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Development of Technical Standards Suitable for China's "Go Global" Railway Strategy

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Abstract: In this paper, the author summarizes the main differences between the railway technology standards of China and foreign advanced railways, analyzes technical barriers encountered in terms of product and technology standards in the "go-global" move of China's railway, proposes basic principles and goals for the development of the standards, as well as strategies for different host countries, and comes up with appropriate measures and suggestions.
Keywords: China's "Go Global" railway strategy; technical standards; development

1 Introduction

In recent years, China has implemented sweeping developments in railway and high speed railway (HSR) in particular, and recorded immense achievements that has attracted worldwide attention. In parallel with the continuous expansion of the railway network and unremitting implementation of technological innovation, China's railway has built up a systematic and complete technology standard system, which ensures a safe, reliable, and efficient operation. Along with the unceasing efforts of the Belt and Road Initiative, the role of railway technology standard is becoming increasingly important. Thus, concerns over the development of technology standard system adaptable to "Go Global" of China's railway are also increasing.

2 Current status of standards for product and technology

2.1 Technology standards of China's railway and their features

Technology standards of China's railway have been developed under the prerequisites of complying with Chinese laws and regulations, fitting for Chinese geography, environment, and resource, and fully reflecting market demands. Supported with scientific and innovative technological results, these standards have been established by referring to international standards and advanced technologies, and on the basis of systematically summarizing railway construction practices and operation. In the course of continuous expansion of the railway network and unremitting implementation of technological innovation, China's railway has built up a systematic and complete technology standard system that contains three subsystems respectively for conventional, high speed, and heavy haul, and covers all railway specialties such as locomotive and car, track, communication, signaling, traction power supply, operation and service, and system integration. The system essentially meets the demands of railway construction and operation in China [1], and has better compatibility and adaptability compared with other railway systems.

2.2 Internationalization for technology standards of China's railway

To support the "Go Global" strategy of China's railway, China

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has been pushing forward the internationalization of its railway technology standards in recent years. China has translated a batch of high-quality Chinese railway technology standards, undertaken leadership in organizations, such as the International Organization for Standardization (ISO), the International Electrotechnical Commission (IEC), and the International Union of Railways (UIC), and actively joined in the drafting, revision, and discussion of international standards. In addition, China has promoted orderly mutual recognition between the Chinese railway technology standards and foreign ones, signed *Framework Agreement on Sino-France Cooperation in Standardization*, and is carrying out mutual recognition of railway technology standards with the UK. Thanks to the continuous progress of internationalization of railway technology standards, several overseas railway projects such as the Laos–China Railway and the Jakarta–Bandung High-Speed Rail have confirmed the use of Chinese railway technology standards.

3 Main problems for product and technology standards in the "Go Global" move of China's railway

3.1 Technical barriers in product and technology standards for the "Go Global" move of China's railway

Technology standards have become the actual technical trade barriers for the "Go Global" move of China's railway [2]. For regions and countries with advanced railways, such as EU countries and Commonwealth of Independent States (CIS) countries, Chinese railway products have to comply with European Norms (EN), Technical Specification for Interoperability (TSI), or State Standard of the Soviet Union (GOST), and obtain corresponding certificates to access the markets. However, certain differences exist in the contents of Chinese, EU, and GOST standards; therefore, the certification procedure is difficult, the cycle is long, and the cost is high [3].

In developing countries and regions such as Southeast Asia, South America, Africa, and the Middle East, most countries do not have self-contained standard system for railway product and technology and they do not set technical barriers to restrict foreign railway products entering into their domestic markets. Nevertheless, based on practical experience, obstacles also exist; some countries may require the use of domestic, EU, or UIC standards, while some may opt to use Chinese railway technology standards, add additional provisions in the Chinese standards such as "not lower than those in relevant European standards," or require supervision of a third party. All these may bring certain obstacles for Chinese enterprises and increase cost and workload.

