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RESEARCH ON THE DEVELOPMENT PATH OF NINGBO TRANSPORTATION EQUIPMENT MANUFACTURING INDUSTRY IN 16 CEEC

Bo Wang
Ningbo University of Technology, Ningbo, Zhejiang, China

Danjuan Hu
Ningbo University of Technology, Ningbo, Zhejiang, China

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Abstract

Ningbo's transportation equipment manufacturing enterprises have reached the world's leading level in technology, but the CEEC, whose economic level surpasses our country, are lagging behind in terms of transportation infrastructure construction. With the promotion of the "One Belt and One Road" strategy, the well-developed transportation equipment manufacturing industry in Ningbo hopes to enter the vast market of CEE, and CEEC also urgently need to improve the status quo of domestic transportation infrastructure construction. In this context, based on the science and technology cooperation alliance between our university and universities in CEE, the external output of Ningbo's advanced transportation equipment manufacturing industry can be achieved by carrying out long-term cooperation forum activities, jointly applying for international science and technology cooperation projects and human resources exchange training cooperation and decision-making consultation service cooperation, etc. to improve China's position in the global industrial chain and value chain and promote the deep integration of economic cooperation among countries along the One Belt and One Road.

Keywords: *transportation equipment manufacturing industry; CEE; S&T cooperation alliance; output*

1 INTRODUCTION

With the continuous deepening of China's "One Belt and One Road" strategy, the Ministry of Science and Technology has advocated to actively promote the export a large number of advanced and applicable technologies and scientific and technological talents accumulated in China to the countries along the line. As a competitive industry in China, transportation equipment manufacturing has reached the world's leading level in technology. As countries along the “One Belt and One

Address of the corresponding author:
Bo Wang
bo305@hotmail.com

Road" initiative, the 16 countries in CEE are relatively backward in terms of infrastructure and have an urgent need for interconnection and infrastructure construction, which provides a good opportunity for China's transportation equipment manufacturing industry.

As a strategic fulcrum city for the country's CEE strategy, Ningbo City has a good foundation for cooperation with CEE. We intend to provide services to the development of the CEE cooperation partners and China's transportation equipment manufacturing industry in the 16 countries in CEE through the scientific and technological cooperation alliance, thereby outputting equipment manufacturing standards to meet the external expansion needs of Ningbo's advanced transportation equipment manufacturing industry and improve China's position in the global industrial chain and value chain and promote the deep integration of economic cooperation among countries along the One Belt and One Road.

2 ANALYSIS OF THE STATUS QUO OF THE TRANSPORTATION INFRASTRUCTURE CONSTRUCTION IN 16 COUNTRIES IN CEE

16 countries in CEE as countries along China's "One Belt and One Road" initiative, from the perspective of per capita income and per capita GDP (figure 1), half of the countries' economic level has surpassed China's, or even more than China's, but most countries are relatively backward in infrastructure construction, and transportation facilities such as railways, roads and ports are facing renewal problems. Calculate according to the total infrastructure investment accounted for about 5 % of GDP, the demand for infrastructure in CEEC reached $ 68.03 billion in 2015, while the turnover of engineering contracting projects in CEEC was $ 1.18 billion, only accounting for 1.73% of them (figure 2). It can be seen that China and the 16 countries in CEE have extensive space for cooperation and development in the construction of transportation infrastructure.

