

# The New Trends and Developments of China-EU Scientific and Technological Innovation Cooperation

ZHANG MIN

PhD., Institute of European Studies, Chinese Academy of Social Sciences

CHINA

[zm64spain@163.com](mailto:zm64spain@163.com)

*Abstract: Building an innovative country is a core element of the modernized economic system in China, which will provide a new opportunity for the deepening of relations between China and the world's innovative countries. The relation between China and European countries has been recently intensified and the cooperation in the field of scientific and technological innovation tends to be diversified, innovative and forward-looking. This paper analyzes the new trends and developments from three different perspectives: first, ST and innovation cooperation between China and the EU under the Horizon 2020. The second, the Sino-British science and technology cooperation and the related innovative partnership, and, third, the innovative strategic partnership between China and Switzerland. These three cooperation models present a new direction of science and technology innovation development between China and European countries. They may lay basis for upgrading the "China-EU comprehensive strategic partnership" into the "China-EU innovative comprehensively strategy partnership" in the future.*

*Key Words: Sino-EU ST and Innovation; Innovation Cooperation Strategy; Innovation Strategic Partnership*

*JEL Classification: O1, O10, O19*

## 1 Introduction

Over the recent years, China's attention towards science, technology and innovation-driven development has risen to an unprecedented strategic height. During the past 40 years of reform and opening-up, China has achieved remarkable economic development results and has become the world's second largest economy. However, there are many problems that come hand in hand with high-speed economic growth, such as low quality and efficiency of development, serious damage to the environment, weak innovation ability and the need to improve the level (of real economy) living standard. The Chinese average annual economic growth rate has been unable to maintain its high-speed growth of nearly 10% over the past 40 years, settling for only a medium high-speed growth of about 7%. The economic growth pattern has entered a transition period that objectively requires a change in the driving force of economic growth, from "factor-driven" and "investment-driven" to "innovation-driven".

In this context, the Chinese Communist Party Central Committee and the State Council issued the Outline of the Innovation-Driven Development Strategy in May 2016, which put forward the strategy for innovation-driven development. In the report of the Nineteenth National Congress of the Communist Party of China, General Secretary Party Xi Jinping once again emphasized that "innovation is the first driving force for development and the strategic support for the construction of a modern economic system", and put forward clear goals and tasks for the establishment of an innovative country<sup>1</sup>: 1. Emphasizing that innovation is the first driving force for development and the construction of a modern economy, and the strategic support of the system. 2. Aiming at becoming the one of the world's innovating scientific research leaders, by strengthening basic research, focusing on forward-looking, leading and breakthrough research. 3. Strengthening the

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<sup>1</sup> In the fifth part of the report of the 19th National Congress of the Communist Party of China, "Implementing the new development concept and building a modern economic system", it is clearly pointed out that China's economy has changed from a period of high-speed growth to a period of high-quality development, and is in the critical period of transforming the mode of development, optimizing the economic structure and transforming the driving force of growth. Building a modern economic system is a breakthrough considering the urgent need of the mouth and the strategic goal of our country's development, while accelerating the construction of an innovative country is a key in building a modern economic system.

construction of national innovation system and building a system for technology innovation based on deep cooperation between industry, the academic universities and the research sector; 4. Training and cultivating international-level strategic scientific and technological talents and scientific and technological teams. Relying on an innovation-driven development strategy and on the goal of building an innovative country created new opportunities for cooperation between China and the EU in the field of scientific and technological innovation and put forward higher requirements.

