveness of collaborative innovation to be maximized.

Big data technology and cloud computing technology are complementary and coexisting technologies. Big data technology refers to the technology of processing massive data on cloud computing infrastructure and rapidly obtaining valuable information for users. Big data processing technology mainly includes five components: data collection, data preprocessing, data storage management, data mining analysis, and data presentation and interaction. In traditional innovation processes before big data technology, although attempts were made to process information through computer networks, the lack of corresponding massive data and data technology support, or the inability of network infrastructure to timely and effectively process enormous datasets, often rendered them powerless in the face of information explosion and massive information storage, acquisition, analysis, mining, and development utilization. Consequently, they could not effectively support innovation platform construction, and the platform' s due functions failed to be truly realized. Thus, concepts in the collaborative innovation process were narrow, and transmission directions were limited; demands for innovation achievements were vague, and transformation directions were blind. After introducing big data technology, these problems can be readily solved. It can not only truly realize the management, analysis, and application of massive distributed big data among various innovation entities and between innovation entities and industrial chains but also broaden the scope of accessible information resources in industrial innovation fields. With the emergence of cloud computing and other technologies and their effective integration with big data, the technology for constructing big data-based collaborative innovation information service platforms is guaranteed. By utilizing massive data distributed in collaborative innovation systems, it provides effective pathways for ensuring and promoting knowledge, technology, and resource interaction, transfer, and diffusion among various innovation entities, thus achieving the construction goals of regional collaborative innovation service platforms.

4. Architecture and Integrated Operation Mode of Collaborative Innovation Service Platform

4.1 Architecture To realize the aforementioned functions, university collaborative innovation service platforms must establish sound operational mechanisms to ensure necessary support and guarantee for scientific and technological achievements at every stage and link of the transfer process. This is the design issue of auxiliary support systems. In the early stage, effective co-construction, co-awareness, and sharing of information must be ensured to achieve seamless docking between information resource providers and receivers. In the middle stage, effective screening of technological achievements must be ensured to realize organic integration of technological achievements with related guarantees.

In the later stage, effective capital investment must be ensured to achieve integration of technological achievements with financing funds. These operational mechanisms are realized through various subsystems, including an information sharing subsystem, credit evaluation subsystem, and capital financing subsystem. Through the construction of these subsystems, we aim to effectively solve major problems currently existing in university-industry cooperation processes, such as information asymmetry, lack of credit systems, and insufficient capital support.

4.1.1 Information Sharing Subsystem Effective information sharing is the primary content of collaborative innovation service platform function realization and the core component of the platform. A complete information sharing subsystem should specifically consist of four modules: "information resource service sharing, scientific and technological literature service sharing, scientific and technological intermediary service sharing, and achievement transformation service sharing." Regarding its operation process, it includes three links: information collection, sharing, and selection. Regarding its functions, it should possess four capabilities: storage, service, sharing, and control. First, it should be an "information storage unit" that uses big data technology and cloud computing means to store relevant big data information. For technology itself, a technology that can be successfully transferred must provide data information on its advancement, creativity, practicality, technical market prospect analysis and prediction, and enterprise (equipment, talent, capital) absorption feasibility. Second, it should be an "information server" where participating and cooperating parties can achieve seamless docking and real-time dialogue, and massive information gathered on the platform can be shared and effectively identified in real time to avoid information silos. Third, it should be an "information sharer" where stored information can only demonstrate its value through full sharing, ensuring cooperation timeliness and specificity and continuously improving cooperation efficiency. Fourth, it should be an "information controller" that supports the aforementioned three functions, requiring the subsystem to not only guarantee efficient information processing but also plan, control, coordinate, and even assist decision-making for cooperation links and effects. In summary, the ultimate purpose of building an information sharing subsystem is to provide guarantees for realizing information sharing mechanisms.

4.1.2 Credit Evaluation Subsystem In the cooperation process among platform participating elements, technology is the core element. Whether a technology can be successfully transferred, form an industry, and generate benefits depends not only on the technology, data, and information provided by the technology provider but more importantly on making cooperation more fair, reasonable, and transparent through rational institutional arrangements. As cooperation deepens, multiple or bilateral parties often focus more on balancing risks undertaken and benefits obtained. Therefore, on the one hand, third-party organizations should be introduced to screen, select, evaluate, and intermediate

traded technologies; evaluate behavior subjects within the cooperation network; assess cooperation behaviors; evaluate partners'performance capabilities, cooperation credit, and innovation efficiency; and mediate and notarize contradictions and conflicts during cooperation processes to achieve maximum trust among parties. On the other hand, platforms should provide relevant original data of traded technologies to enable targeted government supervision, allowing government regulation of transaction processes to be based on evidence according to policies and regulations. The dual role of market and government can realize effective technology screening. In summary, the purpose of building a credit evaluation subsystem is to provide guarantees for realizing credit evaluation mechanisms.