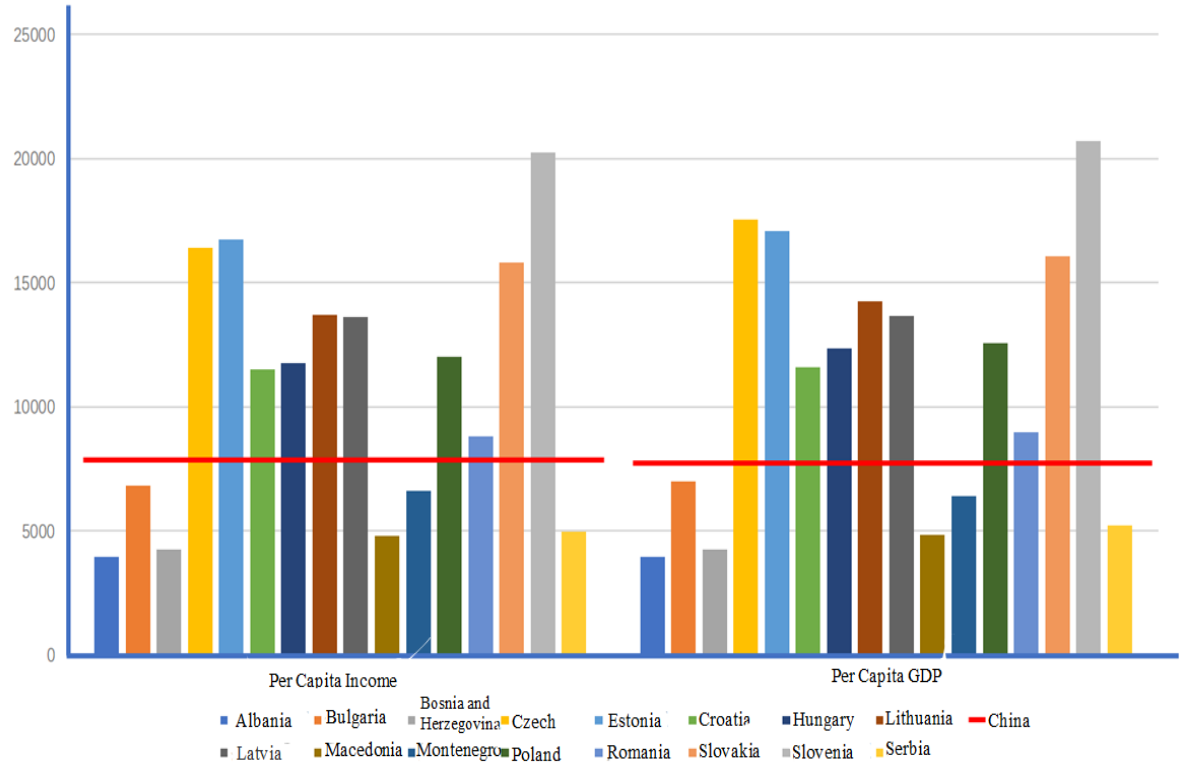


Figure 1 Per Capita Income and Per Capita GDP of China and 16 countries in CEE in 2015 (unit USD)
Data Source: World Bank

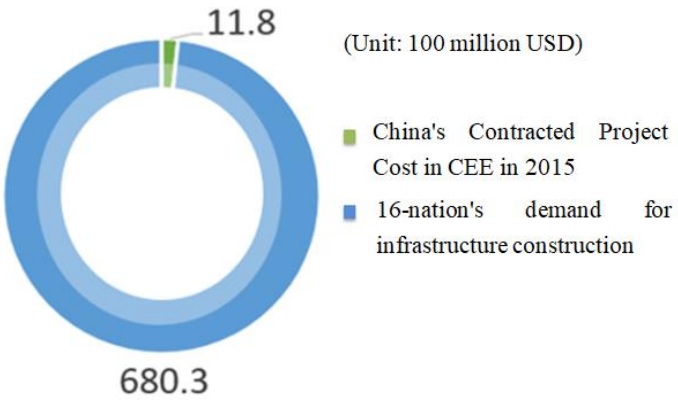


Figure 2 China's Contracted Projects in CEE
Data Sources: World Bank and Ministry of Commerce of the Peoples Republic of China

Table1 Serbia's railway construction planning project (2015)

Name of capital construction	Amount of money	Project description
XI corridor, E - 763 highway, Belgrade - south of the Adriatic Sea: Surčin - Obrenovac, and Preljina - Boljare	495 million EUR	Surčin—Obrenovac: 17.6 kilometers Preljina—Požega: 30.96 kilometers Obrenovac—Preljina: 103.14 kilometers
The part of XI corridor, E - 763 highway, Belgrade - south of the Adriatic Sea: Preljina - Boljare.	1.8309 billion EUR	Total length is 107 kilometers
The construction of Niš - Merdare (-Priština) highway.	855 million EUR	Construction Route: Niš-Prokuplje Merošina-Pločnik-Kuršumlija-Merdare, the construction section can achieve the highest internal rate of return, there are totally 22 kilometers from Merdare to Priština.
The modernized reform of Belgrade of Serbia area-Budapest Railway (The Railway Project of Hungary-Serbia)	1.132 billion EUR	Reconstruction/Modernized reform Belgrade-Budapest double line railway, speed 200 kilometers per hour
The modernized reform of the railway line between Serbia and Albania (area within the territory of Serbia)	400 million EUR	Including the reconstruction and modernized reform of Lapovo-Kraljevo-Lesak railway, and Lesak-Prizren railway and the construction of Prizren-Skadar railway. This railway has suitable development technology and characteristics.
The reconstruction of Požarevac - Majdanpek railway	30 million EUR	The total length of the railway is 254 kilometers, the railway is rebuilt and installed on the route of retaining existing traffic lines, to make the speed up to 100km/h, the shaft is allowed to load 22.5 tons, the load of 8.0t/m is shared by the railway. Suitable communication, signal, and safety system are equipped to the railway.

