

Exploration of the Triple Helix Model of High Speed Railway Technology Innovation of Industry University Research Integration

Qinghui Cheng

School of Intelligent Construction, Fuzhou University of International Studies and Trade, Fuzhou 350202, China

Abstract: The main body of technological innovation in China's high-speed railway industry - universities and research institutions, high-speed railway construction enterprises and the government - are connected by the demand for high-speed railway construction, forming a "triple helix" relationship structure where three forces intersect and influence, stick together and spiral upwards. High speed railway construction enterprises play a leading role in China's high-speed railway technological innovation and construction process, universities and research institutions play a crucial role in technological research and development in China's high-speed railway technological innovation and construction process, and the government team led by the Ministry of Railways plays the role of organizers and commanders in China's high-speed railway technological innovation and construction process.

Keywords: Triple helix; High-speed railway; Technological innovation; Integration of industry; Academia and research.

1. Introduction

Generally speaking, universities and research institutions, as social organizations, possess abundant knowledge reserves, advanced technological equipment, and strong knowledge innovation capabilities. Industry refers to the basic organizational structure system of social production formed by the interconnection of talent, technology, materials, funds, information and other elements that exist and develop in human society, economy, and management activities; As an external manifestation or constituent unit of the industry, enterprises have strong innovation needs and material capabilities to stimulate high-tech industries, and can keenly capture market dynamics and people's needs. The government has the ability to allocate funds and organize regulation, and is the creator and maintainer of science and technology innovation policies and environment, capable of bearing certain risks in science and technology innovation.

2. The Integrated Model of Industry University Research in China's High-Speed Railway Technology Innovation

When China decided to build its own high-speed railway, its technological reserves were not as abundant as the outside world imagined. In such an environment, relying solely on enterprises, universities, and research institutes to explore from scratch is difficult to achieve the current construction speed of China's high-speed railway. At this time, the government needs to play a strong organizational and coordinating role to promote the research and development process of China's high-speed railway technology. Another practical issue is that in order for China's high-speed railway to achieve leapfrog development, it must introduce, digest, absorb, and innovate the technological achievements of the world's high-speed railways. In view of the fact that in the process of technology introduction in other industries in China, different interest subjects separately attacked and

fought each other, leading to "competition between the snipe and the clam, and the winner benefited", and finally letting foreigners pick up a lesson from the failure, China's high-speed railway technology introduction must change its thinking. China has unique national conditions, a large population, vast territory, and obvious market advantages. We must integrate the market, fully leverage the huge advantages of strategic buyers, aim at targets, hold hands, firmly control the initiative, and become the ultimate winner at the negotiation table, ultimately achieving the goal of low-cost introduction, re innovation, and saving a lot of funds for the country. The most suitable target for integrating the market and fully leveraging the huge advantages of strategic buyers is the Ministry of Railways. Therefore, the Ministry of Railways must play a unique organizational and coordinating role in the technology research and development and construction of China's high-speed railways, in order to achieve the strategic goals of China's high-speed railway construction. According to relevant data, China's successful introduction of high-speed railway related technology and equipment at a relatively low cost has been cited as a classic case by Stanford University in the United States, appearing in students' textbooks.

In summary, in the process of technological innovation in China's high-speed railway, it can be considered that the integration of industry, academia, and research in high-speed railway technological innovation belongs to the "government driven+market-oriented model".

3. Triple Helix Model

The "triple helix" innovation model of industry university research relationship was first proposed by Etzkowitz and Leydesdorff in 1995. It refers to the strengthening of resource and information sharing and communication among universities, industries, and governments through organizational structural arrangements, institutional design, etc., in order to achieve efficiency and effectiveness in the utilization of technological resources. The Triple Helix International Conference has been held five times since 1996,

forming the Triple Helix Innovation System Theory. At the International Conference on the Triple Helix, there has been considerable controversy and debate regarding the empirical basis and paradigm implications of the triple helix. However, at least the following categories of triple helix models have been identified and confirmed: alpha triple helix, beta triple helix, and gamma triple helix.

