Overall Development Strategy Research on "Internet Plus" Action Plan

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Abstract: In the new technological revolution and industrial transformation occurring worldwide, the integrated development and use of the Internet in technology and industrial fields as well as in various economic fields have broad developmental prospects and unlimited potential. Internet use has become the inevitable trend of the era and is generating a strategic and overall impact on the national economy and social development. This study examines the current development situation and analyzes the problems related to the development and use of the "Internet Plus" in technology and industry as well as its application and cross-border integration. This study introduces the concept of "Internet Plus," and its system architecture and technical system, and provides recommendations for an action plan to implement the "Internet Plus" in China for achieving goals, completing key tasks, providing strategic support, guarantees, and so on.

Keywords: Internet Plus; integrated development; development strategy

1 Introduction

The new round of technological revolution and industrial change around the world reveals broad prospects and unlimited potential for integration between rapid development of the Internet, industries, and applications and the demand for change and advancement in all areas of society and the economy. This has become an irresistible trend with a strategic and overall impact on the economy and social development in various countries. The integration of seven types of new technologies, that is, the new Internet, information and communication, artificial intelligence, energy, materials, biological [1], and application technologies, is triggering all-round development and reforms. In particular, the in-depth integration of new Internet technologies [Internet of Things (IoT), Internet of Vehicles, mobile Internet, satellite network, space-ground integrated network, future Internet, etc.], new information and communication technologies (cloud computing, big data, 5G, high-performance computing, modeling/simulation, quantum computing, etc.), new artificial intelligence technologies (The Academician Pan Yunhe's report at the World Intelligence Congress titled China's Next-generation Artificial Intelligence proposed five major technologies; that is, big data intelligence, swarm intelligence, man-machine hybrid intelligence, cross-media reasoning, and autonomous intelligence.), and application technologies in various fields is triggering the development and reform of new models, new means, and new forms in the national economy, people's livelihoods, and national security. Thus, the era of the "new Internet + big data + artificial intelligence +" has arrived [2].

Manufacturing industries in the developed countries, especially the United States, Germany, the United Kingdom (UK), and Japan, have adopted innovative strategies and formulated national plans to consolidate their leading advantages in technologies and industries. These strategies and plans also focus on

actively using the future industrial development and fully support the integrated development of the Internet and smart manufacturing from the perspectives of policy guidance, innovation system building, key technology research, major project implementation, and so on. The United States introduced strategic measures such as the *Industrial Internet*, *Advanced Manufacturing Partner*, *National Network for Manufacturing Innovation*, and *National Strategic Plan for Advanced Manufacturing*. Germany presented the *Industry 4.0 Plan* and proposed the *Securing the Future of German Manufacturing Industry: Recommendations for Implementing the Strategic Initiative Industry 4.0* and the *High-Tech Strategy 2020*. The UK implemented the *UK Industry 2050* and proposed *The Future of Manufacturing: A New Era of Opportunity and Challenge for the UK*. France presented the Industry of the Future Initiative and the New Industrial France Initiative. Japan released the *New Robot Strategy* and established the Industrial Value Chain Initiative alliance. The EU formulated the *Europe 2020 Strategy*.

China successively issued the *Guiding Opinions of the State Council on Actively Promoting the "Internet Plus" Action Plan*, the *Made in China 2025*, the *Guiding Opinions of the State Council on Deepening the Integrated Development of Manufacturing and the Internet*, the *Guiding Opinions of the State Council on Deepening "Internet Plus Advanced Manufacturing" and Developing Industrial Internet*, and other national strategic plans and measures. The *Guiding Opinions of the State Council on Actively Promoting the "Internet Plus" Action Plan* stresses on accelerating the in-depth integration and innovative development of the Internet and various fields, expediting enhancement of the industrial development level, improving the innovation capabilities of various industries, and building new advantages and drivers of economic and social development. The *Made in China 2025* clearly focuses on the need to integrate new-generation information technologies with manufacturing to promote smart manufacturing and make manufacturing larger and stronger. The *Guiding Opinions of the State Council on Deepening "Internet Plus" Advanced Manufacturing and Developing Industrial Internet* clarifies the promotion of a modern economic system by promoting in-depth integration of the Internet and the real economy and building the three major functional systems, the network, platform, and security. The integrated development of the Internet and various fields has become the basis for the development of China's sharing economy.