Name of capital construction	Amount of money	Project description
The reconstruction and modernization reform of Pančevo-Zrenjanin-Banatsko Miloševo-Senta-Subotica railway	96 million EUR	The railway is rebuilt and installed on the route of retaining existing traffic line, to make the speed up to 100km/h, the shaft is allowed to load 22.5 tons, the load of 8.0t/m is shared by the railway. Suitable communication, signal, and safety system are equipped to the railway.
The reconstruction of Petrovaradin-Beočin railway	16 million EUR	The railway is rebuilt and installed on the route of retaining existing traffic line, to make the speed up to 100 km/h, the shaft is allowed to load 255KN, a load of 80 KN/m is shared by the railway. Suitable communication, signal, and safety system are equipped to the railway. Railway Electrification.
The construction (reconstruction) of Segedin-Horgoš-Subotica-Cikerija-Baja railway	15 billion EUR	The part of the railway through Hungary is subsidized by the European Union and Hungary.
The reconstruction of Novi Sad - Odžaci-Bogojevo railway	19 million EUR	The railway is rebuilt and installed on the route of retaining existing traffic line, speed up to 100/h, installed type rail, the shaft is allowed to load 22.5t, the load of 8t-m is shared by the railway. Suitable communication, safety signal system, and signal tower are equipped to the railway.

Take Serbia as an example, Serbia's railways have been in disrepair for a long time, the equipment has been severely deteriorated, and the standard-reaching rate of railway facilities is only 44%. According to the *General Planning for Transport Infrastructure Construction in Serbia 2010-2027*, Serbia will invest 22.2 billion euros in the construction of expressways, railways, airports, and ports in the next 17 years. It can be seen that Serbia has a huge demand for transportation infrastructure construction. Judging from the railway construction planning project announced by Serbia (the year 2015) (Table 1), Serbia mainly focuses on the modernization reconstruction and equipment renewal of railways, but due to the small scale of Serbian domestic companies and the substandard level of technology, it is difficult to undertake the construction of large-scale projects. So, the most railway construction is contracted to foreign companies. Therefore, there are great development opportunities for Chinese enterprises to enter the market in CEE.

3 ANALYSIS OF DEVELOPMENT STATUS OF NINGBO TRAFFIC EQUIPMENT MANUFACTURING INDUSTRY

Ningbo's transportation equipment manufacturing industry includes enterprises represented by rail traffic equipment, bridge engineering mechanical equipment and high-end ship equipment manufacturing enterprises. After years of development, Ningbo has emerged a group of advantageous enterprises with strong technical force and strong

production capacity and has achieved an international leading level in many fields. Take Zhejiang Zhongrui Heavy Industry Technology Co., Ltd and Ningbo CRRC New Energy Technology Co., Ltd. as examples (Table 2), both enterprises have strong research and development teams, supercapacitors and drilling rig preparation technologies with fully autonomous intellectual property rights and the overall technology power is in the international leading position. In addition, the companies' products have participated in a number of well-known projects at home and abroad, which have accumulated rich practical operation and management experience for the infrastructure construction towards the international market. For example, the Hangzhou Bay Sea Cross Bridge and Bangladesh PADMA Bridge that Zhejiang Zhongrui Heavy Industry Technology Co., Ltd participates in the construction.

Zhejiang Zhongrui currently has only one branch company in Indonesia and its products are mainly sold in Southeast Asia. Hope to take advantages of the “One Belt and One Road” opportunity to set up branch companies or offices in countries around Europe to accelerate the promotion strength of Zhongrui products. Ningbo CRRC is a core subsidiary of CRRC Zhuzhou Investment Holding Co., Ltd. and has sales networks in the United States and Central and Western Asia countries. Although it is also involved in CEEC, it is limited to Poland, Serbia, and Croatia and other four or five countries, not yet throughout CEE. It can be seen that although the company has strong production capacity, advanced product technology, and rich practical operation and management experience, it has not penetrated into the vast market of CEE. However, the proposal of the “One Belt and One Road” strategy has provided a broader space and development platform for Ningbo enterprises to "Go Global". Enterprises are all hoping to take advantage of this to create, penetrate and occupy the markets in CEE.

