

Construction of Internet Plus Standards System

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Abstract: The rapid development of information technology has brought new opportunities for the Internet Plus initiative. Meanwhile, the current Internet Plus standards are insufficient to meet the requirements of Internet Plus technologies, industries, and applications; therefore, an Internet Plus standards system needs to be constructed, and this study conducts a theoretical research for this purpose. It analyzes the current status of the general standards for key technologies, integration standards, and sub-sector standards systems related to Internet Plus, and summarizes the problems facing future development. A preliminary plan for the Internet Plus standards system is proposed, covering six aspects: general, security, common support, service integration, guidelines and evaluation, and application standards. To meet the standardization needs of sub-sectors such as collaborative manufacturing, modern agriculture, smart energy, people-benefiting services, intelligent transportation, and green ecology, specific recommendations are proposed for the formulation of the Internet Plus standards as well as the application and promotion mechanisms of Internet Plus. Furthermore, it is suggested that effective pilot demonstration, scientific talent training, and a sound long-term mechanism can effectively guarantee the practice of Internet Plus standardization.

Keywords: Internet Plus; standards system; standardization; industry application

1 Introduction

The integrated development of the Internet and various economic and social fields has an extensive application prospect and has become an irresistible trend in recent times [1,2]. During the 2020 Spring Festival, China's mobile Internet traffic reached up to 2.716×10^6 TB, with a year-on-year increase of 36.4%. Telemedicine, e-commerce, mobile payment, and other Internet services have played an important role in the prevention and control of the COVID-19 pandemic and the resumption of work and production [3], and new Internet Plus terms, such as Cloud Office, health code, and online education, have been widely accepted by the public. According to the *Report on the Work of the Government* in 2020, e-commerce, online shopping, online services, and other new business forms have played an important role in fighting the pandemic, and new supportive policies should be introduced to comprehensively promote the Internet Plus concept and create new advantages for the digital economy.

Standards are an integral part of Internet Plus [4], and they play an important role in promoting technical progress and industry development and in ensuring application innovation. The following policy documents have been made for the deployment of Internet Plus standards: the *Construction and Development Planning for National Standardization System (2016–2020)* proposed accelerating the popularization, application, and in-depth integration of standardization in all economic and social fields and gave full play to the effect of Standardization Plus [5]; the *Guidelines for Informatization Standard Work in the 13th Five-Year Plan* proposed information

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economy, e-government, and information benefits among others as important areas of informatization standards during the period of the 13th Five-Year Plan [6]. To support the development of relevant technologies, industries, and applications, the Internet Plus standards system should meet the following requirements: (1) Be goal-oriented, i.e., highlight the goal of providing support for industrial policies and decisions, lay a solid foundation for technical innovation, and provide application guarantee; (2) be systematic, i.e., specify the relationship between and position of all parts in the system and take comprehensive and overall consideration to reflect integrity; and (3) be open and expandable, i.e., make room for emerging technology standards and dynamically adjust relevant structures and contents in accordance with the development and change in the industry.

Compared with smart city and big data, the Internet Plus standards system is more complex. When conducting relevant research, the technology system of Internet Plus, information technology (IT), and the standardization of all industries should be sorted out. At present, in China and abroad, general key technologies have been standardized and industries have widely converged, and some emerging industries are also commencing the preparatory work for standardization. However, the Internet Plus standards system has not yet been established, the standardization of all industries is relatively independent, and the existing achievements cannot directly guide the development of the Internet Plus technology, industry, and application. To meet the realistic demand for building the Internet Plus standards system, this paper addresses the status quo of development, summarizes the existing problems, and suggests construction ideas and promotion mechanisms for the Internet Plus standards system in China to standardize and promote the development of Internet Plus.

2 The role of Internet Plus standardization

Standardization is not only an important measure that leads to the innovative development of Internet Plus but is also an effective way to establish the international right of speech, promote the high-quality development of industries, and improve people's livelihood.