2 Current situation and issues related the development of "Internet Plus"

While actively introducing strategies for the integrated development of the "Internet Plus" and various fields, countries around the world focus on core technology research and development to make use of technology and gradually promote the development of various industries for the coordinated development and promotion of technologies, industries, and applications.

(1) In terms of network infrastructure, the United States' *National Innovation Strategy* proposed Internet use as the foundation for national innovation planning. While the UK implemented the "Broadband Delivery UK (BDUK) Project," the EU's *Europe 2020 strategy* clearly mentioned the need for innovation in various fields using information and communication technologies. (2) As regards manufacturing, the United States proposed the *Industrial Internet* and the *National Strategic Plan for Advanced Manufacturing*. While Germany proposed their *Industry 4.0 Plan,* the UK proposed their *Smart Manufacturing Plan* and the *High Value Manufacturing Plan.* (3) In the agricultural field, large farms in the United States have become leaders in applying agricultural IoT technology. Japan has been vigorously developing precision agriculture on medium-scale farms, with focus on the development of farmland crop mapping systems and other intelligent agricultural systems. Australia developed eco-agriculture based on high-speed broadband network construction. (4) In the energy field, while the United States mainly focuses on the design of energy networks, Germany focuses on researching information and communication networks. (5) As regards the medical field, the United States released the *Latest Strategy for American Innovation*, with focus on "Precision Medicine Initiative" and "BRAIN Initiative" in the fields of medical and health. It their recently released *Federal Health IT Strategic Plan 2015–2020,* Japan released the *New Robot Strategy* in 2015 relating to medical care and other key areas. (6) In the field of transportation, while the United States launched their IntelliDrive program and developed collaborative intelligent transportation systems, European countries launched their DRIVE C2X project for 2020 and conducted research on collaborative intelligent transportation technologies. (7) As regards environmental protection, some developed European countries and the United States have established perfect ecological environmental monitoring network systems.

Chinese industries face enormous challenges in this crucial period of transition from the low end to the high end of the value chain, and from "Made in China" to "Created in China." Under the need for various strategic measures, several fields in China have shown progress in promoting the "Internet Plus" integration process. (1) As regards network infrastructure, continuous breakthroughs have been achieved in areas of high-performance computing, network communications equipment, intelligent terminals, and software. Also, a number of leading companies have emerged in the fields of mobile Internet, big data, and cloud computing. (2) China took the lead in this field of manufacturing by proposing new concepts such as cloud manufacturing. Important breakthroughs have been made in key technology and equipment for smart manufacturing as well as in intelligent products, intelligent interconnected products, and enabling tools. (3) Foundations have been laid in agriculture through R&D for

agricultural sensors, remote sensing technology, and agricultural robots. (4) In the energy field, an array of guiding documents on revolution in energy production and consumption such as the *Guiding Opinions on Power Demand Side Management in the Industrial Sector* and *Opinions of the CPC Central Committee and the State Council on Further Deepening the Reform of the Electric Power System* have been issued. (5) In the medical field, the smart healthcare and telemedicine model is currently under vigorous development. (6) In the field of transportation, research on intelligent network-linked vehicle–road collaboration started late, and core technologies such as the common smart vehicles technology and identification of vehicle driving status are only basically grasped. (7) As regards environmental protection, a transition is seen from "digital environmental protection" to "smart environmental protection," with gradual deepening of the application of smart environmental protection.

The gradual integration of "Internet Plus" with various fields has promoted changes in the application models, means, and forms of various fields, and has enabled positive progress in Internet technology, industry, applications, and cross-industry integration, laying a strong foundation for accelerating the promotion and development of "Internet Plus"

At present, China's central ministries and commissions as well as local provinces and municipalities have released "Internet Plus" action plans, and this has led to a boom in innovation and entrepreneurship in the Chinese society as a whole. However, the depth of the "Plus" is increasing with the number of "Internet Plus" targets. The Internet is no longer an information network in the traditional sense, or tool in the general sense, but a fusion of human social space, virtual cyberspace, and physical space. During its development stage, "Internet Plus" encountered issues of restructuring, transformation, and upgrading of technologies, industries, and application, as well as new demands of social interaction. Even now, the integration of "Internet Plus" with various industries or fields faces several problems.