Table 2 Introduction of Ningbo typical transportation equipment manufacturing enterprise

Enterprise	Main products	Scientific research level	Technological superiority	Application fields	Existing cooperation projects
Zhejiang Zhongrui Heavy Industry	All-hydraulic drill rig	Long-term cooperative relations have been established with many scientific research institutes and universities, such as Central South University and Zhejiang University, and it has independent intellectual property rights, and has applied for and obtained more than 20 patents authorized by the State Intellectual Property Office.	1. High efficiency and energy saving, reliable and stable transmission performance. 2. Effective control of perpendicularity and aperture accuracy, and wear reduction of drilling tools. 3. Easy operation, low maintenance cost and comfortable operating room environment.	Ocean wind power construction of the large bridges at home and abroad, port, etc., sewage treatment wells and other engineering fields.	Hangzhou Bay Sea Cross Bridge，Hong Kong-Zhuhai-Macao Bridge, Malaysia Penang Bridge, Mozambique Maputo Bridge, Bangladesh PADMA bridge, Fujian Pingtan Gulf Wind Farm and so on.

Enterprise	Main products	Scientific research level	Technological superiority	Application fields	Existing cooperation projects
Ningbo CRRC New Energy Technology CO., LTD	60000F battery capacitive supercapacitor	It sets up the CRRC Super Capacitor Research Institute and Zhejiang Postdoctoral Workstation, bears more than 30 scientific research projects such as the national "863 Project", national science and technology major projects of MIIT" Strong Industrial Base Project 2016", Ningbo industrialization project and key research topics, CRRC inner projects and so on.	The energy density is 40Wh/kg, and the charging time is only 6~8min, which can enable the bus (electric bus) to travel more than 20 kilometers in full load with one charge time and save electronic power more than one third than that of conventional trolleybuses.	It is used in super electric energy tramcars, trolleybuses.	Supercapacitor energy storage trams such as Guangzhou Haizhu Roundabout Tram, Shenzhen Longhua Line, and Jiangsu Huaian Line, etc. supercapacitor energy storage trolleybus, oil and electric hybrid car of Ningbo bus line; Guangzhou metro 1500V line storage system.
AOTU Heavy Industry, CO., LTD	ME (350t 10 r350t) universal gantry crane	It has been established the R&D Center of the Provincial High-tech Enterprise of AOTU Heavy Industry. Using its own technology to get the research achievements of *Energy Saving Technology for Design of New Type Hoisting Machinery Lightweight*, which is included in the catalog of *National Key Energy*	It adopts all-frequency PLC control technology, overload protection, fault alarm display laser ranging and other domestic and foreign advanced technology, it can be sensitive to the slight changes in the lifting process.	Advanced manufacturing, military industry, rail transit, aerospace, nuclear power, coal, chemical, electric power, shipbuilding and metallurgy and other matched fields.	Ningbo railway transport line 1, line 2, Wuxi railway transport line 2, and cooperation with Sri Lanka, Venezuela, Nigeria and other countries.

Enterprise	Main products	Scientific research level	Technological superiority	Application fields	Existing cooperation projects
		Conservation Technology Promotion (fifth). Two of new products obtain the MOST Innovation Fund, among which 1 item is listed in the 2011 annual fund key support project.			
Ningbo Shangong Intelligent Security Technology, CO., LTD	GFRP series fiber grating strain sensor	Now it has a full set of equipment and laboratory of related technology and auxiliary product research, R&D center respectively In Hangzhou Binjiang District, Ningbo Wangchun Industrial Park, Harbin, bears the national "863 Project", the National Science and Technology Support Plan and so on scientific research projects, as well as also sets up Expert Committee in which the academician of the Chinese Academic of Engineering, the expert in The Recruitment Program of Global Experts, Chang	The engineering test requires that the standard distance of the adjustment range can be up to 1~2cm, which has the advantages of simple project layout and large range, good durability, and high precision, etc.	Transportation infrastructure, urban public infrastructure, civil engineering construction.	Qinlai Expressway, Wuhan Railway Line4 the Second Phase Project, Daqin Railway Bridge, Jiangxi Jiujiang Bridge, etc.

Enterprise	Main products	Scientific research level	Technological superiority	Application fields	Existing cooperation projects
		Jiang Scholars, and many other well-known experts take the experts position.			

4 PROBLEMS IN THE "GO GLOBALLY" OF NINGBO'S TRANSPORT EQUIPMENT MANUFACTURING INDUSTRY

4.1 Face a variety of risks

The "Go Globally" of Ningbo's transport equipment manufacturing industry faces various risks, including political risk, economic risk, social environmental risk, legal risk, contract risk, and cultural risk among different countries (Houming, 2015). Its concrete manifestations are shown in Table 3.