A large number of existing studies have confirmed that the reason why scientific and technological innovation has become the driving force of economic growth is that it can continuously improve the economic growth mode, create and increase productivity, step-up the upgrading of traditional industries, and comprehensively enhance economic competitiveness. "In the strategy of innovation-driven development, the scientific and technological innovation capability, as an important support of national core strength, has nurtured the evolution of national economic development to a stage of more detailed division of labor, more rational structure and higher performance, and then has overcome the "middle-income trap". Breakthrough technologies brought about by basic research and scientific exploration are constantly emerging. They reshape the world competition pattern and provide an opportunity window for the late-developing countries to become the front-runners of global economy. Through innovation and the cultivation of new economic growth points, they provide a basis for maintaining medium and high-speed economic growth and striding toward the "double goals" of industries at the high and middle levels. (Xielin, Yuchen, & Xuechen, 2017)

Over the recent period, China has been catching-up in technological terms. In the process of technological development, first of all, it relies on opening up, introducing, digesting and absorbing foreign advanced technology. In order to realize the "innovative national strategy" proposed in the report of the 19th National Congress nowadays and in the future, China should increase its openness to the outside world in the field of scientific and technological innovation and continue to promote the pace of international cooperation. Compared with the United States and Japan, China's scientific and technological cooperation with Europe has more strategic value. This is because the China-EU scientific and technological cooperation is the core content of the comprehensive strategic partnership between China and Europe. The EU is the main source of technology transfer to China. In recent years, the China-EU scientific and technological cooperation has significantly increased, and it has become more and more active within the EU, its member countries and other European countries. Establishing innovative partnership has become a new direction for promoting Sino-EU scientific and technological cooperation. The Sino-EU scientific and technological cooperation has gradually shifted from traditional technical cooperation to scientific and technological innovation cooperation. The new highlights and progresses of the China-EU cooperation in science and technology innovation are characterized by three aspects.

## **2 Scientific and Technological Innovation: A New Bright Spot in China-EU Relations**

### **2.1 Turning from Scientific and Technological Cooperation to Innovative Cooperation**

The China-EU science and technology cooperation has become a core part of the China-EU comprehensive strategic partnership. So far, the important moments in the process of Sino-EU scientific and technological cooperation are as follows: Firstly, in 1998, China and the EU signed the Sino-EU Agreement on Scientific and Technological Cooperation; the EU R&D framework programme and China's high-tech research plan and basic research plan (i.e. plan 863 and plan 973) are open to each other, which means precious opportunities for cooperation for scientists on both sides. So far, the Agreement on Scientific and Technological Cooperation has been renewed three times, namely in 2004, 2009 and 2014. Secondly, in May 2009, China and the European Union signed the China-EU Science and Technology Partnership Plan, and the relationship between China and the European Union in science and technology cooperation has gradually shifted from a European-oriented one to an increasingly equal partnership. The two sides jointly decide, select and fund research projects in mutually beneficial priority areas. At the same time, the China-EU Scientific and Technological Cooperation Working Group has been upgraded and renamed the Steering Committee for China-EU Scientific and Technological Cooperation. Through regular meetings, the coordination and management of scientific and technological cooperation between China and EU branches such as the General Research Department, the General Energy Department and the General Information Department have been strengthened. Thirdly, during the 15th China-EU Summit in 2012, China and the EU signed the Joint Statement on China-EU

Innovation Cooperation Dialogue and held the first China-EU Innovation Cooperation Dialogue in Beijing on November 21, 2013. The two sides discussed how to optimize and adjust the innovation governance system and promote effective innovation support measures, to provide a better environment for innovation and other issues to strengthen communication and consultation. (Delegation of the European Union to China, 2016). Fourthly, in 2015, China and Europe established a joint funding mechanism for scientific research and innovation (CFM). This is one of the results of the annual "China-EU Innovation and Cooperation Dialogue". On September 7, 2015, at the "Pursuing Excellence - Promoting the Exchange and Cooperation of Scientific Research Personnel between China and Europe", the two sides announced the launch of a new "China-EU Joint Funding Mechanism for Scientific Research and Innovation".