As regards technology research, China reveals a lack of in-depth research on the meaning of "Internet Plus." Internet Plus has a fragmented architecture and technology system, with no perfect top-level standardized technology design, cooperation mechanisms, or core technological standards and guidelines for cross-industry integration. In addition, research is lacking on general, asymmetric, and disruptive technologies. The "Internet Plus" core technology has no "core" in China. The study of technologies integrating the Internet with other fields is in its infancy. All these factors are technological barriers to the development of the Internet. At the industrial development level, there is a lack of tools and system platform companies developing independent intellectual property rights, hardware and software companies developing and implementing technologies and systems, and operation centers and professional service companies providing Internet technology services. At the application integration level, the Internet's integration with consumption shows remarkable results, but its cross-industry integration with other application areas is still in its infancy, lacking in application demonstration projects requiring integration with related fields. At the system innovation level, the innovation system for the development of "Internet Plus" is still blank, and building "Internet Plus"-related innovation centers is still in its infancy. At the policy level, the development of new forms is weak, facing obstacles in policies, mechanisms, laws, and regulations. Policies, laws, regulations, multi-party coordinated supervision systems, and governance systems for the development of "Internet Plus" integrated forms need to be urgently established. There is also a serious shortage of talent in cross-industry integration.

To better implement the "Internet Plus" action plan and accelerate the development of various related fields, this study offers preliminary recommendations on the Internet Plus' meaning, system architecture, and technology system, as well as its goals, priorities, and strategic support for implementing the "Internet Plus" action plan in China.

3 The connotation, system architecture, and technical system of "Internet Plus"

3.1 The connotation of "Internet Plus"

"Internet Plus" is a newly developed form of the Internet. It enhances the vitality of the real economy and promotes the continuous evolution of economic patterns. "Internet Plus" includes all the "Internet Plus" industries. It is not a simple enhancement. "Internet Plus" engenders a service cloud of user-centric smart resources and capabilities in a ubiquitous network with the help of digital, networking, and intelligent technological methods; that is, in-depth integration of new Internet, information and communication, artificial intelligence, energy, material, and new biological and application technologies. "Internet Plus" enables the use of smart resources and capabilities on demand, anywhere and at any time, via smart terminals and smart cloud platforms. Users can autonomously and intelligently perceive, interconnect, collaborate, learn, analyze, recognize, decide, control, and execute [3,4] human-, machine-, material-, environment-, and information-related issues in the "Internet Plus" system-wide lifecycle activities (industry chain). This enables the integration and optimization of human, technology/equipment, management, data, material, and fund (six elements) lifecycle activities as well as the talent, technology, management, data, material, and capital flows involved in such activities to form a new interconnected, service-oriented, collaborative, personalized (customized), flexible, socialized, intelligent model based on a ubiquitous network that puts users first, as well as a new form that features "ubiquitous interconnection, data-driven, shared services, cross-industry integration, autonomous intelligence, and innovation." This is done to continuously enhance the market competitiveness of companies (or groups), optimize processes, improve product quality, increase

production efficiency, stimulate the vitality of productive activities and services, and foster new areas of economic growth.

3.2 The "Internet Plus" system architecture

The "Internet Plus" system architecture is shown in Fig. 1. It mainly consists of the following five levels.

(1) The resources/capabilities/products layer: This layer, in each application field, includes the various soft and/or hard resources, professional capabilities, and products connected to the entire system.

(2) Perception/access/communication layer: This layer connects the various types of physical hardware and software resources/capabilities to the network through perception, IoT, and terminal technologies, to thereby achieve a comprehensive perception and interconnection of resources/capabilities/products, and support virtualized packaging and service invocation of system resources, capabilities, and products. Moreover, for immediate processing, perceived data can be processed locally; this is known as edge computing and processing.