More than 280 international standards have been issued in the IT field in the recent five years, and these standards have played an important role in promoting the development of operating system, database, office software, and other basic technologies, leading to the development of emerging technologies such as cloud computing, big data, and artificial intelligence. For example, the ISO/IEC 23360 *Linux Standard Base (LSB)* series of international standards effectively drives the development of the operating system.

Standards solidify the experience and knowledge of all industries, and standardize technical specifications, data formats, and operation methods of industries, which is conducive to promoting cross-industry technological innovation and leads to the rapid integration of technology, industry, and application. For example, GB/T 33356–2016 *Evaluation Indicators for New-type Smart Cities* gathers the evaluation practice experience of global smart cities and promotes the further integration of urban traditional trades and informatization [7].

Standards accelerate the large-scale application of key Internet Plus technologies and offer a wide range of technological benefits. In April 2020, a series of national standards for personal health information code were issued. This measure has broken down the original data barriers in cross-regional cloud and big data, has promoted the unity of the epidemic prevention forces at all localities, and has been actively promoted and applied in all kinds of industries and fields, providing a useful support for economic and social development.

3 Status quo of Internet Plus standardization

3.1 Status quo of the application of general key technology standards in China and abroad

Many countries strive to develop standards for general key technologies with commanding heights, including big data, cloud computing, Internet of Things, and mobile communication to lay a solid foundation for developing key technologies.

Internationally, big data is standardized in accordance with the Joint Technical Committee 1 of the International Organization for Standardization/International Electrotechnical Commission (ISO/IEC JTC 1). Among these, Subcommittee 32 (ISO/IEC JTC 1/SC32) mainly aims to promote data management and exchange standards, and Work Group 2 of Subcommittee 42 (ISO/IEC JTC 1/SC 42/WG 2) initially formulates terms and definitions, reference models, and other standards [8]. The National Technical Committee on Information Technology Standardization (SAC/TC28, hereinafter referred to as the National Information Standardization Committee) is responsible for the development and formulation of China's big data standards. So far, 24 national standards have been published, and nine standards are still under study, which provides the necessary support for development in

the big data industry [9].

The research institutions of cloud computing international standards mainly include ISO/IEC JTC 1, International Telecommunication Union-Telecommunication Sector (ITU-T), Distributed Management Task Force (DMTF), Storage Networking Industry Association (SNIA), Canadian Standards Association (CSA), and Organization for the Advancement of Structured Information Standards (OASIS), and their research contents mainly focus on basic standards such as vocabulary and framework, Infrastructure as a Service (IaaS) such as data resource access and management, and Platform as a Service (PaaS) such as application deployment and management. China's cloud computing standards are centrally managed by the National Information Standardization Committee, focused on the collaboration of government, industry, universities, research institutes, and users, and are closely combined with the actual demands of industries and the direction of technology development. Relevant achievements are of guiding significance for industry development [10].

The international standard research institutes of the Internet of Things mainly include the International Organization for Standardization (ISO), ITU-T, the Third Generation Partnership Project (3GPP and 3GPP2), and the Institute of Electrical and Electronics Engineers (IEEE). ISO places emphasis on the system structure and security of the Internet of Things and Sensor Network, ITU-T focuses on the research on ubiquitous network, 3GPP and 3GPP2 are concerned with the direction of communication network technology, and IEEE focuses on the underlying communication protocols in equipment. China's Internet of Things standards are centrally managed by the National Information Standardization Committee. There have been 49 published national standards, and 17 standards are still under study, which guarantees the basic needs for the standardization of industries [11].

The formulation of global standards for broadband Internet and industry development are mainly led by some international IT enterprises. In terms of mobile Internet, the European Long Time Evolution Technology (frequency division duplex, LTE-FDD) and China Long Time Evolution Technology (time division duplex, LTE-TDD) are taken as the main standards in the era of the 4G mobile communications system (4G). China has become a significant force in the development of the 5G mobile communications system (5G) [12].

3.2 Strategies of countries to promote integration standards

Internet Plus is a deep integration between IT (represented by the Internet) and all industries. The United States, the European Union (EU), Japan, and other countries and regions adopt different strategies to promote the formulation of integration standards.

