China's Standards Development Strategy and Foreign Policy

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In recent years, the competition for control over international standards have been seen to affect the future balance of power among countries. What makes standards grow in importance from simply being technical specifications to acting as a strategic resource in international relations? How is standards development strategy historically associated with foreign policies? This paper aims to explore the international political process that leads from confrontation to cooperation through standardization by analyzing the changes in the actors, scope, purpose, and means of standards development in China, which is becoming active in international standardization activities.

1. Introduction

In recent years standards are seen as a source of profit and a leverage for strengthening industrial networks, and therefore it is recognized in the context of international politics that national governments should take leadership to strategically win the international standardization competition. It has been widely studied that standards can be a source of competitive edge for business enterprises by "acquiring rights based on technologies, standardizing rights, and industrializing standards," and the effects of how standardization promotes productivity and international trade have been verified from an economic perspective.[1]

While examining such economic perspectives, especially in international politics, we have observed an increase in discussions surrounding standardization from a variety of perspectives beyond just an extension of competition between companies. For example a study analyzing the competition for control over standardization from the perspective of coordination game theory,[2] a study pointing out that the structure for

externalizing regulations within the EU into international standards is the strength of the EU,[3] and discussions about the influence of relevant markets and governments on international standardization.[4] There have also been various studies about China's international standardization activities, some going beyond singular perspectives such as techno-nationalism or techno-globalism to point out that there are differences in preferences among sectors, government agencies and business enterprises, and that China's national strategy may vary depending on the technology in question.[5]

Previous studies have established a common recognition that technical standards can become a source of power in international politics and have made progress in identifying who controls technical standards and understanding the power gained from controlling standards. It has also been suggested that government preferences and intervention in standardization represent different political positions. Analyses of the factors and structures that influence government policies toward standardization have also progressed, with an increasing number of case studies. However, there have not been many studies analyzing the history of how standardization policy preferences that underlie individual cases were formed. While it is recognized that winning control over more standards will lead to a shift in global power, analyses of its association with conventional international relations have not necessarily been accumulated.

This paper, therefore, aims to analyze how China's standards development strategy has historically evolved from the perspective of China's foreign relations.

In the following, I will outline the features of standardization and their changes to consider why the competition for winning control of international standards leads to international confrontation. Next, I will track the historical evolution of standards development strategy and foreign policies in China to examine how China's foreign policies were linked to its domestic standards development strategies and international standardization activities by analyzing the changes in the actors, scope, purpose and means of standards development.

Through these analyses, I believe we will be able to elucidate the political aspect of standardization and open a window on the international political process that leads from confrontation to cooperation through standardization. This is also an attempt to envisage, from the perspective of international politics surrounding international standardization, what kind of international order will be formed by China which is increasingly becoming a global power.

2. Features of standardization and their changes

In the context of traditional industries, standardization was a matter of management, and the origin of industrialized mass production that spread since

industrial revolution can be attributed to standardization of technical specifications based on technology compatibility. Generally speaking, "standards" are "rules, regulations and other arrangements[6]" and assume the roles of measurement units, minimum standards, and standards to facilitate efficient production and distribution.[7] "Standardization" means to "establish such standards"[8].

As international trade and division of labor advanced along with globalization, standardization became ever more important as an infrastructure to ensure smooth international trade of products and services, and adaptation to international standards became a necessary qualification for participation in the global value chain.[9] In recent years, international standards have come to be perceived as a strategic resource to attain competitive advantage for global business development.

Environmental changes

Standards, what once used to be technical specification, grew in importance from "public property" for enhancing technical compatibility to a "strategic resource" largely as a result of the following three changes in the environment.

(1) Advancement of network technologies: With the advancement of digital technologies, digital components were modularized and further standardized to allow for networking.

(2) Emergence of standards with intellectual property rights: Since the 1980s, as information technologies grew more and more complex, in some high-tech areas it became necessary to certify potential platform technologies as a standard technology and determine related specifications before those technologies reached a level of maturity as a platform technology. This led to the increase of technology standards involving patents. Standards including intellectual property rights became a source of economic income.

(3) Furthermore, the enactment of Agreement on Technical Barriers to Trade (WTO/TBT)[10] had a significant impact. In 1995 when WTO/TBT came into force, WTO member states became obligated to adopt relevant international standards as their domestic standards. This dramatically boosted the importance of international standards.

Changes in the standards development process

Based on these changes, changes also occurred in the standards development process. Up until the late 1980s, the product standards of a specific company with a dominant position in the market often used to be adopted as the so-called "de facto standard." In fact, since the US had a huge domestic market, it used to encourage the adoption of de facto standards as a result of competition based on market mechanism.

Later in the 1990s, with the rapid progress of information processing technologies, the division of labor in production increased, products grew more complex, interconnectivity advanced and research and development grew larger in scale, making it difficult for the standards of a single company to dominate the whole market. This led to the increase of forum and consortium standards developed through collaboration among multiple companies. [11] In 1995, with the enactment of WTO/TBT, it was mandated that international standards were to be adopted as a basis when compulsory standards were necessary in trade between WTO member states, which increased the importance of de jure standards established by international standardization organizations.[12] In addition, with China's accession to WTO in 2001, compliance with de jure standards also became necessary to expand into the enormous Chinese market.