(3) Service platform layer: This layer is mainly oriented toward three types of user portals (intelligent service provider, system platform operator, and intelligent service user portals), and provides basic middleware, including virtual resource/capability

management, knowledge/model/algorithm management, intelligent service system building management, intelligent service system operation and service evaluation, big data processing engines, artificial intelligence engines, and embedded simulation engines. It also provides various application support services in the fields of smart manufacturing, modern agriculture, smart energy, beneficial services, intelligent transportation, and smart environmental protection.

(4) Intelligent application layer: This layer mainly provides interconnected (collaborative), service-oriented, personalized (customized), flexible, socialized, and intelligent models for application in the fields of smart manufacturing, modern agriculture, smart energy, beneficial services, intelligent transportation, and smart environmental protection.

(5) People/organization layers: These layers involve people and organizations in the new artificial intelligence system and full lifecycle activities.

Each layer has its own standards and safety management systems.

3.3 The overall "Internet Plus" technical system framework

As shown in Fig. 2, the "Internet Plus" technology system framework mainly includes the overall technology system as
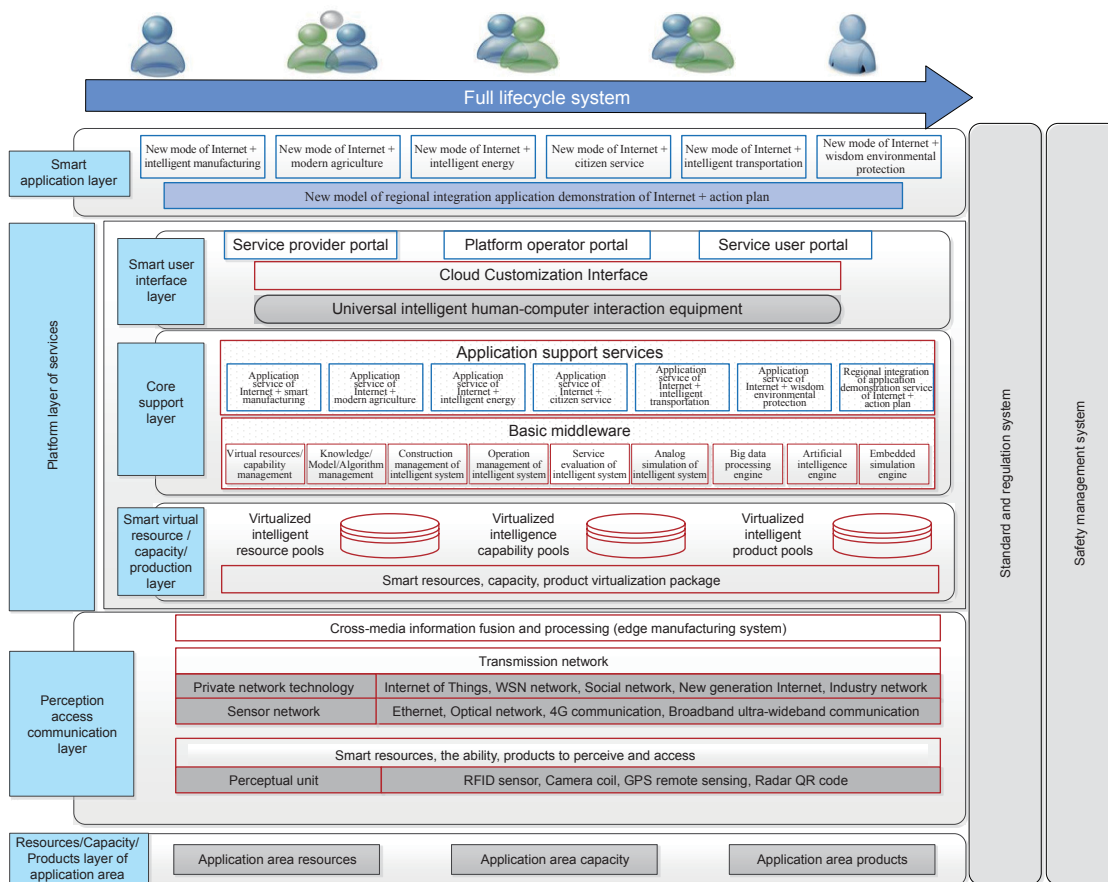