The innovative aspect of this kind of cooperative model is that the joint funding mechanism was set up by the Chinese Ministry of Science and Technology and the European Commission's Research and Innovation Directorate. In order to implement the joint funding mechanism highlighted in the joint statement of the 17th China-EU Summit, the mechanism relies on the European Union Research and Innovation Programme "Horizon 2020" and on China's relevant five-year research and innovation funding plan (2016-2020). The European Commission plans to continue to invest about EUR 100 million annually in the "Horizon Programme"<sup>2</sup>. Within the framework of the 2020 Plan, support institutions were established in Europe to participate in joint projects with Chinese institutions. The Chinese side has supported the establishment of institutions in China to participate in joint projects with European partners under the framework of the Horizon 2020 Programme. This mechanism has greatly increased the proportion of Chinese scientific researchers participating in the EU R&D framework programme as project hosts, and has transformed China's participation in the EU R&D framework programme from its previously decentralized application status to a centralized and unified declaration through the National Science and Technology Management Information System of the Ministry of Science and Technology, thus enabling the scientific and technological cooperation system between the two sides. (As a result, the China-EU scientific and technological cooperation initiative has been strengthened to yield win-win results. This model has been highly praised by both China and Europe<sup>3</sup>.)

## **2.2 Innovative Highlights of the China-EU Scientific and Technological Cooperation**

### **2.2.1 The transformation of the scientific and technological cooperation governance system**

The management mode of Sino-EU scientific and technological cooperation has completed three stages: one-to-many centralized management<sup>4</sup>, multi-head management and collaborative management. The improvement of the management mode effectively integrates the existing resources of the Sino-EU scientific and technological cooperation and makes the cooperation between the two sides develop towards high efficiency and equality.

After the signing of the China-EU Agreement on Science and Technology, the model of China-EU

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<sup>2</sup> Launching a new joint funding mechanism for scientific research and innovation with China, International Online, <http://news.cri.cn/gb/42071/2015/09/08/8011s5094725.htm>.

<sup>3</sup> "Scientific and technological cooperation is an important part of China-EU comprehensive relations, and science and innovation will inject momentum into economic growth and social development," said Minister Wan Gang. "The establishment of joint funding mechanism will have a significant impact on the strategic partnership between China and Europe, and scientific research and innovation has become an important part of this partnership," said Carlos Modas, member of the Council of Europe for Scientific Research and Innovation.

<sup>4</sup> Before the signing of the Agreement on Science and Technology Cooperation between China and Europe, the one-to-many centralized management model was applied (1981-1998). The one-to-many centralized management model means that during this period, China was under the unified responsibility of the National Science and Technology Commission for scientific and technological cooperation with foreign countries, while the energy, information and development departments of the European side were equal. Given the decision-making and science and technology management functions, it was necessary to expand the functions of this department by developing cooperation in relevant fields of science and technology after the establishment of diplomatic relations between China and Europe. During this period, China and the EC mostly adopted the aid and demonstration mode in their scientific and technological cooperation. As the leading role of the EC, China was in a passive position, and the costs of personnel training and expert visits were basically borne by the EC. Most of the Sino-European cooperation projects were related to projects under China's plan "863". Although China was relatively weak in cooperation, it has also improved the research level of domestic researchers and accumulated international cooperation research experience.

cooperation was a typical multi-head management model (1998-2015). The 1998 agreement clearly states that "*China will continue to participate in EU research activities for development as a developing country*". This provision guarantees not only that China can participate as an equal partner in the main part of the EU Framework Programme, but also continue to enjoy the assistance treatment applied to developing countries in the International Cooperation Specific (INCO) of the Framework Programme. Since then, China's scientific research institutions and personnel do not need to use the National Science and Technology Commission (Ministry of Science and Technology) as an intermediary, as long as they can find EU research partners, they can directly establish links with them to apply for funding within the framework plan (Gao, Liu, 2019). This agreement at the national level has transformed the "one-to-many" model of Sino-EU cooperation into a "multi-to-many" multi-head management model, and the Sino-EU scientific and technological cooperation has entered a full blooming stage.