These developments accelerated the involvement of national governments in the process of the establishment of de jure standards, which are decided on the basis of one vote per country. Through standardization, technology will strengthen features such as self-reinforcement, process dependency, and increasing return. Because the information and communication networks, and other emerging technologies that are further standardized, are important not only economically but also in terms of national security, concerns were raised about becoming locked into a specific technology network, which is something that would increase vulnerability. These concerns cause activities surrounding international standardization to be political issues that can affect the global power balance.

3. Historical changes in standards development strategy and foreign policy in China: Early days of standards development (-1978)

In recent years, China has gained attention for its role in international standardization activities. However, analyses of how China's foreign policy and its recognition of international situations have affected its standards development and international standardization strategies have not necessarily been compiled. Therefore, this section will track the historical evolution of standards development strategy and foreign policies in China by focusing on the changes over time of the actors, scope, purpose, and means of China's standards development and examining the process of confrontation and cooperation surrounding standards development.

3.1. From dependence on Soviet Union standards to "self-reliance"

China once prospered during the eras when manufacturing techniques were being standardized. For example, *The Artificers' Record* (Kaogong ji) which laid out the first

manufacturing design standards in China during the Spring and Autumn period, standardization of written language, currency, and weights and measures implemented by Qin Shi Huang, and standards of military equipment and construction written during the Song period are known as important classic examples in the world's history of standardization. After those eras, however, China had long been a traditional agricultural country and therefore did not put much efforts in developing standards for industrial technologies compared to Western countries.[13]

Since 1949 when the People's Republic of China was founded, most industrial technology standards were based on standards introduced from the Soviet Union as part of Soviet-aided projects for building large scale plants. The first national standards (Guo Biao standards) were issued in 1958. Improvement of the quality of industrial products was highlighted as a key task in the first Five-Year Plan (1953-1957), and in 1956, the State Science and Technology Commission was established in the State Council with the mission of developing science and technology standards towards the realization of "Four Modernizations" (i.e., modernization of agriculture, industry, science and technology, and national defense). Later in 1957, the bureau of standards was established within the State Science and Technology Commission as an organization that issues national standards. Newly issued national standards were as limited as less than 100 items per year in average over the two decades from 1958 to 1978,[14] but as tensions between China and the Soviet Union escalated, the importance of developing China's own national standards came to be recognized as a means to support technology development for achieving "self-reliance". In response to the formulation of the first Medium- to Long-Term Plan for the Development of Science and Technology (1956-67),[15] the 10-year Plan for Standardization Development (1963-1972) was announced.

3.2. Limited involvement in international standardization

China's involvement in international standardization activities was limited during this period. While China's foreign trade faced a harsh environment amidst the Cold War and increasing tensions between China and the Soviet Union, China became a member of International Electrotechnical Commission (IEC) in 1957.[16] IEC is an international standardization organization that develops international standards in the field of electric and electronic technologies. It is said that, by participating in IEC, China tried to show its intentions of opening up to world.

During this time, China actively provided foreign aid to strengthen its ties with "Third World" countries including those in Asia and Africa. China's assistance in the construction of the Tanzania-Zambia Railway in the 1970s is a representative example. In addition to providing financing, China provided full technical support from design to construction, operation and maintenance of the railway, sent nearly 3,000 engineers[17] and accepted nearly 200 engineering students from Tanzania[18]. Although foreign aid

projects offered during this period was tinted with ideological colors and deviated from economic discipline, the equipment, technical standards and management skills provided through these projects were organically integrated, which was a key feature that had significant implications on promoting standardization in today's Belt and Road Initiative.[19]

4. Adaptation to international standards (1978-2001)

Since the Chinese economic reform was launched in 1978, China's recognition of the global market showed change. First was its shift from the traditional "two worlds" model to a "one world" model. Second, China departed from the conventional perspective of North-South divide and exploiter-exploited relationship and admitted that international economic relationships including China's own relations with other countries can be perceived as interdependent relations and came to affirm international division of labor.[20]

4.1. Standardization to integrate China into the international market

Along with these changes in recognition, technology transfer from overseas and market liberalization provided means for modernization, and the development of domestic standards was accelerated to integrate China into the global economy. In 1978 the China Association for Standardization (CAS) was established with ratification by the State Council, and following the enforcement of Standardization Regulation, the Standardization Law (China's basic law regarding standardization) came into force in 1989, ushering in an era of legislation and control of standardization activities in China.[21]

Especially because China had applied for accession to the WTO in 1986, it needed to reform its standards system to meet the requirements for accession. To give an example, mandatory standards require that the properties, manufacturing processes and production methods of certain products are in conformity, but such standards are deemed as non-tariff barriers. For many years, most of China's national standards were mandatory standards, but China started reviewing them when it filed the application for accession to WTO and reduced the percentage of mandatory standards (2487 items) to all national standards (18,784 items) to 13% by the end of 1998 and the contents of the remaining mandatory standards were revised so as to comply with WTO/TBT.[22] Although China's relations with the Western countries temporarily deteriorated due to the Tiananmen Square Incident in 1989, Deng Xiaoping's Southern Tour marked a clear and complete shift to a "socialist market economy." The end of the Cold War also

contributed to the promotion of reinforcement and reform of the standardization system to facilitate the increase of direct investment to China and export from China.