4.2 The "Go" of "Go Globally" is too blind

In recent years, with the promotion of national policies, some enterprises in Ningbo have also gradually marched towards CEE. However, because most enterprises only use "Go Globally" as a short-term action to transfer old equipment, obtain investment subsidies, or enjoy preferential policies, they can't stand at the strategic height of corporate sustainable development to plan the "Go Globally" behavior of enterprises, thus limiting the international competitiveness of Ningbo's transport equipment manufacturing industry. At present, the "Go Globally" enterprises in Ningbo are too accustomed to fighting alone, and there is a lack of necessary cooperation among enterprises, and integrated innovation is rarer (Qin, 2017)

Table 3 Types of Risks that "Go Globally" of Ningbo's Transport Equipment Manufacturing Industry May Encounter

Type	Specific Risk	Concrete Manifestation
Uncontrollable Risk	Political risk	Political party replacement, terrorism, war
	Economic risk	National sovereign credit risk, exchange rate risk
	Environmental risk	Destroy the natural environment, the opposition of residents of the host country
Controllable Risk	Legal risk	Different legal systems
	Contract risk	Irregular contract signing
	Cultural risks among different countries	The social system, cultural customs, religious beliefs

4.3 The "Go Globally" approach is relatively single

The "Go Globally" strategy is divided into two levels: first, the output level of goods, including the output of goods and elements such as goods, services, technology, and management; and second, the output of capital, which is through foreign direct investment to build overseas factories (Guimin & Ping., 2016(4):). From the current situation in Ningbo City, Ningbo's transport equipment

manufacturing industry still basically stays at the initial stage of the “Go Globally” strategy, that is, product output is the main factor, and technical output, service output, management output, and capital output are seriously insufficient.

5 PATH STUDY OF TECHNOLOGY ALLIANCE'S SERVICE FOR THE "GO GLOBALLY" OF NINGBO’S TRANSPORT EQUIPMENT MANUFACTURING INDUSTRY

5.1 Conduct long-term forum activities to promote technical exchanges and industrial cooperation negotiations

Since Ningbo became the first batch of innovative pilot cities in China in 2010, it has successively become China's first pilot demonstration city of “Made in China 2025” and one of the first two national demonstration parks for the transfer of scientific and technological achievements. The bi-directional exchange platform of China and CEEC has consecutively undertaken more than 20 activities since 2014 such as the CEEC Investment and Trade Expo and China-CEEC Investment Cooperation Meeting (Table 4).

Take the China-CEE Cooperation Forum held from June 9 to 12, 2017 as an example (Figure 3), during the forum, we visited Zhejiang Zhongrui Heavy Industry Technology Co., Ltd. with representatives from Bulgaria, Poland, the Czech Republic and Serbia and other countries.

Table 4 Table of China-CEEC' Exchange Platforms (Using Ningbo as the Host City)

China-CEEC Forum on Cooperation Development	China-CEEC Commercial Chambers Investment and Business Symposium
China-CEEC Cooperation Conference for Chamber of Commerce	Partnership for Connectivity China-CEEC Customs Cooperation Forum
China-CEEC Educational Cooperation Forum	China-CEEC Trade (Cross-Border E-Commerce) Symposium
China-CEEC Educational Cooperation Conference	China-CEEC People-to-people and Culture Exchange Activities
China-CEEC Tourism Cooperation and Exchange Conference	China-CEEC Culture and Arts Communication Activities
China-CEEC Cooperation Seminar for Chamber of Commerce	China (Ningbo)-Central and Eastern European Countries S&T Achievements Promotion Communication Activities
China-CEEC Investment Cooperation Meeting	China (Ningbo) -CEEC Economic & Culture Exchange Week
Fruit and Vegetable Meat Show of CEEC	China (Ningbo) -CEEC Investment Cooperation Industrial Park Promotion
The Overseas Chinese Businessman of CEEC Summit Ningbo	Central and Eastern European Countries Products Fair
China-CEEC Mayors Summit	Guest of Honor Activities

At the exchange meeting, bilateral exchanges and consultations were held on the hot technical issues in the field of capital construction, and they conducted further communication and understanding of Zhejiang Zhongrui Heavy Industry Technology Co., Ltd.'s main product, hydraulic reverse circulation drilling rig. Afterward, the Serbian representative provided suggestions and related information for Zhejiang Zhongrui Heavy Industry Technology Co., Ltd. to enter the CEE markets through the mail and helped to get in touch with the Minister of Transport, Republic of Serbia.