Alpha triple helix: Under this framework, the national government includes academia and industry and has a direct relationship with them. Here, it is referred to as the model of industry university research authoritarian restraint [5].

β - Triple helix: consisting of separate tissue layers with strict boundaries, which highly restrict the connections between these layers. This model example can be seen in the Soviet Union and Eastern European countries that use shock therapy. Here, it is referred to as the industry academia research laissez faire model.

The gamma triple helix model: It can be expected to generate a knowledge base construction layer, and under its further developed interwoven and overlapping institutional system, each can play a role in the others, and create a hybrid hybrid organization at the interaction interface. This overlap and bonding partially integrate the fundamental arrangement in this distributed network mode, thereby maintaining incompleteness and tending towards flexible migration and transition.

In China, the socialist market economy system has been basically established. The main construction units of high-speed railways in China, such as China Railway Group, China Railway Construction Corporation, China South Locomotive and Rolling Stock Corporation, and China North Locomotive and Rolling Stock Corporation, have been separated from the Ministry of Railways and are self-financing enterprises. Some non-railway enterprises that were not originally under the supervision of the Ministry of Railways can also participate in high-speed railway construction, such as China State Construction Engineering Corporation, China Communications Construction Group, China Hydropower Construction Group, etc. Therefore, it can only be considered that the main construction units of high-speed railways in China are influenced by the Ministry of Railways and not under its control. This is especially true for universities. After the reform of the national higher education system, all 11 universities under the Ministry of Railways have completely separated from the Ministry of Railways. Among them, Beijing Jiaotong University (formerly Northern Jiaotong University), Central South University (including Changsha Railway Institute) and other universities are still directly under the jurisdiction of the Ministry of Education after restructuring. However, the heavyweight unit in railway research institutions, the Railway Science Research Institute, is still a public institution under the jurisdiction of the Ministry of Railways. Therefore, China's high-speed railway technology innovation industry university research integration model belongs to the gamma triple helix model.

The triple helix model of industry university research in China's high-speed railway technology innovation provides a good methodological research tool. The main body of technological innovation in China's high-speed railway industry - universities and research institutions, high-speed railway construction enterprises and governments - are connected by the demand for high-speed railway construction, forming a "Triple Helix" relationship structure where three forces intersect and influence each other, and then spiral

upwards together. The triple helix provides each participant with multiple options. Each participant in each aspect is adaptive, and innovation within each spiral arises within the entire large spiral system, thus connecting with other spirals and being selected for utilization in the first place. The economic and social benefits generated by the spiral will also be quickly absorbed by the subsystem. The triple helix uses this power to maintain the evolution of internal functions and structures, quickly forming selective specific combinations and absorbing energy again. As a result, the entire model gains continuous innovation power.

4. Analysis of the Functional Positioning of All Parties in The Triple Helix Model

In the process of integrating industry, academia, and research in high-speed railway technology innovation in China, the government's function is to formulate strategic plans and major policies for cooperative development, coordinate major cooperative projects, etc; The function of universities and research institutions is to focus on high-tech basic research and development work, providing advanced technology and research results; The function of an enterprise is to focus on the research and development of applied technology and process innovation, and to commercialize scientific and technological achievements. Specifically, in the process of technological innovation and high-speed railway construction in China, the functions of the government, enterprises, universities, and research institutions are as follows:

(1) High speed railway construction enterprises play a leading role in China's high-speed railway technology innovation and high-speed railway construction process. High speed railway construction enterprises are the implementers of China's high-speed railway construction and the masters of high-speed railway construction technology, experiencing the wind and grass of high-speed railway construction. High speed railway construction enterprises bear the responsibility of summarizing technical difficulties, developing technological innovation directions, and cooperating with universities and research institutions for technological innovation in practical work. Due to the fact that researchers from universities and research institutions cannot stay on the front line of construction for a long time, the on-site technical workers and personnel have the deepest feelings about the shortcomings of high-speed rail technology and their expectations for technological innovation. They have the most say in discovering research directions. It should be said that only high-speed rail construction enterprises can propose the most targeted research and development directions, and the industry university research of high-speed rail can truly be implemented to solve practical problems.