3.2 Differences in main technology standards for railway products between China and advanced countries

The gap between the Chinese railway technology standards and foreign ones is narrowing, although differences remain in certain aspects, such as a standard system structure, standard establishment philosophy, indicator setting method, and test methods.

3.2.1 Differences in standard system structure

The Chinese railway technology standards are established and classified into three subsystems respectively for high speed, heavy haul, and conventional speed, which are independent, with less cross reference and inevitable repeated contents. In contrast, the European railway technology standards are categorized according to different types such as safety and function, and established in a modularized manner, with more cross reference and strong linkage. Therefore, relevant standards have to be referred to use one standard.

3.2.2 Differences in standard establishment philosophy

International standards and those in advanced countries focus on requirements on function, performance, and so forth, while Chinese ones highlight requirements on manufacture and specify details.

3.2.3 Differences in indicator setting method

The EU standards often determine design parameters or technical indicators by calculation with formula, while Chinese ones include no calculation in most cases but specify detailed requirements and technical indicators directly on the basis of calculation or test results, with emphasis on operability.

3.2.4 Differences in some test methods

Technical indicators and items in the tests for some products (rail, sleeper, etc.) in China differ from those in the EU standards.

3.3 Adaptability of Chinese railway technology standards to foreign railway markets

3.3.1 No wide recognition for Chinese railway technology standards

Compared with western countries such as the US, the UK, and France, the start time for the internationalization of Chinese railway technology standards is late, promotion efforts are inadequate, and English versions are few. These result in poor knowledge and understanding of Chinese standards for foreign railway enterprises. The Chinese railway technology standards are used minimally worldwide and need to be recognized further.

3.3.2 Weak voice in establishing international standards

At present, the establishment rights of international standards are held by advanced countries. Developed countries are dominating the formulation of international railway standards, while China has less influence. Moreover, most international standardization organizations regard one country as one member. Consequently, China has only one vote, while the European countries have obvious advantage.

3.3.3 Excessive details and poor flexibility of product standards

The Chinese railway technology standards also specify detailed requirements on manufacture in addition to functional indicators, which lead to many constraints and even unnecessary costs for Chinese enterprises in some cases.

3.3.4 Unrecognized theoretical basis and test methods in standards establishment

Parameters or indicators in foreign railway technology standards are determined theoretically, which are mostly deduced strictly in accordance with mathematical formulas. On the contrary, the Chinese railway technology standards prefer practical applicability and do not explain the calculation and derivation process of some indicators. Besides, test methods in some product and technology standards have differences compared with those in foreign standards. The approach and test methods adopted for the Chinese railway technology standards are not easily accepted or acknowledged by foreign railways.

3.3.5 Inadaptability to special geological conditions and operational environments of the host country

Each country has its distinct economic basis, geographical conditions, operation conditions, and enterprise requirements such that Chinese railway technology standards cannot fully adapt to the national, geographical, operation, and environmental conditions of the host country in some cases.

3.3.6 Intellectual property risk

Some product and technology standards of China's railway involve technologies previously imported, whose application scope were limited; therefore, their application in the "Go Global" process may encounter the risk of intellectual property.

4 Development strategy for product and technology standards suitable for "Go Global" of China's railway

4.1 Basic principles

In order to promote application of the Chinese railway technology standards in foreign railways, the following principles shall be adhered to: strategic synergy, demand coordination; overall planning, division of responsibility; enterprise domination, government promotion; highlighting advantage, driving network with nodes; market segment, various approaches.

4.2 Development goals

4.2.1 Short-term goal (2016–2020)

China's railway will actively join in the establishment and revision of strategies, policies, and rules in international standardization organizations such as ISO/TC269, ICE/TC9, and UIC. Moreover, China's railway will encourage experts and institutes to undertake more important posts and tasks in these organizations so as to make greater contribution to and promote influence in the activities of these organizations. China's railway will also track the activities of international railway standards, convert international standards applicable to China, and accelerate integration between the Chinese railway technology standards and foreign ones. In addition, China's railway will actively lead or participate in the establishment and revision of international standards and promote increased Chinese preponderant or special technologies to be incorporated into international standards. China's railway will push forward the translation of important standards and make Chinese standards to be recognized and applied in a larger scope based on overseas project contract, export of major equipment, and foreign aid projects [4].