In the United States, standards are mainly formulated by leading enterprises and standardization institutes. Driven by business, relevant technologies and standards such as big data, cloud computing, and the Internet of Things have been applied in all industries in the economic society, which promotes the integrated development of IT and all industries [13]. For example, in the United States, IT standards for civil use are closely integrated with the field of military applications, of which more than 85% of military technologies are applied from both the military and civil aspects.

Before the establishment of the EU, its member countries had a certain basis for national standards. Therefore, the member countries adopted a standardization strategy mainly for regional coordination. In 2008, the EU Council proposed removing the barriers to the integration of IT technology, industry, and application for all countries through standardization and supported the integration between many fields and IT to form a unified European market [14].

In Japan, the division of labor is conducted in accordance with the system of administrative control and implemented by relevant departments within their respective jurisdictional limits. There is a clear division of management in terms of informatization and standardization in all fields, and the overlapping functions caused by interdisciplinary integration are handled based on negotiations between departments.

3.3 Construction of an industry standard system in China

In the collaborative manufacturing field, the National Intelligent Manufacturing Standardization General Group was established in 2015, which aimed to promote the standardization of China's intelligent manufacturing, coordinate the technical contents and centralized management of standards, and conduct the pilot demonstration and application of standards. More than 300 standards have been published or are under study, and the intelligent manufacturing standard system, which included the categories of basic commonalities, key technologies, and industry application, was developed preliminarily [15].

In the modern agriculture field, the agricultural informatization standard plans are published by the competent

agricultural department annually. In *the 13th Five-Year Plan for National Agricultural and Rural Informatization Development Plan*, the standardization of IT equipment configuration, agricultural software, and agricultural electronic products has been deployed [16].

In the smart energy field, the technical standard system for UHV AC transmission proposed by the State Grid Corporation of China includes planning and design, equipment and materials, engineering construction, measurement test, operation and maintenance, and environmental protection and security, which consists of 79 national standards and energy industry standards.

In field of people-benefiting services, the *Foundation Framework of National Health Information Standards* contains four major standards: basis, data, technology, and management. The *National Standards and Norms for Hospital Informatization Construction (Trial)* issued by the National Health Commission has made more detailed arrangements in the aspects of handy services for the public, electronic medical records, hierarchical diagnosis, and treatment and regional collaboration.

In the intelligent transportation field, the *Standard System Table of Transportation Informatization* issued by the Ministry of Transport comprehensively clarified the standards of industry informatization, involving highway and waterway construction and management, transportation and logistics, safety emergency, and integrated affairs, and guided the formulation and revision of standards for traffic informatization [17].

In the intelligent environment protection field, the *Standard Guide for Environmental Informatization (HJ 511–2009)* established the environmental informatization standard system, including the general, application, information resource, application support, network infrastructure, information security, and management standards.

4 Problems faced by Internet Plus standardization in China

Currently, the foundation of Internet Plus standardization in China is insufficient to meet the needs for Internet Plus technology, industry, and application in the new situation.

4.1 Non-perfection of standards system construction

A standards system is the top-level design and overall layout of standardization. The Internet Plus action lacks a standards system corresponding to the current technology, industry, and application needs, and each industry has its own informatization standard. The process of developing standards in different fields is relatively independent and lacks a collaborative mechanism, which makes it difficult to form a unified mechanism.

4.2 Low international right of speech in key technical standards

IT applications have developed rapidly in China, and the gap between the Internet of Things, cloud computing, big data, and communication technology between China and developed countries has gradually narrowed. However, China lacks the international right of speech in terms of relevant key technical standards, which is mainly reflected in the following aspects: the presence of a big gap in the standard research level, conveners of most standardization organizations are foreign experts, and formulation of key standards is led by foreign research.

4.3 The lack of application integration standards

The Internet Plus action focuses on cross-border integration but fails to make a breakthrough in the integration standards of cross-platform and cross-business Internet Plus data intercommunication, business collaboration, and other applications. The existing standards cannot guide the deep integration applications in big data, cloud computing, Internet of Things, communication, and other directions.