Since 2015, the collaborative management mode has been applied. In accordance with the China-EU Joint Initiative to establish a Joint Funding Mechanism (CFM), beginning with 2016, the Ministry of Science and Technology of China provided financial support for Chinese institutions to participate in the research and innovation projects of the Horizon 2020 Programme and the exchange of research personnel. During 2016-2020, China and Europe were going to raise EUR 1.5 billion and EUR 500 million, respectively, for the joint funding scheme. Since then, the EU R&D framework projects hosted by China have been submitted to the website of the Ministry of Science and Technology, and the proportion of projects hosted by Chinese researchers has been greatly increased. In the past, the Chinese decentralized application procedures were aligned to the unified application procedure through China's National Science and Technology Management Information System and the European Union Scientific Research Information Network. This scientific and technological cooperation mode effectively integrated the existing resources of China-EU scientific and technological cooperation, changed the decentralized state of previous multi-pronged cooperation, and promoted efficient and equal development of bilateral cooperation.

The main reasons for adopting the third cooperative management system are as follows: Firstly, multi-head management mode promotes the cultivation of scientific research teams on both sides, but it cannot avoid unnecessary competition and waste of resources. When Chinese scientific research teams directly apply for European projects, they can't get the direct support of the Ministry of Science and Technology, and the Ministry of Science and Technology does not have an overview of the situation and of the actual project cooperation progress. There is a gap between the scientific and technological cooperation management agencies and the specific departments executing the projects. Secondly, in the Horizon 2020 Programme, which has been implemented since 2014, China and other emerging economies have no longer automatically received Horizon 2020 project funds. Chinese participants had to provide funds or in-kind contributions to participate in projects. Therefore, the China-EU scientific and technological cooperation under the government-led participation, with the Chinese Government Providing research funds was the basis for promoting the establishment of a partnership between China and Europe for scientific and technological innovation.

### **2.2.2 Cooperation between China and Europe under the R&D Framework (Plan) Programme**

The EU's R&D Framework Programme (FP) has been fully open to China since 1998<sup>5</sup>. The cooperation between China and the EU in the FP has been the main channel for China-EU scientific and technological cooperation. 1998 coincides with the implementation period of the Fourth Research and Development Framework Programme of the European Union. "In the fourth R&D framework programme of the European Union, China participated in 81 projects, 52 of which were the Cooperation Programme for Developing Countries (INCO-DC), which received EUR 25 million from the European Union, and was the developing country with the largest amount of projects and funds in the INCO-DC plan. In the fifth R&D framework plan, China participated in a large number of projects altogether. There were 110 projects, of which 44 were INCO-DC projects. In the sixth R&D framework plan, China participated in 239 projects and received about EUR 35.19 million of EU research funds, accounting for 10.88% of the total EU project funds received by the third countries (non-EU countries), second only after Russia. In the seventh framework plan, China

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<sup>5</sup> In 1998, the fourth EU R&D framework plan included cooperation with third countries (INCO) for the first time. The INCO sub-plan, i.e. the Cooperation with Developing Countries (INCO-DC), emphasized the participation of developing countries, which provided the possibility for China to participate in the EU scientific research program.

successfully applied for 410 projects (Zhang, 2018).

At present, China is the largest partner of the EU Horizon 2020 programme, focusing on cooperation in the food, agriculture and biology, energy, water, information and communication, nanotechnology, space and polar research industries. The Chinese University of Science and Technology, Tsinghua University, Peking University, Shanghai Jiaotong University and other universities joined the programme. The EU also encouraged Chinese personnel to apply for scholarships and exchange schemes provided by the European Commission for Scientific Research and the Marie Curie Action Plan.

### **2.2.2 New Development Opportunities for the China-EU Innovation Cooperation**

During the Third China-EU Dialogue on Innovation Cooperation (June 2, 2017), China and Europe signed the Agreement between China's Ministry of Science and Technology and the European Commission on the Implementation of the Sino-EU Flagship Cooperation Plan for Research and Innovation and Other Research and Innovation Cooperation Projects in 2018-2020 through the Joint Funding Mechanism, in order to create intergovernmental scientific research for the follow-up of China and Europe. The new cooperation provides guidance and basis.