Fig. 1. Systematic frame of the "Internet Plus" system.

well as the technology systems covering the perception/access layer, platform, software technology system, standard technology system, security technology system, support technology system, and integration application technology system. The overall technology system covers business models, system architecture technologies, system integration technologies, and system development and application implementation technologies. The perception/access layer technology system covers various sensor technologies, as well as technologies of the traditional Internet, IoT, Internet of Vehicles, mobile Internet, satellite networks, space-ground integrated networks, and future Internet. The platform technology system includes the basic generic platform technology and application platform technology. The basic common platform technology focuses on smart resource/capability perception, IoT, virtualization/service-oriented technology, virtualized service environment building/management/operation/ assessment, smart virtualization cloud trusted service, analysis and mining, artificial intelligence engines, embedded simulation technologies, and universal man–machine interaction technologies and knowledge/model/big data management. Application platform technology focuses on "Internet Plus" intelligent manufacturing, modern agriculture, smart energy, public services, intelligent transportation, and smart environmental protection system technologies. The software technology system covers system, platform, and application software technologies. The standard technology system covers the overall, security, common support, service integration, and industry application standards, and guidelines and assessments. The security technology system covers the physical, technical, management, and commercial security protection technologies. The support technology system covers common technologies such as information and communication, emerging, and application technologies, as well as intel-
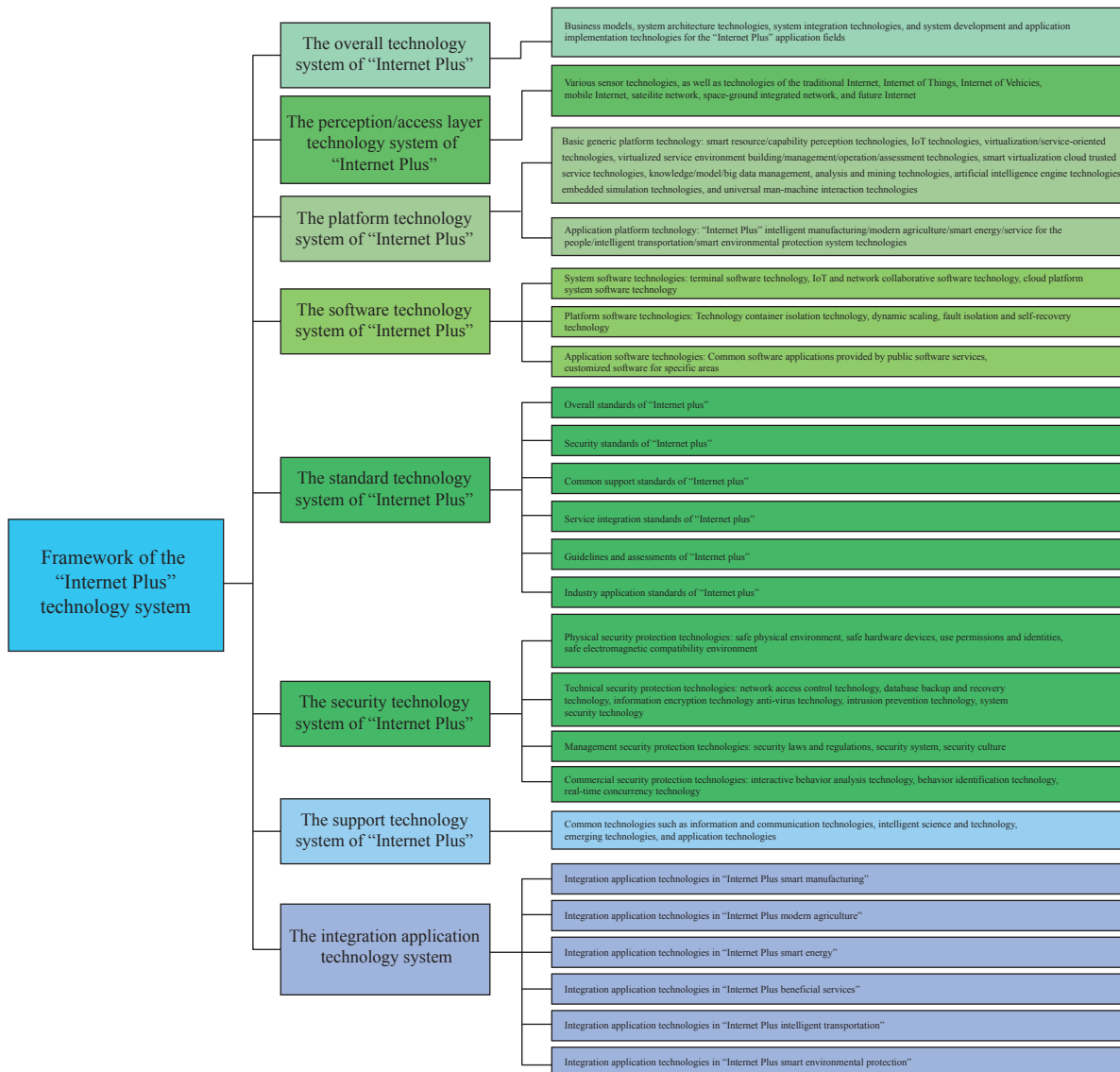