Through the existing work model, our experts have inspected foreign related enterprises and determined research directions and research plans. After the achievements are produced, Chinese

experts negotiate cooperation with foreign partners and rush abroad to carry out relevant verification experiments. It is expected to achieve performance optimization and meet national standards and reach cooperation agreements to achieve achievements transfer and transformation cooperation.

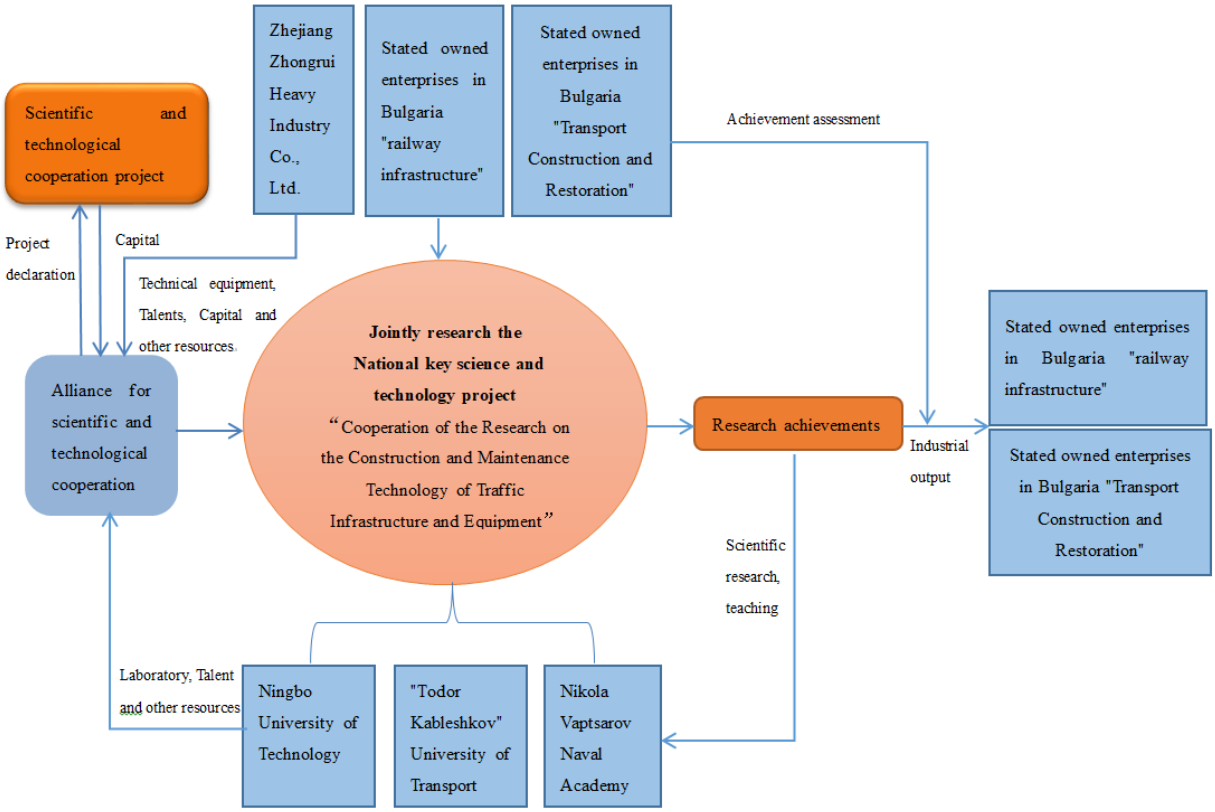


Figure 3 The flow chart of the conference activities

5.2 Rely on International Scientific and Technological Cooperation Projects to Lead Capacity Output

Since the implementation of the "One Belt and One Road" strategy, China has ushered in a good opportunity for international science and technology cooperation with CEEC. Over the years, our university and Bulgaria, Slovakia, and other Central and Eastern European countries have jointly declared more than 20 international science and technology cooperation projects represented by the National Key Science and Technology Program for "Cooperation in Research and Development of Harsh Environment Transport Infrastructure Construction and Maintenance Technology and Equipment", of which three items have been approved, and strived for 12 national talent projects. Through the joint application of scientific research projects, Ningbo and CEEC have achieved the output of leading production capacity relying on international science and technology cooperation projects (Figure 4).