4.2. Participation in international standardization activities as a follower

During the period from the start of the economic reform to accession to WTO (1978-2001), although China was still a follower in international standardization activities, it gradually stepped up its participation.

At IEC, to which it became a member in 1957, China joined the IEC Executive Committee in 1981 and as of 1985, China participated in all of the 80 technical committees and 122 subcommittees of IEC, and 21 Chinese experts were participating as rapporteurs in 14 of the 700 working groups.[23] In 1990, the annual IEC General Meeting was held in Beijing, China for the first time and Lu Shaozeng, Vice Director of China State Bureau of Technical Supervision (CSBTS) was elected as IEC Vice President.

It was in 1978, the same year as the China Association for Standardization (CAS) was established, that China became a member of International Organization for Standardization (ISO), an international organization which develops international standards in all areas other than electric and electronic technologies.[24] In 1983, China became a member of the ISO Council. As of 1985, China was represented by P members (who actively participate by voting[25]) in 80 of the 165 technical committees, 247 out of the 659 subcommittees, and by 20 rapporteurs in 15 of the 1391 working groups. It also held the secretariat of a subcommittee.[26]

A few years later in 1987, ISO issued the ISO 9000 family as a set of standards for quality management systems including third party certification, which was introduced in many countries as the criteria for business activities and product trading. In China, interest was traditionally higher in executing planned production in line with the planned economy program, and quality management tended to be neglected. However, China had been faced with the pressures of market competition since the economic reform, and awareness for product quality heightened especially after Zhang Ruimin of Haier Group ordered his employees to destroy faulty refrigerators that failed product inspection.[27] In 1988, China established the national standards of GB/T10300[28] Quality Management and Quality Assurance based on ISO 9000, and by 2001, China held the largest number of ISO 9000 certifications in the world.[29]

China also holds many certifications for ISO 14000 (issued in 1996) that sets requirements for environmental management systems. In 1995, the National Technical Committee on Environmental Management of Standardization Administration of China was set up within the Bureau of Technical Supervision and implemented the ISO 14000 family from 1997. As of the end of 2010, China holds approximately 40,000 ISO 14000

certifications, the largest in the world.[30]

5. Integration of science and technology policies and standards development strategy following accession to WTO (2001-2008)

After gaining accession to WTO in 2001, it became even more necessary to comply with the global production standards and technical standards systems were further developed mainly by the State General Administration for Quality Supervision and Inspection and Quarantine (AQSIQ) and Standardization Administration of China (SAC). In terms of relationship to the US, China was positioned by the US as a "potential rival" in 2001, and a counterpart in a "constructive partnership" after the 9.11 Attacks, and as a "potential adversary" in the US National Security Strategy Report published in 2002, reflecting both competition and cooperation.[31] In response, China advocated the creation of a "new political and economic world order" and positioned itself as a "responsible major power" in an attempt to multi-polarize the world order.

Therefore, the aims of China's standardization activities during this period shifted from integration of China into the global economy to a more proactive aim of gaining advantage in the global economy by linking technologies and standards, and focus was placed on participation by business enterprises.

5.1. Standardization as a means to gain competitive advantage

The 11th Five Year Plan (2006-2010) and the National Medium- and Long-Term Program for Science and Technology Development (2006-2020) were published in 2006, which together set out long-term basic policies encouraging active innovation and strengthening of science and technology capacities. The 11th Five Year Plan includes several dozens of statements referring to standardization activities for the first time.[32] In response, SAC formulated the 11th Five Year Plan for Standardization[33] to enhance domestic systems for supporting the Medium- and Long-Term Program for Science and Technology Development. This was China's first five-year plan specifically focused on standardization.

In referring to the background of the development of the Five Year Plan for Standardization Zheng Weihua, President of China National Institute of Standardization shared his views as follows. "As global trading continues to increase, technical standards have become an important component of trade regulations. While today's international competition is centered on innovation, it is gradually transitioning to competition for converting innovation into technical standards." "…China's challenge lies in the fact that, despite rapid growth of China's innovative capabilities, its

standardization system has not caught up with those capabilities." "Innovations are not contributing to the progress of the industry as a whole through standardization, because there are no voluntary standardization organizations run by private entities in China, and business enterprises do not have the means to convert their innovations into standards through private or industry organizations." "Participation in international standardization activities is limited, we lack human resources, and have an inefficient system for collecting funding for international standardization activities. International standards developed under the initiative of China are practically nonexistent, accounting for a mere 0.2% of all existing international standards." [34] Labor-intensive mass production of low-added value products was the mainstream of industrial production in China at that time, and Chinese enterprises used to pay significant license fees to foreign companies. In light of this situation, China reinforced the idea that it should develop standards to support domestic economy and social development on one hand, and on the other, drive the development of proprietary technologies to upgrade its industry and convert those technologies to international standards for profitable growth. Although this problem recognition was based on conventional ideas like the technology trap and dependence theory, implementation of the plan proceeded in a practical manner.