4.2.2 Long-term goal (2020–2050)

China's railway will take up a bigger proportion of the expert database and leadership posts in international standardization organizations such as ISO/TC269, ICE/TC9, and UIC, and weigh in on the establishment and revision of strategies, policies, and rules. Some Chinese preponderant technologies will be incorporated into international railway technology standards. When the Chinese railway technology standards become more compatible with and adaptable to international ones, China will own a complete and systematic international version of railway technology standards compatible with international ones, and the degree of acceptance of the Chinese railway technology standards worldwide will significantly improve.

4.3 Strategies to accommodate different host countries

Category I: Countries with poor railway infrastructure and ambiguous requirement on technology such as those in Africa and Southeast Asia. Most of these countries lack self-contained standards for railway product and technology, making them important target markets for the internationalization of the Chinese railway technology standards. China's railway shall strongly recommend the complete set of Chinese technologies and equipment in these countries or regions and strive to implement the Chinese railway technology standards. Meanwhile, with the prerequisite that the host country agrees to implement Chinese standards in principle, China shall also enhance flexibility of the Chinese railway technology standards and make proper adjustments according to the specific requirements of the host country.

Category II: Countries with good railway infrastructure and clear requirements on technology, such as those in Europe. These countries have advanced railway systems and matured railway technology standards. They are reluctant to accept foreign technology standards; therefore, the widespread implementation of the Chinese railway technology standards is hardly possible in

European market. Furthermore, China's railway shall fully exert existing capabilities and actively undertake railway projects or export equipment in accordance with the requirements of the host country.

Category III: Countries other than those in these two categories, such as those in the Middle East, some countries in North America, and Russia. China's railway shall give an overall consideration to multiple factors such as technology, standard, politics, and economic benefit. On the one hand, China's railway shall enhance overseas publicity and recommendation of technology standards, encourage these countries to understand China's railway system deeply, especially China's advantages in HSR technology and cost, on the other hand, China's railway shall attempt to meet the requirements of the countries on railway construction and operation with high standard and under special conditions, and actively introduce the Chinese railway technology standards, realizing international application of the standards by means of partial or indirect acceptance.

5 Suggestions on developing technology standards to promote "Go Global" of China's railway

5.1 To enhance development of Chinese railway technology standard system

5.1.1 To strengthen management of Chinese railway technology standards and perfect the standard system

China's railway shall assign one institute to manage the internationalization of Chinese standards and define its responsibilities and working scope. Meanwhile, China's railway shall determine strategy for the internationalization of Chinese standards, decide the major direction or important field, carry out standardization-oriented research programs for its preponderant or prospective technologies, draw up the plan for intellectual property strategy of key technologies, and guide the internationalization of the Chinese railway technology standards. On the one hand, national and industrial standards are under the charge of the National Railway Administration (NRA), mainly concerning requirements on safety, basis, system, compatibility, and interoperability. On the other hand, China's railway formulates technology standards or normative technical documents to guarantee uniformity and compatibility of product, technology, equipment, and technique, if needed. Meanwhile, China's railway shall organize experts to systematically examine and complement the weak links of industrial technology standard system, complete the system and optimize it, accelerate the establishment and revision of key technology standards, perfect the technology standard system continuously, improve the advanced nature and economy of the standards, and enhance the competitiveness of the Chinese railway technology standards in international projects. Furthermore, China's railway shall strengthen the awareness and management of intellectual property, develop and hold more patents relating to the mainstream railway technologies in the future, push forward the patent obtaining process of independent technologies, actively promote the standardization of patents, develop the procedure for "patented technology–standardized patent–international standard," build up a standard system based on independent intellectual properties, and improve the competitiveness of Chinese railway products in global market.