The science and technology cooperation alliance has established a good cooperation relationship with more than 30 related scientific research institutions. On this basis, each person promotes the output of transport equipment technologies and standards by following up on their respective responsible enterprises, and the exchanges with relevant cooperative enterprises and colleges and universities in CEE. At the same time, the project's research achievements will be integrated. On the one hand, it will be negotiated with the principals of foreign colleges and universities to compile Ningbo's transport equipment and manufacturing technology into teaching materials, translate them into English or foreign official languages for colleges and universities' research and teaching; and on the other hand, it is used for the R&D and transformation of existing equipment of enterprises to meet the special needs of the CEE markets, and

to enter the 16-nation markets, and finally realize the output of products.

5.3 Promote scientific research achievements and industrial docking through deep integration of industry-university-research

The scientific and technological cooperation alliance is a platform for promoting the transformation of scientific research achievements. It is a link and bridge for cooperation between scientific research institutes, universities, and enterprises. It can create opportunities for the docking of scientific research achievements and industry from the following two aspects：

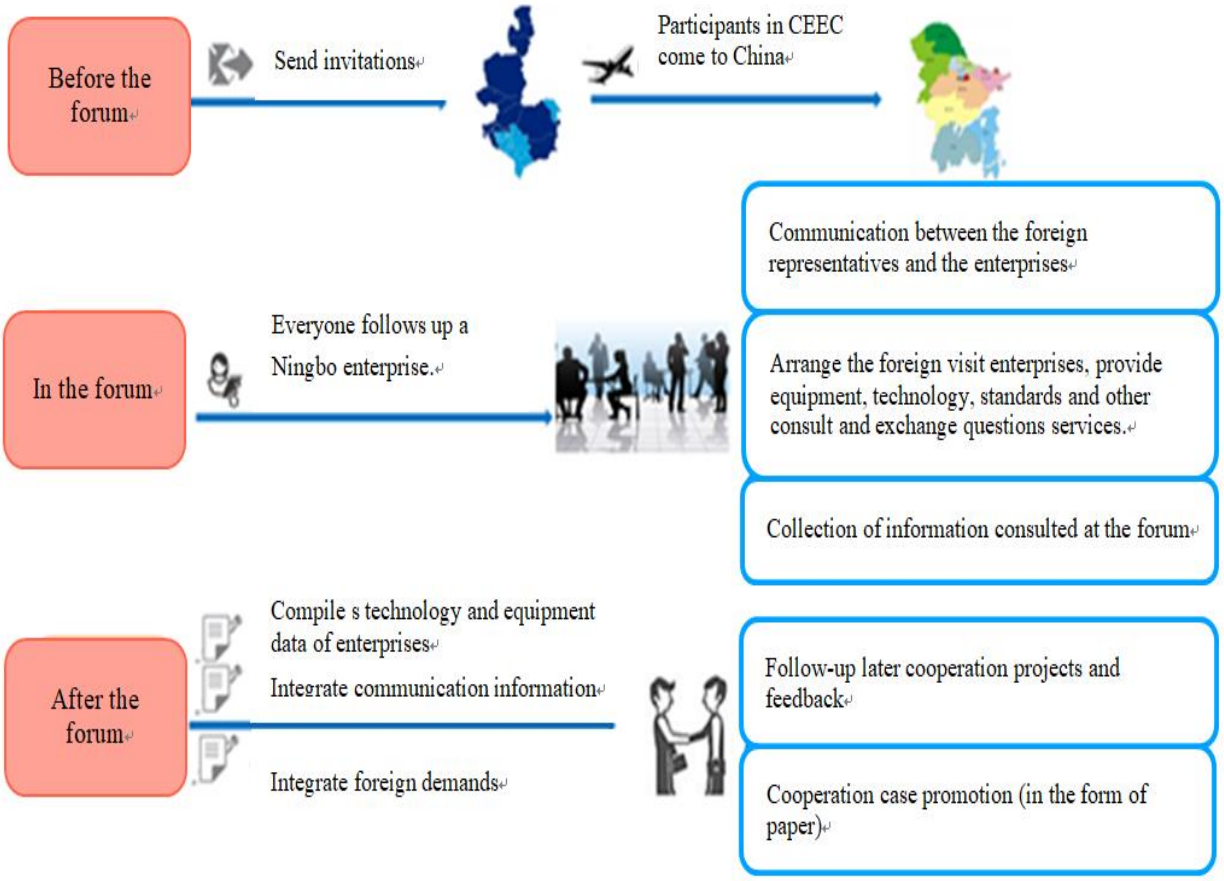
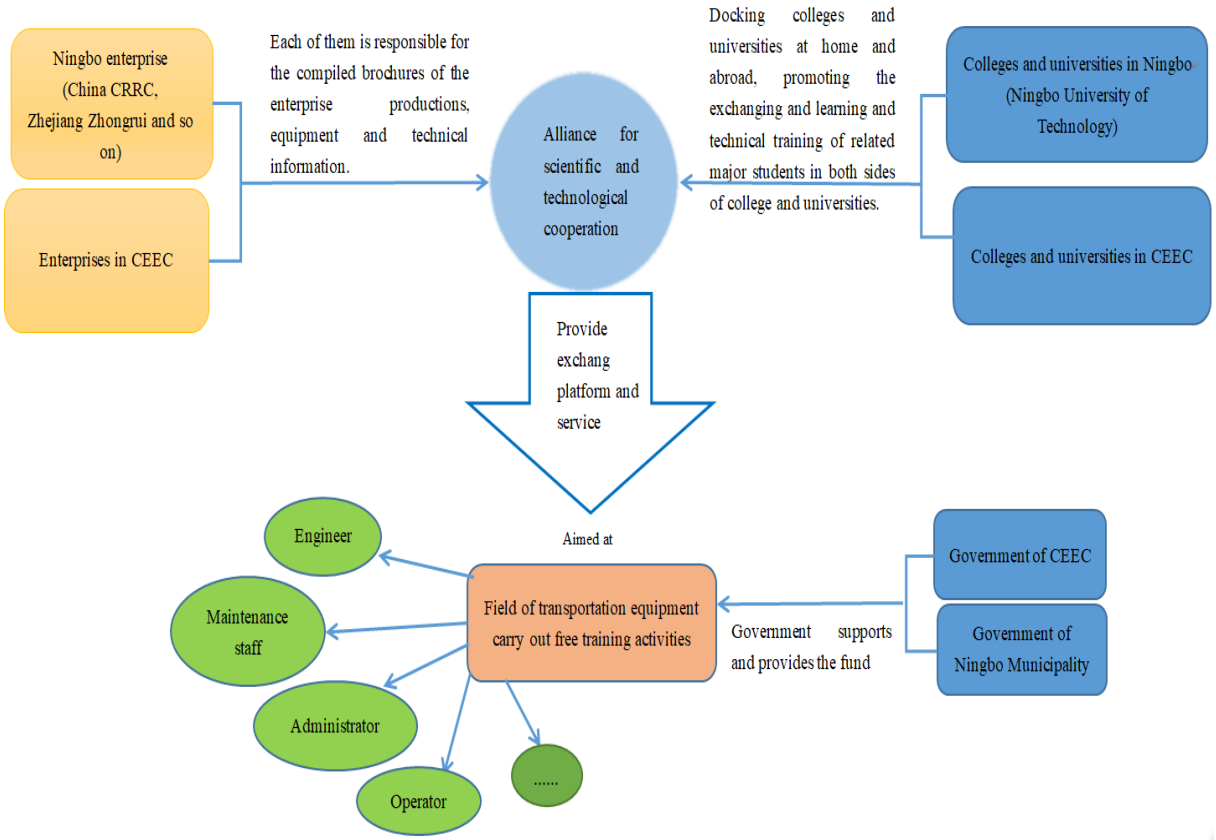