The Five Year Plan for Standardization called for the establishment of an international standardization system led by business enterprises and also set numerical targets such as "to establish 6,000 items of national standards every year up to 2010, of which 2,000 items should be standards related to intellectual property rights for indigenous innovations; Standards development/revision cycle should be shortened to within two years to accelerate the speed of standardization of innovation; Propose 50 new items for international standardization and become involved in the development of 500 items of international standards closely related to Chinese industries; Foster 1,000 experts in international standardization; Hold more secretariats of technical committees and subcommittees in international standardization organizations and raise China's share to 6%." [35]

However, there is no denying that China's international standardization efforts lagged behind the US, Europe and Japan. EU has worked to build a standardization system since the 1980s towards unification of all standards in the region. The European Committee for Standardization (CEN) signed the Vienna Agreement with ISO in 1991 and the European Committee for Electrotechnical Standardization (CENELEC) signed the Dresden Agreement with IEC in 1996, which formalized the framework of cooperation and collaboration in the planning process of EU standards and international standards, to expedite the adoption of EU standards as international standards at international standardization organizations. [36] Although the US has long emphasized market-driven standardization, the US too, formulated a standardization strategy in 2000, which underlines US intentions to maintain its global advantage through

international standardization in the key fields of telecommunication, environment and safety.[37] With regard to Japan, while falling short of Europe and the US, Japan formulated the Comprehensive Strategy for International Standardization in 2004, which laid out an action plan to seamlessly promote technology development and standardization as well as human resource development to support the strategic efforts of the private companies and industry sectors.[38] This was in light of the lessons learned from Japan's failure to internationally standardize its 2G mobile telecommunications technology despite the sophistication of the technology itself . When viewed from Chinese perspectives, "the international standardization strategies of Europe, US and Japan are attempts to gain control over technology and intensify market competition," moreover, "…in spite of being a great manufacturer, China has little control over international technical standards. That is why we must reform our management system to win control of international technical standards."[39]

5.2. Acceleration of international standardization activities

China's involvement in international standardization organizations increased since its accession to WTO in 2001. During this period, contribution to international cooperation was added to the responsibilities of international standardization organizations to encourage the participation of developing countries. It may be that these initiatives helped increase China's influence on international standardization organizations. For example, following the organizational reform of International Telecommunication Union (ITU) in 1990, "development" was positioned as an important activity of ITU;[40] and IEC introduced the Affiliate Country Programme in 2001 to encourage the participation of developing countries. Listed in IEC's Affiliate Country Programme were African countries including Tanzania, Zambia, Ethiopia and countries like Yemen[41] that had strong ties with China and did not have the opportunity to participate in international standardization.

Recognized for its active participation in ISO activities, China became a permanent member of the ISO council in 2008, 12 years earlier than initially planned.[42] Yu Zida, Deputy General Manager of the Haier Group was sent to IEC in 2005 as the first IEC expert member from a Chinese business enterprise. As of the end of 2005, China participated as a P member in 88 of the 90 technical committees and 82 of the 88 subcommittees of IEC.[43]

However, the process for international standardization of indigenous technologies was far more difficult than participating and voting at international standardization organizations. China has been participating as a Plenipotentiary Conference member of International Telecommunication Union (ITU), a UN agency that develops international standards on telecommunication technologies, since 1947, but China's proposal to incorporate WAPI (China's indigenous WLAN standards) as an international standard

was rejected in 2006 because of security concerns raised by the US. TD-SCDMA is a 3G mobile telecommunications system approved in 2001 as the first international standards based on Chinese indigenous technology, but it was technically inferior to WCDMA pushed by Europe and CDMA2000 promoted by the US. Commercialization of TD-SCDMA was delayed for 8 years and its use never spread beyond China despite its adoption as an international standard. Nevertheless, these attempts to try and take the initiative in international standardization have been useful in informing the formation of a value chain toward the development of 5G technologies. [44] Moreover, the success of international standardization cannot always be measured by the dissemination of the technology. Some studies suggest that international standardization of indigenous technologies provide an advantage in price negotiations with foreign companies, by presenting a less expensive indigenous technology alternative supported by international standards when introducing other international standard technologies. [45]

6. Since the Global Financial Crisis (2008-)

As the global economy plunged into a recession following the 2008 Global Financial Crisis, the emergence of Chinese economy became more evident than ever. When the Obama Administration announced its "rebalancing" policy to Asia in 2011, China started to actively engage in foreign policy demanding a greater voice in the international community. Aiming to build a "new model of major country relations," while avoiding direct confrontation with the US, China tried to create a favorable environment for itself through the development of emerging technologies and the Belt and Road Initiative to secure enough space for continued economic development.

When the US-China rivalry over emerging technologies intensified during the Trump Administration, the technology rivalry manifested as criticism of the authoritarian nature of Chinese technology and product standards. There was particularly strong opposition against the export of AI surveillance and 5G technologies. For China, any external criticism against the state regime is always regarded as a threat that may lead to a revolt against the regime (in other words, an attempt to transform the Chinese system) by linking with internal contradictions. China had learned through its experience, such as the massive recall of Chinese-made pet food in the US (2007) and the poisoned infant formula scandal that shook China (2011), that not only criticisms linking emerging technologies and the authoritarian system but all criticisms regarding product standards, whether from inside or outside the country, tends to spread their focus "from product to industry, industry to the economy and society, and from the government to the political regime."