(2) Universities and research institutions play a crucial role in technological innovation and construction of high-speed railways in China. Knowing the truth and not knowing the reason behind it, one can never grow from elementary school students to college students. The main implementers of technological innovation in China's high-speed railway are universities and research institutions. They must go deep into the front line of construction, digest the new technologies and processes introduced by the Ministry of Railways, compare them with China's actual national conditions, accept research and development funds from various channels according to

the actual needs of high-speed rail construction enterprises, and carry out research and development of high-speed rail technology with Chinese characteristics.

While experiencing the forefront of high-speed rail technology in the world, universities and research institutions must simultaneously develop high-speed rail construction technologies that meet China's actual national conditions to adapt to the situation of high-speed rail construction in China, and explore advanced high-speed rail technologies at the forefront, providing a substantial technical reserve for future high-speed rail technology competitions to ensure that China's high-speed rail technology keeps pace with the times and competitive advantages. For example, China is developing vacuum tube maglev with a speed of 4000 kilometers per hour. The astonishing characteristics of vacuum tube maglev trains are a speed of 4000 kilometers per hour, energy consumption less than 1/10 of that of passenger planes, noise and exhaust pollution, and accident rates close to zero. As a new generation maglev train, the vacuum tube maglev train will integrate Beijing and Washington into a two-hour transportation circle, and completing a global trip in a few hours has become a recent goal for scientists. China has already taken the lead in this research. In 2007, the project was listed as a National Natural Science Foundation project, and experts such as Professor Zhang Yaoping successfully applied for a large number of related patents. A transportation revolution is imminent.

(3) The government team led by the Ministry of Railways has played the role of organizer and commander in China's high-speed railway technology innovation and high-speed railway construction process.

① The Ministry of Railways is the organizer and implementer of China's high-speed rail technology introduction.

To achieve leapfrog development and meet the transportation needs of building a moderately prosperous society in all respects, China's railways must emancipate their minds, expand openness, boldly introduce advanced foreign technologies, and rapidly improve the level of technical equipment. Bold introduction is not a complete copy of foreign technology, nor is it a single introduction of technology and equipment from a certain country. It is based on the needs of China's railway modernization, widely absorbing and drawing on all advanced technologies and achievements from around the world, selectively and selectively introducing technology, especially core technologies and key equipment. The Ministry of Railways has adhered to the four basic principles of high-speed railway technology introduction: ensure progressiveness, introduce technology must face the world, and adhere to a high starting point; Ensure the maturity and standardization of technology, and avoid using railway technology that has not been tested in practice; Ensure applicability; Ensure reliability, stable technical equipment performance, good quality, and can guarantee transportation safety.

② The Ministry of Railways is the driving force and accelerator of China's independent innovation in high-speed railway technology.

Independent innovation is more important than technology introduction. The introduction of technology only puts China on the shoulders of high-speed rail technology giants, but how far China's high-speed rail technology can go still depends on China's independent innovation. As the industry supervisory unit, the Ministry of Railways has spared no effort in the

technological innovation of China's high-speed railway. Since the 1990s, it has carried out a large number of scientific and technological projects every year, and has effectively organized and coordinated work around the introduction of high-speed railway technology and China's high-speed railway technology reserves. It has determined China's own high-speed railway technology route, established its own high-speed railway research team, formulated China's own high-speed railway technology specifications, trained its own senior high-speed railway technicians, developed high-speed railway technology equipment with Chinese characteristics, and determined China's high-speed railway construction plan, etc.