4.4 Lack of standard applications and promotion mechanisms

Internet Plus standards are involved in the integration of IT and various fields, such as big data, cloud computing, Internet of Things, and communication, and multiple industries such as the manufacturing industry, agriculture, and energy. However, owing to the lack of coordination and pilot promotion mechanisms for practical application, implementing these standards is difficult.

5 Construction of the Internet Plus standards system

5.1 Construction ideas

The Internet Plus standards system aims to support the full lifecycle development of Internet Plus technology, industry, and application, to ensure that standards play a supporting role in the whole process. Considering the rapid development in the IT field, the standards of the Internet Plus technology industry and application will vary accordingly, and an “Others” sub-category is reserved in the main category of the standard system for holding a space for the dynamic adjustment of technology development.

The Internet Plus standards system includes six major parts, namely general, safety, common support, service integration, guidelines and evaluation, and application standards (Fig. 1). Among them, safety and common support standards mainly use existing technology standards, while service integration standards and guidelines and evaluation standards focus on new research contents.

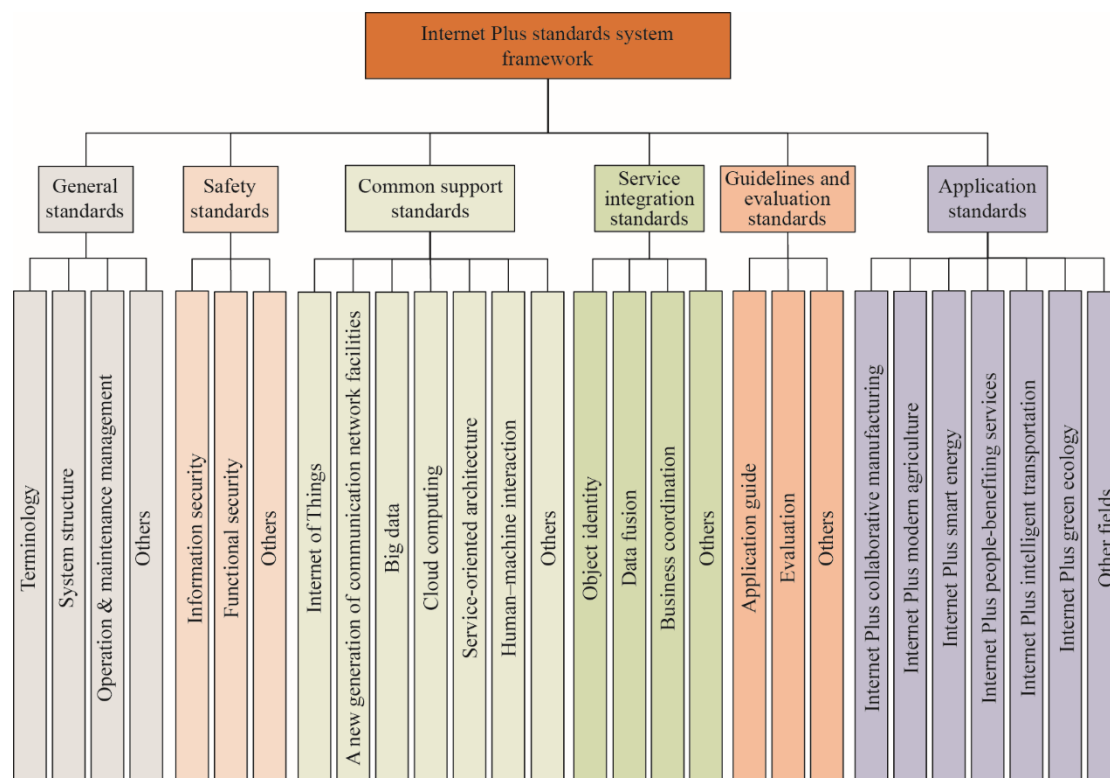


Fig. 1. Composition of Internet Plus standards system framework.