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6.1. The "Go Out" strategy and "China Standards 2035"

During this period of such drastic change in the international power structure, China accelerated standardization of emerging technologies and its strategy of "going out" with China's standards for the world. At the same time, the government's instructions on standards development were further strengthened. It was an interesting change that improvement of product quality was strongly advocated not only for emerging technologies but also for traditional industries and consumer goods.

Following the announcement of the 12th Five Year Plan for Standardization in December 2011 and the inauguration of the Xi Jinping administration in 2012, Decision of the Central Committee of the Communist Party of China on Some Major Issues Concerning Comprehensively Deepening the Reform was adopted in the Third Plenary Session of the 18th Central Committee of the Communist Party of China held in November 2013. This Decision particularly highlighted reform of the economic structure, and while admitting the expanding roles of the market in development strategies and standards development, it emphasized the role of the government to supervise and control the market.[46] In March 2015, the State Council issued the Reform Plan for Deepening Standardization, which encouraged various entities "to jointly develop standards under government guidance, driven by the market, and through participation of society" and "to actively participate in international standardization activities, aiming to become a leader in international standardization to enhance their voice."[47] In December the same year, the Development Plan of National Standardization System Construction (2016-2020) was issued, setting out policies to strengthen the standardization of governance capabilities in the 13th Five Year Plan (2016-2020), promote China's standards to go global, and improve the level of internationalization of standards. The Development Plan included specific targets, for example, to "take part in the formulation/revision process of 50% of all international standards formulated or revised annually" and to "promote mutual recognition of standards with countries along the Belt and Road as well as China's main trade partner countries"[48]

In addition, President Xi Jinping presented the motto of "high-quality power" in the 19th National Congress of the Chinese Communist Party in 2017, and emphasized that "China's economy has been transitioning from a phase of rapid growth to a stage of high-quality development."[49] While this is associated with China's aims to promote ecologically sustainable development without linking development to GDP growth, it also has to do with the government's intentions to prevent the outflow of domestic consumption. Chinese consumers have long been inclined to trust foreign products over domestic products, which was one of the reasons behind the shopping spree by Chinese tourists on overseas trips.

Since "quality" is defined as "the degree to which a set of inherent characteristics fulfils requirements," and "standard" is "the fundamental concepts and principles of

quality management," [50] management of standards is essential to raising quality levels. To this end, Guidance on Promoting Improvement of the Quality of Products and Services [51] (2017) and Opinions on Strengthening the Construction of the Quality Certification System and Promoting Comprehensive Quality Management [52] (2018) were issued in succession by the State Council, which outline the need for strengthening the standardization system and structural reform towards "high-quality power". Furthermore, it is worth noting that the Standardization Law was revised in 2018 for the first time in three decades and the scope of standardization was expanded from manufacturing industries to include agriculture, service industry, and public works management. [53] Start of research for the China Standards 2035 Project was also announced in 2018 [54] and under the leadership of Chinese Academy of Engineering, research groups were formed to study the following four subjects: (1) Research on Strategic Orientation and Objectives of Standardization; (2) Research on China Standardization System, Method and Evaluation; (3) Strategic Research on Supporting High-quality Development Standardization System; and (4) Strategic Research on Standardization Military-Civil Integration Development. The findings were incorporated in the Main Points of National Standardization 2020 [55] announced in March 2020, and will concretize into Outline of the National Standardization Strategy to be issued going forward.

Table 1: China Standards 2035 Project

General Task	**Research to determine strategic orientation and objectives of standardization: to set the overall objectives**
Individual Tasks	**Research on China's standardization system, method and evaluation** To present the model for realization of the objectives identified through the General Task and evaluation method
	Research on standardization system strategy to support high-quality development To identify strategies that will help promote 1) Rural revitalization, 2) Manufacturing, 3) Service industry, 4) Social governance, and 5) Ecology
	Research on standardization strategy for the development of military-civil integration To seek balanced development of both national defense and economy through 1) Research on systems and policies to integrate military and civilian standards, 2) Research to develop a roadmap for promoting priority areas of integration of military and civilian standards

Core Members (not exhaustive)	Zhao Xiangeng: Expert on condensed-matter physics
	Lang Hehui: Expert on telecommunications technology
	Zhu Gaofeng: Expert on telecommunications technology and management
	Gan Yong: Expert on metallurgical materials
	Zhang Gang: Former counsellor of the State Council, Member of the National Manufacturing Strategy Advisory Committee
	Zhang Xiaogang: Former president of ISO
	Yu Xinli: Director, Department of Standards Technology Regulation, State Administration for Market Regulation
	Yin Weilun: Expert on forest cultivation
	Gong Ke: President of the World Federation of Engineering Organizations (WEFO)

Wang Liheng: Expert on missile power technologies
You Zheng: Vice-president, Tsinghua University, Expert on mechanical-electronic systems
Gao Congjie: Expert on membrane separation technologies
Li Linie: Expert on direct-current transmission
Wu Qingping: Expert on food-safety sciences and technologies