Fig. 2. Overall framework of the "Internet Plus" technology system.

ligent science and technology. The integration application technology system covers the technologies in fields such as "Internet Plus" smart manufacturing, "Internet Plus" modern agriculture, "Internet Plus" smart energy, "Internet Plus" beneficial services, "Internet Plus" intelligent transportation, and "Internet Plus" smart environmental protection.

4 Suggestions on "Internet Plus" goals and key tasks

4.1 "Internet Plus" goals

By 2020, the preliminary system architecture, technology, standards, evaluation, and management systems of "Internet Plus" will be formed, and breakthroughs will be made in common base, asymmetric, and disruptive technologies. The cross-industry integration technology, and the service integration, guidelines, evaluation, and other key standards of the various "Internet Plus" fields, will be studied. The integrated development environment, universal integration platform, standard coordination mechanism, and standardization platform will initially be built to serve "Internet Plus," and intelligent interconnection products and autonomous and controllable enabling tools will be developed. A support system development group and implementation enterprises as well as service implementation and operation centers providing technologies and services will be fostered, and a number of pilot application demonstration projects will be established. Infrastructure support will be further enhanced to accelerate the development of fixed broadband networks, next-generation mobile communication networks, and next-generation Internet, and improve the infrastructure such as IoT and cloud computing. Systems and mechanisms, standards and regulations, credit systems, and talent protection measures will be established for the integrated development of the Internet. The enterprises in all fields will be Internet-enabled and "data-driven" to foster the formation of ecosystems in different industries and cross-industries.

By 2025, the Internet Plus' complete technology, standards, evaluation, and management systems will be formed, and breakthroughs will be achieved and mastered in key technologies. The Internet Plus' integrated development environment, universal integration platform, standard coordination mechanism, and standardization platform will be improved and optimized, and domestic intelligent interconnection products, chips, devices, operating systems, and basic and industrial software with brand and market awareness will be developed. A group of leading enterprises engaged in system integration, implementation, and operation will be established. Typical application demonstration projects in various fields will be promoted to the industrial level to form industrial chains and industrial clusters, and to build the "Internet Plus" ecosystem. Breakthroughs must be achieved in

key support and integration technologies, such as a ubiquitous network, precision control, and blockchain, as well as further infrastructure consolidation. Guarantee measures, standards, regulations, and laws for the integrated development of the Internet will gradually be improved. Public data resources will be gradually made available to the public, and the developmental environment will be made more open and inclusive.

By 2030, a complete innovation system covering the "Internet Plus" technology, standards, evaluations, and management systems will be formed, and internationally competitive intelligent interconnection products and autonomous and controllable tools will be developed. The "Internet Plus" industry ecosystem for global collaborative development will be created and guided to accelerate the transfer of industries to the high end in the value chain, to effectively support in-depth integration and development of the Internet with various industries, and promote new forms of ubiquitous interconnection, data-driven shared services, cross-industry integration, autonomous intelligence, and innovation in various areas.