General standards are common Internet Plus standards in various fields and an important foundation for guiding the formulation of relevant standards in various fields.

Safety standards regulate the safety of IT related to various technologies and applications of Internet Plus and guarantee the elimination of potential threats to safety.

Common support standards consist of relatively mature and widely applied common IT standards and aim to provide basic IT support for service integration. The service integration standards are the core and key standards that support information sharing and business collaboration in the Internet Plus cross-field.

Guidelines and evaluation standards provide the formal interpretation and application guidelines of the technical standards for Internet Plus users. They not only offer guidance and support to Internet Plus standards but also provide a reference index for measuring the development of Internet Plus technology and application.

Application standards are the focus and core of applying Internet Plus cross-border integration. They play a role in leading and normalizing standards, make it easy for traditional industries to reconstruct business and production patterns by using Internet technologies and ideas, and guide the upgrading and reconstruction of traditional industries.

5.2 Formulation of industry application standards

5.2.1 Internet Plus collaborative manufacturing

In terms of key technologies, standards for intelligent equipment, smart factories, intelligent services, industrial software, big data, and the industrial Internet shall be further improved. In terms of industry application, a group of standard complexes shall be built by focusing on equipment for clean power generation, nuclear power, energy conservation and environment protection, ocean engineering, and railway traffic to jointly form the intelligent manufacturing standards structure with the basic common standards.

5.2.2 Internet Plus modern agriculture

Standards for agricultural IT foundation and agricultural application shall be developed, of which the former includes sub categories such as information terms, information equipment, storage media, transmission media, software and software engineering, and coded character sets, and the latter includes sub categories such as agricultural application systems, agricultural business support platforms, and agricultural business development tools.

5.2.3 Internet Plus smart energy

In terms of smart energy, the general standards of energy Internet as well as common cross-industry standards and important technology standards combined with smart city and China's high-quality development plan shall be formulated, mainly including energy conversion standards of energy Internet, as well as equipment, information exchange, safety protection, energy trading, measuring collection, and supervision standards.

5.2.4 Internet Plus people-benefiting services

Technical standards (format and interface) related to the contents and methods of people-benefiting services, as well as service standards mutually recognized and shared across regions shall be strengthened and improved. Supporting standards for information resource catalog system specification, data sharing exchange, and so on shall be formulated, and the implementation and application in urban services, medical treatment, public health, and other fields shall be promoted. In medical treatment, public health, and elderly care fields, a cloud platform for storing data and a coding system for standards shall be established to promote the collection, opening, integration, and mining of data in these fields.

5.2.5 Internet Plus intelligent transportation

In terms of intelligent transportation, close attention shall be paid to formulating national communication standards for the collaboration of driver-vehicle-road (V2X) as well as facility and equipment interface specifications, and the international intelligent vehicle standard system shall be built. Standards of the electronic navigation channel chart for inland rivers shall be unified, and standards of radio frequency identification for inland vessels shall be formulated. Meanwhile, the technical standards related to logistics information platforms shall be formulated, and the internationalization of national intelligent transportation technical standards shall be promoted.

5.2.6 Internet Plus green ecology

The calculation methods of carbon emissions from key industries and their evaluation standards shall be improved, and standards for monitoring, querying, pushing, and warning the environment and pollutants shall be strengthened and improved. The standardization of product environment information transmission shall be implemented, the standards for the product environment information statements should be formulated, the recovery and tracing of waste resources should be standardized, and waste flow tracking and recovery standards should be improved.

5.3 Construction of an application and promotion mechanism

The application and promotion of Internet Plus standards shall allow the complete participation of the government, enterprises, and third-party institutions, and a long-term mechanism of standardization in line with the characteristics of Internet Plus action shall be formed and optimized (Fig. 2).

The government shall play its role by participating in policy support, guidance, and coordination; establish the standardization work organization, identify problems by investigation, and determine key enterprises and products; introduce encouragement policies and identify key industries and enterprises; establish a supporting system for

standardization by relying on third-party institutions; conduct standardization publicity; and increase the standardization awareness of the whole society.