Not only did the Ministry of Railways take the initiative to elevate high-speed railways to the national level and become a national strategy in China, but in the "Medium - and Long Term Plan for Railway Network" submitted to the State Council for discussion and approval, the construction mileage of high-speed railways was clearly set at 16000 kilometers. High speed railway technology became a major science and technology project formulated by the Ministry of Science and Technology, and was supported by national science and technology funds. The National Natural Science and Technology Foundation of China also provided research and development funds for high-speed railway technology innovation, and the National Development and Reform Commission supported the Ministry of Railways in establishing a national engineering laboratory for high-speed railway related technologies. The government team led by the Ministry of Railways, including the Ministry of Science and Technology, the National Development and Reform Commission, the National Natural Science and Technology Foundation of China, and other institutions, played a significant role in the construction.

③ The Ministry of Railways is becoming an important driving force for the export of China's high-speed railway industry.

The construction of high-speed railways will be a key focus of China's railway construction in the near future. However, the significance of high-speed railway construction is not only reflected in providing a convenient mode of transportation, but also in driving the structural and technological upgrading of China's manufacturing industry. He Huawu, chief engineer of the Ministry of Railways and academician of the CAE Member, pointed out at the fourth Asian Manufacturing Forum a few days ago that high-speed railway construction is an integration of multi-disciplinary, multi field and high-tech. The benefits of China's high-speed railway are reflected in all links of the industrial chain, which has formed a huge high-tech development industry chain, which has a strong driving role in metallurgy, machinery, construction, materials, rubber, electricity, information, precision instruments, environmental protection and other industries. It has cultivated a number of star level enterprises, providing a big stage for the equipment manufacturing industry to further improve its scientific and technological innovation ability and technological progress. For example, in the heavy machinery industry, a complete set of equipment for the production, transportation, and erection of 900 ton box girders has been successfully developed, enabling 80.5% of the Beijing Shanghai high-speed railway to pass through elevated bridges. This has also spurred and cultivated a group of enterprises with 900 ton box girder transport vehicles; The high-speed railway in China with a speed of 350 kilometers per hour uses ballastless tracks, and

this technology has also cultivated some enterprises that develop complete sets of equipment for ballastless track construction; In addition, in the field of machine tools, due to the use of large horizontal machining axle boxes in the high-speed railway processing car assembly, it is necessary to achieve optimal rigidity, avoid cutting chatter, and also have dynamic frequency analysis. Equipment companies will undergo qualitative changes in terms of technology, output value, and manpower. This has attracted high attention from overseas equipment manufacturers. For example, executives from Siemens and Alstom have expressed concerns about China becoming an exporter of high-speed railways.

5. Conclusion

The triple helix model of industry university research innovation in high-speed railway technology tells us that with the development of the network and the deepening of cooperation, the knowledge flow between universities and industries has undergone a series of subtle and complex changes. These come from testing and feedback on research ideas, information obtained from market structures, etc. The government, as a policy maker, funding supporter, consultant,

and talent demander, will also join this knowledge flow.

References

- [1] Jianghai, Ma Qiang Refactoring the Industry University Research Cooperation Model Suitable for Universities [J]. Research on Science and Technology Management, 2004, (5):15-17.
- [2] Luo Wei, Tang Yuanhu Game analysis of university enterprise cooperative innovation [J]. Systems Engineering, 2002, (1):28-31.
- [3] Written by Schumpeter, compiled by Kong Weiyuan, Zhu Panfeng, and Lou Jifang Economic Development Theory [M]. Beijing: Beijing Publishing House, 2007
- [4] HENRY ETZKOWITZ. Academic industry relations: A sociological paradigm for economic development [M] // LEYDESORFF H, VAN DEN BESSELAAR P. Evolutionary Economics and ChaosTheory 1997.
- [5] Loet Leydesdorff. The Triple Helix Model and the Study of Knowledge Based Innovation Systems [J]. Int. Journal of Contemporary Sociology, 2005, 42(1):12-27.