List of research activities (not exhaustive)	
2018 March	Launch of China Standards 2035 project
October	Visit to Zhejiang Province: Zhejiang province was the first province in China to launch standardization activities. Exchanged views with government agencies and enterprises related to standardization
November	International Symposium on Standardization Strategies and China Standardization Expert Committee Academic Seminar
December	Visit to Guangdong province : Inspected standardization activities at the forefront of Chinese economic reform
	Visit to China Electric Institute: Reviewed standardization models related to the "Go Out" strategy
2019 January	Visit to Qinghai Province: Reviewed eco-friendly standardization models under the strategy
February	Visit to Hubei province: Inspected National Technical Standard Innovation Base(Optics Valley of China) and other spots
	Visit to Jinan City, Shandong Province: Inspected social insurance services, civil services, etc.
	Visit to China Information Communication Technologies Group Corporation: Inspected the development of 5G, optical communication, large-scale integrated circuit, network security, and smart city technologies
March	Interim exchange meeting
2020 January	Publication of report

Table 2: Main Points of National Standardization 2020 (issued in March 2020)

1. **Upgrade the strategic positioning of standardization activities:**   Compilation of Outline of the National Standardization Strategy based on the findings of Standards 2035   2. **Deepen standardization reform:**   Management of mandatory national standards and industry standards. Development of urban development models through standardization. Improvement of standardization levels of business enterprises.   3. **Improve the level of high-quality development capabilities**:   Building standardization systems in important fields including prevention of novel corona virus, advancement of manufacturing industries, agriculture, safety and quality of food products and consumer goods, service industries, social governance, and biological technologies, etc.   4. **Participate in the governance of international standards and improve international standardization levels**:   Enhancement of international standardization in technology areas including new energy, new materials, quantum computing, digital twin, manufacturing of AI, and industrial construction, etc.   5. **Enhance scientific management and enhance standardization governance**   Enhancement of R&D and service capabilities at the National Technology Standards Innovation Base and construction of standard platforms based on big data, cloud computing, etc.

Table 1-2 Source: Prepared by the author based on information collected from the websites of the Chinese Academy of Engineering website, Chinese ministries and business enterprises as well as media reports

The China Standards 2035 Project is often viewed from the international community as a successor to the Made in China 2025 policy and a plan embodying the Chinese government's ambitions toward global leadership in emerging technologies. [56] It may have been taken as a threat all the more sharply because many companies of developed countries had enjoyed success built on the development of international standards. However, while writing more international standards is positioned at the core

of China Standards 2035, it is also necessary to note that quality improvement agenda such as structural reform of traditional industries, enhancement of quality, safety and customer service, have been positioned as a key objective, no less important than international standardization. [57] This reflects the dilemma that China faces while working to enhance its technical capabilities.

Within China, standardization is understood as an important component of Xi Jinping's "Thought on Socialism with Chinese characteristics for a New Era." [58] If it is "quality" that creates the difference between a "large country" and a "major power," China Standards 2035 may contribute to wider acceptance of Made in China 2025 by not only networking the technologies accelerated by Made in China 2025, but also improving their quality.

As for management standards relating to quality, environment and safety, however, standards developed in Europe are already deeply rooted in the global community through a process known as the Brussels effect. According to Columbia University Professor Anu Bradford, [59] "Brussels effect refers to the EU's unilateral power to regulate global markets through the following three factors: in addition to the fact that (i) EU has an institutional framework to eliminate products and services that do not meet EU standards, (ii) EU can externalize its laws and regulations outside its borders through market mechanisms, (iii) which is made possible because of the huge and affluent EU consumption market. Despite facing economic and political decline, EU remains an influential power in rebuilding global regulations." "…though China may soon possess the largest consumer market, (i) its projected income per capita in 2050 will be \$17,372, far below that of EU member states. (ii) Less wealthy consumers have a lower appetite for regulations that might compromise growth and economic development. And (iii) since importers set standards by regulating market access and China's economy relies primarily on exports, a "Beijing Effect" is unlikely to replace the Brussels Effect anytime soon. [60]"

Inferring from the above, for China to implement China Standards 2035 aimed at not only international standardization but also enhancing quality of its products and technologies, while accelerating innovation in its unique emerging technologies through Made in China 2025, development of governance standards will also be important, requiring global cooperation and compromise to a certain extent. As a matter of fact, a research comparing the US and China's respective AI strategy reports suggested that while there is not much difference between the US and China in technology levels, China is lagging behind in the fields of ethics and legislation regarding AI. Following the trends of the global community, the 8 principles of China's "Governance Principles for a New Generation of Artificial Intelligence: Develop Responsible AI" published in June 2019, is largely in line with OECD Principles on AI, the first international policy guidelines regarding AI, adopted by OECD in May 2019. [61]

6.2. Leadership in international standardization activities

China is increasingly taking management positions in international standardization organizations and leadership in the establishment of international standards, particularly in recent years. In the 36th ISO Plenary Meeting held in 2013, Zhang Xiaogang[62] (vice-chairman of the Ansteel Group Corporation) nominated by SAC was elected as ISO President for a three-year term of 2015-2017.

In IEC too, China became a permanent member of the IEC Council in 2011, and since 2020 Shu Yinbiao, Chairman of State Grid Corporation of China, has been serving as IEC President (elected in 2018). Likewise in ITU, Zhao Houlin was elected the Secretary-General of ITU in 2014 and assumed office from 2015. He had served nearly thirty years as an ITU senior staff member, following a career as an engineer in the Design Institute of the Ministry of Posts and Telecommunications of China. It is assumed that China's influence on international standards development at ITU will increase.