4.2 Key goals

4.2.1 Science and technology projects

In terms of research on the overall development of "Internet Plus," special research projects will be initiated for technology systems and common platforms to study the "Internet Plus" system architecture, technology, standards, management, evaluation systems, and core technologies. In terms of platforms, a general integrated cloud platform will be built to serve multiple fields. An integrated service cloud platform, a "cloud plus end" big data integration processing platform, and a standardized service platform with independent intellectual property rights will also be constructed. In terms of foundation supporting technology and environment, an "Internet Plus" cross-industry integration technology innovation project will be carried out and a national future network testing environment will be built. In smart manufacturing, special research projects for "Internet Plus" aerospace manufacturing, urban smart travel products, and "Internet Plus" automotive service platforms, and typical industrial process R&D and intelligent optimization manufacturing experimental platform systems for "Internet Plus" process engineering will be carried out. In the field of modern agriculture, special research projects for the key agricultural sensors and instrumentation technologies, agricultural BeiDou navigation technologies, emergency treatment of agricultural disasters technologies, monitoring and tracing technologies for the quality and safety of "Internet Plus" agricultural products, and precision agriculture big data platform technologies will also be carried out. In the field of smart energy, special research projects will be conducted on the basic theories of physical information integration, key smart energy system technologies, and intelligent power dispatch systems

based on knowledge automation. In the field of beneficial services, a national open cloud platform will be built for basic demographic information on the Internet, and technical standard service systems and intelligent applications will be established. In the field of intelligent transportation, special research projects will be conducted for integrated traffic perception systems, integrated traffic information sharing and system interconnection, automotive IoT, and smart vehicles. In the field of smart environmental protection, research will be carried out on technology for building a space-ground integrated three-dimensional system for monitoring the ecological environment, an ecological environment big data platform focusing on business operation services, big data platforms for ecological red-line remote sensing and monitoring, intelligent environmental monitoring systems, an intelligent monitoring and control platform for urban air quality, and a big data platform for water environmental monitoring.

4.2.2 Application demonstration projects

In terms of the research on the general development of "Internet Plus," application demonstration projects for integrated cloud service platforms in full industry chains and full lifecycles will be established for the cross-industry integration of "Internet Plus" multiple fields. For a unified software system, an environment conducive to software innovation and entrepreneurship will be built, cross-cutting software boundaries will be opened up, and heterogeneous multi-source systems will be integrated. Integrated service cloud platforms with independent intellectual property rights for the integration of "Internet Plus" with multiple fields will be built, and application platforms in various fields will be vertically integrated to form cloud platforms across regions, industries, and enterprises, and horizontally integrated to form cloud platforms covering product full lifecycle activities. This will also promote the integration and application of core technologies, such as regional, industry, and enterprise clouds; big data; artificial intelligence; and cross-industry integration technologies in key fields. In the fields of foundation-supporting technology and "Internet Plus" infrastructure application, open source software demonstration projects will be carried out. Industrial interconnection smart manufacturing demonstration projects will be carried out in the relevant fields. In the field of modern agriculture, demonstration projects will be conducted for the application of intelligent agriculture, intelligent logistics for agricultural products, and IoT agricultural machinery. Demonstration projects will be conducted on the integration of renewable energy and charging facilities, integration of smart energy and green intelligent transportation, and Internet platforms for energy services in the smart energy sector. In the field of beneficial services, demonstration projects will be carried out for smart health care, trusted Internet health information, chronic disease holographic management, and elderly care integration services. Demonstration projects will be launched for urban transporta-

tion sharing travel application services in the field of intelligent transportation. Demonstration projects will also be implemented in the field of smart environmental protection on space-ground integrated eco-environment monitoring applications, integrated monitoring platforms for pollution sources, and ecological big data platforms.