4.1.3 Capital Financing Subsystem The transfer and implementation process of new technologies requires corresponding capital support. The occurrence, development, and success of innovative technology achievement transactions need a complete investment and financing platform as support, and collaborative innovation service platforms play an irreplaceable role. Successful experiences at home and abroad indicate that effective guarantee of innovation capital generally comes from three sources: first, government financial investment, obtaining government financial support at the policy level; second, enterprise investment, which is the intrinsic requirement of enterprise development; and third, market venture investment, which is the result of market-oriented operation of scientific and technological innovation. In China' s technological innovation system construction, government financial support is limited and mainly plays a guiding role, while enterprises hold an irreplaceable principal position because they are not only implementers of innovation achievements but also main investors in innovation, having intrinsic and urgent demands for scientific and technological innovation. In universities, financial support from the government is often called vertical funding, while capital investment from enterprises is called horizontal funding. The obvious role of venture investment mainly lies in rationalizing the sharing of technical risks and market risks in the process of transferring scientific and technological innovation achievements. Platform establishment should be able to open various converging channels for financing capital to a certain extent, solve potential capital shortage bottlenecks, maximize capital functions in technological innovation and transfer processes, and achieve integrated development of technology and economy. In summary, the purpose of building a capital financing subsystem is to provide guarantees for realizing credit capital financing mechanisms.

In actual operation, the platform adopts a B/S structure, with front-end and back-end designs using different technical approaches for access. Front-end access generally employs HTML5 responsive technology, allowing every user to access the platform anytime and anywhere via mobile phones and PCs to achieve comprehensive, in-depth, and three-dimensional information sharing. The back-end adopts MVC architecture design to implement the system' s main functions.

4.2 Operation Mode

4.2.1 Architecture Design Required by the Platform The integrated model of "Internet Plus" collaborative innovation service platform refers to an operation mode that relies on modern information technologies such as big data and cloud computing to integrate and consolidate talents, information, technologies, laws and regulations, and management systems of all innovation entities. It achieves connectivity, integration, and interoperability of all elements to provide online customers with innovative resource services. These information resources come from universities, research institutes, enterprises, government departments, and third-party organizations such as finance and intermediary organizations. There are two main ways for innovation entities to access the platform: the first is direct access, where each innovation entity uploads its innovation resources to the shared cloud platform provided by the integrated platform by directly leasing it, and uses the platform' s tools to effectively manage its resources and share all resources on the platform with each other. The second is indirect access, in other words, using private cloud access methods. This method proceeds in two steps: first, each innovation entity relies on its established private cloud platform to conduct standardized description and encapsulation of its resources and upload them to the private cloud platform; second, the private cloud platform accesses the public cloud through standard interfaces. On this basis, every independent user of the platform can access required resources through browsers/clients, and every online user can obtain point-to-point services.

Based on the above research, the architecture of the cloud computing-based collaborative innovation service platform is formed, as shown in Figure 2 [Figure 2: see original paper].

4.2.2 Key Technologies Relied Upon by the Platform The platform adopts Hadoop cloud computing platform architecture technology and platform intelligent recommendation functions. Hadoop cloud computing platform architecture technology is based on high-speed computing and storage to develop distributed programs, realized through four steps: first, using the HDFS file system for comprehensive information collection and preservation of big data; second, using MapReduce as a programming framework for efficient information identification and processing; third, using Hadoop HDFS to provide reliable information storage support for the open-source database HBase platform; and fourth, using Hadoop MapReduce to provide high-performance computing capabilities for HBase. The built Hadoop platform runs in the public cloud, providing valuable information through the above series of steps for user retrieval, query, and in-depth mining and data analysis. Its workflow is shown in Figure 3 [Figure 3: see original paper].

The so-called Hadoop cloud computing platform intelligent recommendation function refers to using Hadoop cloud computing platform architecture tech-

nology to achieve personalized and precise service requirements for users. The basic process is: based on user-related information provided by the open-source database HBase, including basic user information, access information, demand information, and usage behavior, collaborative filtering intelligent recommendation algorithms are adopted to analyze and mine platform access users' interest preference information. This enables prediction of target users, concentration and differentiation of similar and different information users, and targeted information push. The recommendation process is shown in Figure 4 [Figure 4: see original paper].

Conclusion

The shared service platform constructed for regional collaborative innovation relying on "Internet Plus" technology is currently a highly vital topic in development and application fields. Regional collaborative innovation information platforms can achieve continuous knowledge and technology innovation and drive regional scientific and technological industrialization to spiral upward by assembling, integrating, and developing various resources of scientific and technological innovation elements to serve regional collaborative innovation. Whether in future close cooperation among government, industry, universities, and research institutes, in the implementation process of regional scientific and technological innovation strategies, or in the transformation process of regional industrial upgrading, scientific and technological collaborative innovation service platforms will certainly be able to provide convenient, intelligent, and personalized services through the active participation of innovation subjects, government promotion, supervision, and guidance, and coordination and assistance from financial institutions and intermediary service organizations. As the core component of the platform, the specific construction of the four modules of the information sharing subsystem requires further in-depth research.

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