Nonetheless, international standardization organizations are a place for international harmonization of technologies, and it is unclear to what extent the interests of the home country of the organization's leader will be reflected in its activities. It is true, however, that we are witnessing changes in the harmonization of technologies carried out by international standardization organizations. The trends of technology harmonization is shifting from between developed countries to between developed and developing countries, and the main actors taking leadership in harmonization are also shifting from national governments to private entities. Technology harmonization is increasingly becoming a trade issue and WTO with the functions to resolve trade conflicts, is now stepping into the realm of international standardization organizations' regulations and recommendations. The leadership of international standardization organizations will be required to respond to these changes to prevent weakening and decentralization of governance. In this context, it is necessary to analyze the influence of the Chinese government on the leadership of international standardization organizations.

The number of international standards developed under the initiative of China is increasing in general. As a result of its international standardization efforts in ISO,[63] China held the secretariats of 8% (66 committees) of the total Technical Committees and Sub Committees (TC and SC) in 2020, which still fell behind the major developed countries (more than 10% of total), although this is a big leap in comparison with China's 2% (14 committees) of the total in 2007.[64] Moreover, in ISO, China leads 121 standard items, which is more than 7% of total newly issued standards in 2020[65], as well as submitted 150 new proposals in 2019.[66] In IEC, China held the secretariats of 10 TC and SC committees, which is about 5% of the total for 2019.

Graph 1: Number of active secretariats at TC and SC and its % of total by country in ISO and IEC
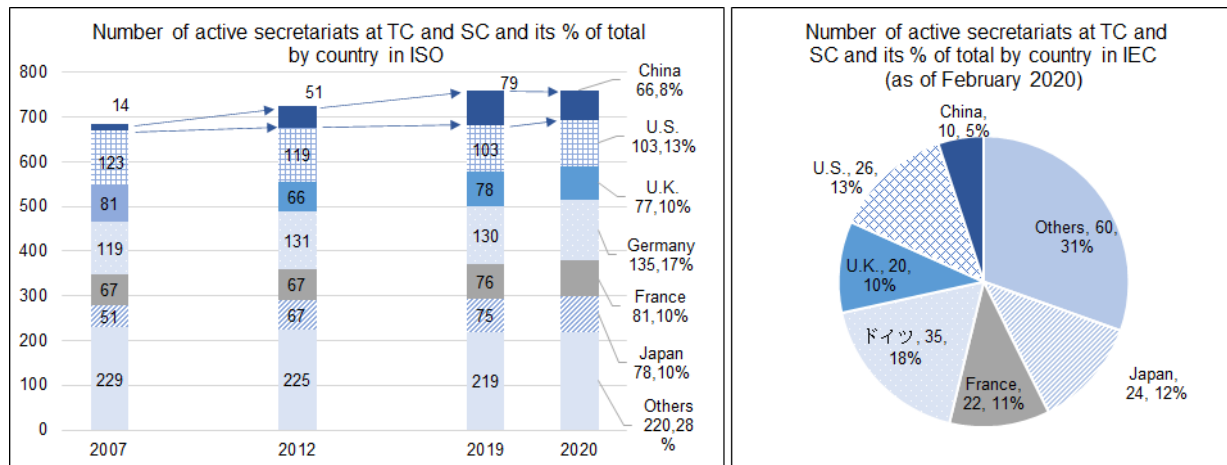
Note: For ISO data, the data for 2012, 2019, and 2020 are from the ISO website, and the data for 2007 is from Shiozawa, 2008.
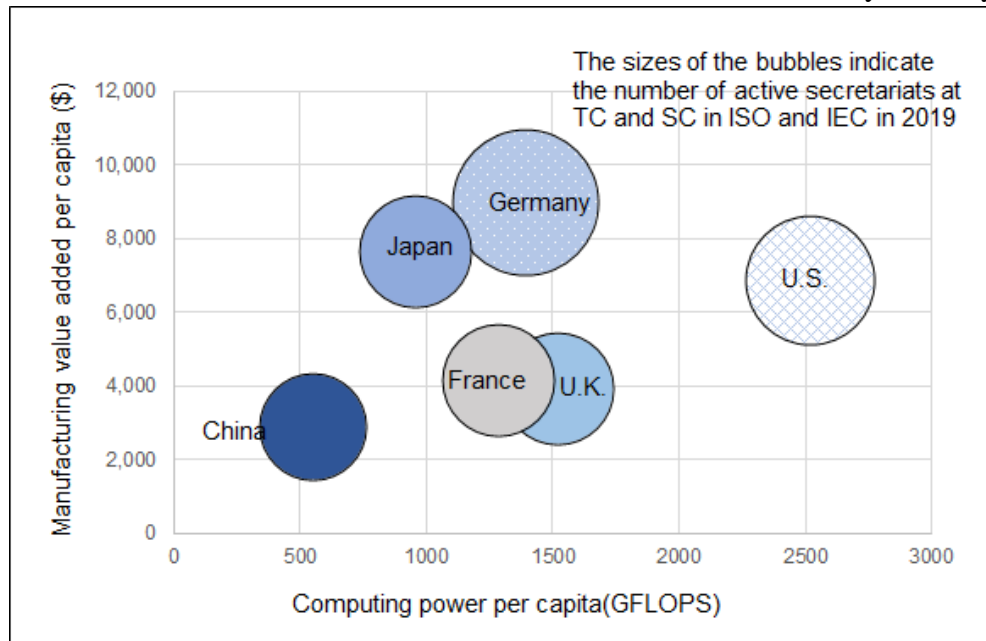Source: Prepared by the author based on information collected from ISO website, Shiozawa 2008, and IEC activity report 2020 issued by IEC Activities Promotion Committee of Japan[67].