Figure 4 The pattern chart of science and technology cooperation project lead production output

1) Talent exchange and cooperation: Based on the cooperation basis of the scientific and technological cooperation alliance, assist Ningbo's enterprises, universities and research institutes to conduct training activities together in the field of transportation equipment manufacturing together with the universities and enterprises in CEEC (figure 5). Taking the talent cultivation as the goal, use 2-3 years to build a solid foundation and open a new prospect, and attract more than 50 scientific and technical personnel and engineers of different levels to Ningbo for training and exchange. Use about 8 years to break through the key points, advance the essence, and form a stable talent cultivation model for both sides.

2) Cooperation in decision-making consultation service: After Ningbo's enterprises have signed the contracts with enterprises in CEEC for the use of transportation equipment, and achieved the output of equipment and technology, by formulating a feedback system, the problems such as the running state of equipment, risen problems in the process of trial and use and others are fed back to the Ningbo's enterprises, then enterprise makes improvements to the equipment based on the



feedback.

Figure 5 Talent exchange training pattern chart

At the same time, combine with the various work in the early stage such as the development of conference activities, application of projects and output of enterprise technology equipment, etc. to master the external output requirements of enterprise technology and equipment as well as the special needs of the 16 countries in CEE, and to establish the direct subordination consulting team of Ningbo Municipal Human Resources and Social Security Bureau. And combined with the existing information to provide consulting services for more cooperation requirements for Ningbo and the 16 countries in CEE for the transportation equipment manufacturing industry.

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