At the end of October 2017, the European Commission officially announced the allocation of innovative R&D funds in the last three years of the EU Horizon 2020 (2014-2020) (2018-2020). According to this programme, the EU will invest up to EUR 30 billion in the Horizon 2020 project in the period of 2018-2020, of which EUR 2.7 billion will be used to launch the European Innovation Council, the new research management institution of the EU. As soon as the scheme was announced, it attracted wide attention from the outside world because it focused on pioneering scientific research with large-scale funds and significant breakthroughs, sociality and market-driven. The new round of project cooperation has the following three new characteristics: (1) EU funding in the field of R&D will be better targeted to change the past wide coverage, funding projects, almost "pepper noodles" funding mode. (2) Focus will be put on supporting innovative, market-driven research, with technological breakthroughs and seeking linkage and balanced development between technological breakthroughs and the market. (3) To adjust and reform the system of the European Research Council and establish and launch the European Innovation Council, project funding, key breakthroughs and scientific and technological innovation governance have been adjusted and changed, which provides new opportunities for more effective innovation cooperation between China and Europe.

Nevertheless, it is noteworthy that the Horizon 2020 programme, which takes reciprocal openness, two-way cooperation, fund allocation and sharing as the new rules and trends of the Sino-European cooperative research projects, puts forward higher requirements on research priorities, fund requirements and intellectual property ownership of research results, which makes it possible for Chinese scholars to participate in research and development projects. The objective is very challenging.

According to the latest plan announced in this report, between 2018 and 2020, the European Commission will allocate EUR 3.3 billion for future low-carbon, climate change adaptation research, EUR 1 billion for circular economy research, EUR 1.7 billion for digitalization and transformation of European industry and services, EUR 1 billion for EU security research and EUR 200 million for immigration research. In addition, EUR 2.2 billion will be allocated to projects in four related areas of clean energy: renewable energy, energy-efficient buildings, electric transport and energy storage. From this sum, EUR 200 million is used to support the development and production of next-generation batteries.

According to the above-mentioned R&D funding priorities over the next three years, China can jointly tackle key issues with the EU in the research and development of in the fields of low-carbon and green development technologies, and provide new technologies, new programs and new practices for China in the areas of green development and low-carbon growth. Strengthening R&D cooperation between China and the EU in the fields of low carbon economy, digitalization and clean energy technology will help China and EU to jointly contribute to a new era of low carbon and green development for mankind.

## **3 Sino-British scientific and technological innovation cooperation has entered an era of co-consultation and decision-making**

The cooperative management system between China and EU and its Member States is divided into super-national level and Member State level. China and EU Member States have signed scientific and technological

cooperation agreements and established scientific and technological cooperation committees. The scientific and technological cooperation with major EU Member States such as France and Germany is getting closer and closer. However, the scientific and technological funding schemes at various national levels are very important. After all, China's openness is limited. At present, Britain is ready to leave Europe, but the bilateral scientific and technological cooperation between China and the UK has continued to advance and made breakthroughs. The Sino-UK cooperation in the field of scientific and technological innovation is unique and worthy of attention and research.

From January 31 to February 2, 2018, British Prime Minister Theresa May made her first visit to China during her term of office, announcing the opening of a new journey in the "golden age" of Sino-British relations, which has injected new vitality into the realization of strategic relationship between the two countries and the strengthening of pragmatic cooperation in various fields. It has become a hot topic to build an enhanced version of the "golden age" of Sino-British relations. President Xi Jinping declared: to jointly create a "golden age enhanced version", we should constantly enhance and highlight the strategic, pragmatic, global and inclusive nature of Sino-British relations.

### **3.1 Sino-British scientific and technological cooperation has always been at the forefront of the world**

In 2015, President Xi Jinping visited Britain, creating a "golden age" of Sino-British relations. In recent years, China and the United Kingdom have been moving on the established track, and their willingness to cooperate has been growing. They are drawing grand blueprints. The deepening of cooperation in the field of scientific and technological innovation has become a highlight in the development of Sino-British relations. So far, the scientific and technological cooperation between the two countries has been fruitful and unique in the global scientific and technological cooperation. Sino-British scientific and technological cooperation is characterized by a pragmatic, pioneering, strategic, forward-looking and global approach. It has become one of the most important areas of cooperation with "golden texture" and "strategic connotation" in the "golden age" of Sino-British relations. Under the current international situation, Sino-British scientific and technological cooperation is in line with the strategic vision of "Globalized Britain" and "Globalized China", and is committed to the long-term goal of building a new type of cooperative relationship between the East and the West, between major developing countries and developed countries (Zhang, 2018).