5 Suggestions on strategic support and guarantee for the development of "Internet Plus"

(1) Strengthen the coordination of policies, laws, and supervision

The top-level building and planning guidance in all fields needs to be strengthened, and medium-level coordination should be advanced. The first suggestion is to strengthen policy coordination, with focus on realizing multi-faceted policy synergies, coordinating the various policy measures and engineering applications, and increasing policy support for integrated innovation and application promotion. Second, the legal co-ordination needs to be strengthened, with focus on improving laws, regulations, systems, and rules to promote the development of "Internet Plus." Also, the legislation on development, supervision, and security needs to be coordinated so as to build a modern legal system that supports the integrated development of the Internet and traditional industries. Third, strengthen supervision coordination, with focus on establishing regulatory authorities and related systems for cross-industry integration; coordinating the supervision of "Internet Plus" resources, entities, and behaviors; strengthening quality supervision of corporate credit information and personal health; and providing basic guarantees for the application of "Internet Plus" in all fields. Finally, improve the information management and evaluation mechanisms for policies, laws, and supervision, making full use of the "Internet Plus" to improve policy implementation and assessment levels, and thereby ensuring effective and relevant strategies and policies. The coordination of policies, laws, and supervision needs to be strengthened. The Internet Plus' top-level building and planning guidance should be strengthened in all fields, and its medium-term coordination should be advanced.

(2) Establish a long-term mechanism for the cooperation of governments, industries, universities, and research institutes, and applications

The first suggestion is to integrate the resources of national ministries, enterprises, research institutes, universities, and industry organizations. Accelerate the building of national and regional innovation centers in key "Internet Plus" areas, and promote innovative breakthroughs and market-oriented applications of common and core technologies related to key fields, and thus enhance independent innovations and security control capabilities in industries. Second, organize the establishment of "Internet Plus" industry alliances in key fields, speed up the exploration of

a market-based collaboration mechanism featuring risk and revenue sharing, and focus on upgrading the level of technological innovation and industrialized application. Finally, strengthen the building and open use of basic databases in key fields by relying on the "Internet Plus" industry alliances, advance the research and application of "Internet Plus" standard systems, and promote the optimization of industrial chains and industrial ecosystems in various fields.

(3) Foster industrial ecology for the sound development of "Internet Plus"

The first suggestion is to expedite the disclosure of government data, support industry associations or third-party organizations in establishing industrial big data platforms and cloud platforms, and strengthen the collection and analysis of industry technology routes, development patterns, institutional policies, and other relevant information. Also, establish a sound environment for product traceability and credit rating to guide the sustainable and healthy development of industries. Second, integrate the forces of research institutes, build national Internet innovation centers, strengthen the research on technological innovation trends and key technology reserves, and provide a strong core technological support for "Internet Plus." Third, guide the provinces and municipalities to study and formulate policies for advancing the application of "Internet Plus" in key fields in the light of local conditions, to thereby form a differentiated regional strategic layout. Fourth, support leading enterprises in key industries to actively build various platforms for innovation and entrepreneurship, create innovative industry-finance integration models such as industrial chain finance, and give full play to the role "Internet Plus" in stimulating small- and medium-sized enterprises to accelerate collaborative development. Finally, vigorously support the fast development of small- and medium-sized innovative enterprises with distinctive characteristics, form a vertical "Internet Plus" industry chain in many small fields, and provide smooth exit channels for venture capital investment through such measures as reasonable acquisitions and public listings by large companies.

(4) Focus on cultivation of talent in integrated innovation

The first suggestion is to encourage universities and colleges to strengthen the building up of new disciplines in the "Internet Plus" integration field, and carry out forward-looking deployment in emerging inter-disciplines. Second, establish an inter-disciplinary three-dimensional talent-training system and build "Internet Plus" talent supply-demand matching platforms and professional talent databases. Third, study and introduce preferential introduction policies for outstanding entrepreneurs as well as high-caliber technology and management teams. Finally, guide the establishment of systems and mechanisms conducive to innovation, support the establishment of innovative jobs, encourage amateur innovation, and accelerate the implementation of income distribution policies such as equity, option incentives, and rewards for the transformation of research achievements by scientific research personnel.

Acknowledgements

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