5.1.2 To establish coordinated development system between technological innovation and technology standard

China's railway shall dedicate more efforts to fundamental and prospective technologies, and build up a good coordinated development system for technological innovation and technology standard. It shall also closely integrate the establishment and revision of standards with practices, such as R&D, test and application of technology and product, enhance the supports of research for standard development, strengthen testing and verification of key indicators of technology standards, transform advanced innovation results into technology standards quickly, use standards to popularize the application of new technologies and products, and drive industry upgrade and development.

5.1.3 To improve independent innovation capability of key technologies and perfect conditions for independent technology test and verification

China's railway shall elevate the capabilities of independent innovation, establish and revise standards according to independent achievements and in combination with independent R&D, manufacture, application and maintenance of key technology and equipment. At the same time, it shall accelerate the development of the Chinese railway technology standard system based on independent technology. China's railway shall leverage capital and policy, increase supports for the construction of test-used facilities and platforms, and provide conditions for inspection and test of independent innovative products. Besides, it shall promote the popularization and application of new independent technologies and equipment in national railways. It shall fully exert the conditions of railway construction and operation to actively provide conditions for tests of independent products on track and on line, thus improving independent technologies and their standards unceasingly.

5.2 To expedite internationalization of Chinese railway technology standards

5.2.1 To cope with basic work favorable for internationalization of Chinese standards

China's railway shall carry out deep researches on the technical standards of main host countries covered by the "Go Global" move, understand both domestic and overseas markets, and lay a foundation for exploiting international market. It shall compare

and analyze railway technology standards at home and abroad, find out the differences, and continuously improve the Chinese railway technology standard system. Moreover, China's railway shall organize experts to translate railway technology standards with great impacts on global railways and complete a batch of high-quality international technology standards and norms. It shall carry out analysis on its preponderant technologies and confirm those that can be transformed into technology standards. In addition, it shall organize experts to translate important Chinese technology standards and interpretive provisions, so as to provide a correct and unified version of Chinese standards for foreign railways.

5.2.2 To actively join in international standardization activities

China's railway shall enhance contact and exchange with UIC, IEC, and ISO, and try to lead and ensure increased participation in the establishment and revision of international standards. It shall promote Chinese personnel to take posts in international standardization organizations and in time, grasp the dynamics of international standards. China's railway shall enhance previous studies on technology standards, organize relevant institutes to join in research subject and grasp and understand international standards more comprehensively.

5.2.3 To elevate the degree of global recognition for Chinese technology standards

China's railway shall follow international standards to develop its technology standards and apply calculation or deduction methods that are common worldwide. In terms of the contents used after modification, notes or explanation shall be added. It shall actively promote mutual exchanges on standardization between governments, carry out mutual recognition of standards, especially of railway technology standards, and encourage more countries to accept Chinese standards. Meanwhile, China's railway shall improve compatibility of the Chinese railway technology standards, and conduct researches on compatibility and interoperability between Chinese standards and those of UIC, ISO, IEC, EN, and so forth, so as to provide technical support for overseas application of the Chinese railway technology standards. In parallel, it shall strengthen the overall planning of publicity, use newspaper, journal, internet, video, and exhibition to reinforce publicity for preponderant technologies and relevant standards of China, increase international awareness about China's railway, and facilitate the use of Chinese railway products and standards by foreign railways.

5.3 To actively propel overseas application of Chinese railway technology standards

5.3.1 To actively accommodate the host country's requirements on railway technology standards

China's railway shall improve the adaptability and flexibility of the Chinese railway technology standards, which enables systematic adjustment based on factors, such as volume, economy, geography, and climate of the host country. It shall help the host country to build up a tailor-made railway technology standard system catering for its transport demands, and drive the country to accept Chinese standards.

5.3.2 To propel overseas application of Chinese railway technology standards by means of projects

China's railway shall make full use of its advantages in technology and economy, closely track the dynamics of overseas railway projects, actively undertake new or upgrading of railway projects overseas, leverage the projects to drive equipment export, and promote Chinese railway technology and the internationalization of the Chinese railway technology standards.

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