Enterprises are the backbone force of the standardization work and shall promote forming a standardization union between enterprises, plan the standardization strategies of enterprises, and formulate the standard system and management system of enterprises. Enterprises shall also participate in the development of national and international informatization standards combined with their respective advantages and take an active part in international standardization work.

Third-party institutions shall consider their own professional advantages, provide policy consulting and test certification services for the government and enterprises, and provide solid technical support for the cultivation of standard basic knowledge and skills and professional talent.

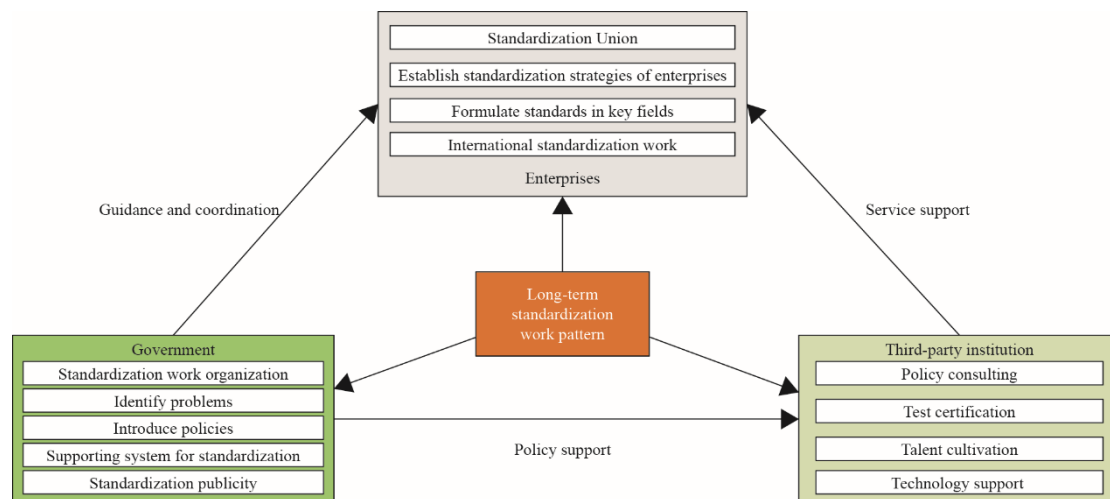


Fig. 2. Application and promotion mechanism of “Internet Plus” standards.

6 Countermeasures and suggestions

6.1 Conducting pilot demonstrations

The pilot demonstration of Internet Plus standardization shall be conducted, and an Internet Plus standards innovation platform on which standards, technologies, and industries support and interact with each other shall be developed. Key IT enterprises and industry application enterprises shall be guided to formulate and revise international, national, and industrial standards to improve the core competitiveness of enterprises and popularize standardization awareness. The pilot application of key standards shall be promoted, which will play a central and leading role within a certain range.

6.2 Strengthening talent cultivation

Close attention should be paid to cultivating inter-disciplinary talents and building scientific research teams, and colleges and universities shall be guided to strengthen the establishment and layout of emerging disciplines related to the integration of Internet Plus. Enterprises, colleges, universities, and research institutes shall jointly establish the industry–university–research training base. Traditional enterprises and Internet enterprises shall be encouraged to gather technical and managerial talents from different fields, to work together and accelerate the growth of practical talents. Qualified and interested key colleges and universities shall be selected to offer courses related to standardization and to cultivate professional teams for standardization.

6.3 Establishing a long-term mechanism

To adapt to the characteristics of the rapid development of Internet Plus, the demands of target industries shall be sorted out regularly, and the Internet Plus standards system shall be updated or improved in combination with the development trend of industry applications. The work plan or establishment guidelines shall be developed to promote the formulation and implementation of key standards. The standard validation and evaluation system shall be established to form a long-term mechanism of standardization work in line with the characteristics of Internet

Plus technology, industry, and application and provide a solid support for the normative development of the Internet Plus action plan.

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