The reasons behind this rapid heightening of Chinese presence are its progress in the development of human resources for international standardization on one hand, and the establishment of a cooperation scheme for the government and private sector to work together toward international standardization on the other. For example, when SAC held the secretariat for ISO/TC17/SC17 (steel wire rod and wire products) in 1993, an advisory committee was organized with the participation of 32 Chinese enterprises and institutions including Shanghai Steel 2nd Plant, Masteel, Ansteel, Information Standardization Institute and General Institute of Building,[68] who each provided funding and human resources to promote international standardization. This case is referred to as a successful example of government-industry cooperation.[69]

Indeed, the level of China's leadership in international standard activities is getting nearer to major developed countries. However, both China's manufacturing value added per capita and computing power per capita, which are the key drivers for a smarter society, remain far behind the major developed countries (see graph 2). Bringing China's active presence in international standard activities into its domestic development will be a massive challenge for the "China Standards 2035 Project."

Graph 2: Manufacturing value added per capita, computing power per capita, and number of active secretariats at TC and SC in ISO and IEC by country

Note: A country's overall computing power is calculated by adding up the terminal computing power, edge computing power and cloud computing power[70].
Source: Prepared by the author based on information collected from the websites of UNIDO and ISO, IEC activity report 2020 issued by IEC Activities Promotion Committee of Japan, and Huawei Position Paper February 2020.

6.3. Belt and Road Initiative

The belt and Road Initiative is also important in the context of China's international standardization strategy. In March 2015, China announced its "Vision and Actions on Jointly Building Silk Road Economic Belt and 21st-Century Maritime Silk Road" and positioned mutual recognition of regulations as well as cooperation in the field of certification and accreditation as a priority in building the Belt and Road. The "Action Plan for Consolidated Promotion of Standardization and the Belt and Road Initiative" (2015−17) was published the same year and the succeeding 2018-2020 Action Plan was announced in 2018. Through such specific and practical cooperation, the initiative aimed to support the export of China's products and technologies. The Chinese government signed framework agreements for cooperation on standardization with more than 10 countries including Serbia and Kuwait. Outcomes of cooperation in standardization were shared at the Second Belt and Road High-Level Forum for International Cooperation held in 2019. Eight items of Chinese standards including Common Portland Cement were exported to Mongolia and 232 items were added to the list of mutually recognized standards on civil aircraft in China and Russia.[71] The momentum is increasingly building up to export Chinese standard systems in areas such as railways, agriculture, and service industries and align the policies, regulations, and standards of countries along the Belt and Road.[72]

A study session on standardization was held as part of the implementation plan for multilateral trade cooperation by the Shanghai Cooperation Organization. Standardization was also discussed as an important agenda at the Forum on China–Africa Cooperation.

7. Conclusion

The above analysis shows that, generally speaking, China's standards development strategy has evolved in connection with its foreign policy. In the process, the actors, scope, purpose and means of standardization have transitioned as follows.

1. In the early days of standards development, as China shifted its policy from "leaning on one side" to "self-reliance," China started to develop its own national standards as a means to support technology development, although the number of standards issued were still limited. On the other hand, China already started to export its standards by integrating them to the design and management of ideology-based foreign aid projects.

2. Since the Chinese economic reform or the "Opening of China" started, and as basic legal and management systems related to standards were developed, standardization came to recognized as a means to integrate China into the global market. Active introduction of ISO14000 and ISO9000 to eliminated poor quality products and promote export to overseas markets enabled   China to integrate into and benefit from the rule-based world trade system.

3. Following China's accession to the WTO, standardization was promoted to defy non-tariff barriers and low-added value production and as a means to gain competitive advantage. China's efforts to develop concrete policies, facilitate active participation of the private sector, and establish intellectual property rights and standards for technologies are all part of China's endeavor of building a system appropriate as a "responsible major power." In fact, the trend to encourage the participation of developing countries in the decision-making process of global standards helped boost China's activities in international standardization organizations.

4. Later on, China's active development of emerging technologies was linked with criticism against the Chinese political regime and its intentions which led to the manifestation of US-China rivalry over emerging technologies. The government's instructions on standards development were further strengthened, but it was also an interesting change that quality improvement including the governance of environmental and safety performance was strongly advocated not only for emerging

technologies but also for traditional industries and consumer goods. Despite this improvement of technical capabilities, the low productivity in the domestic sphere remains a huge challenge in China.

Looking forward, if China Standards 2035 is to aim at "enhancing quality" as well as networking of emerging technologies through Made in China 2025, development of governance standards will also be important, requiring global cooperation and compromise to a certain extent. In addition, experts from China have gained leadership positions in ISO, ITU and IEC, and they will be required to respond to changes in the harmonization of technologies carried out by international standardization organizations. In this context, it is necessary to analyze the influence of the Chinese government on the leadership of international standardization organizations, which provides another subject for future studies.

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