In 1950, Britain became the first Western power to recognize the New China with a strategic vision of facing the world and embracing both East and West. Since the establishment of diplomatic relations in 1972, the two sides have achieved fruitful cooperation results in various fields. The development and deepening of a series of bilateral relations thus set out vividly illustrates every historic moment in which Sino-British scientific and technological cooperation has always been at the forefront of the world. In November 1978, China and Britain signed the Intergovernmental Agreement and Protocol on Scientific and Technological Cooperation. After the smooth handover of the Hong Kong's regime in 1997, bilateral relations entered a new stage of all-round development. In 1998, Sino-British relations were upgraded to a comprehensive partnership. In September the same year, the agreement on scientific and technological cooperation was revised, the high-tech field was identified as the focus of cooperation, and the regular mechanism of joint scientific and technological committees was established, which endowed the bilateral scientific and technological cooperation with a deeper strategic connotation. In 2004, the two countries established a comprehensive strategic partnership. In January 2009, the British Government published the first strategic document on China entitled "UK-China Cooperation Framework", which further strengthened the comprehensive strategic partnership between China and Britain. Then, in 2012, the high-level human-cultural exchange mechanism between China and Britain was launched, and the exchange of scientific and technological talents became a major trend. President Xi Jinping's state visit to Britain in October 2015 ushered in the "golden age" of Sino-British relations and formally established the Sino-British Innovation Partnership, thus bringing Sino-British scientific and technological cooperation into a new era of scientific and technological innovation cooperation. So far, the two countries have held eight ministerial-level meetings of the Joint Committee on Scientific and Technological Cooperation (renamed the Sino-British Joint Committee on Scientific and Technological Innovation and Cooperation after 2015).

### **3.2 The Newton Fund and the Research and the Innovation Bridges Project have achieved fruitful results.**

Under the framework of the China-UK comprehensive strategic partnership, scientific and technological cooperation between the two countries has developed steadily along the lines of equality, mutual benefit and

reciprocity. Attention should be paid to the innovative R&D activities of basic theory and applied science, and joint action related to major scientific research activities should be carried out. For example, the Sino-British Innovation Program, the Sino-British Science Bridge Program, the "China Tomorrow" Program and the Fudan-Tindor Center for Global Environmental Change Research have enhanced the innovative R&D capabilities of China and Britain. We should build innovative partnerships, emphasize talent training, cooperative research and technology transfer, stimulate innovative vitality and get industrialization of innovative achievements. The Newton Fund and Research Innovation Bridges Project and other innovative research funding methods and cooperative research relationship models constitute a beautiful scenic line in the process of Sino-British scientific and technological innovation cooperation.

The Newton Fund, known as the Sino-British Joint Research and Innovation Fund, was officially launched in 2014. It plans to invest £ 200 million jointly by China and the UK over the course of five years to carry out scientific research and innovation cooperation in seven key areas: health, environmental science and technology, food and water security, urbanization, energy, education and creative economy. The implementation of the Newton Foundation series of projects has promoted the strong alliance between the Chinese and British intergovernmental science and technology departments, with the participation of relevant authorities, scientific research institutions and non-governmental organizations from both countries. So far, the Newton Foundation has supported about 460 cooperative projects. Deputy Prime Minister Liu Yandong spoke highly of it, calling it "a masterpiece of innovation and cooperation between the two countries". Talent projects under the Newton Foundation project: Newton Senior Scholars Foundation, Newton International Scholars Foundation and so on, are becoming boosters for training top talents in the field of scientific innovation in China and Britain.

During Deputy Prime Minister Liu Yandong's visit to Britain in September 2015, the two sides signed a plan for launching the Sino-British Joint Scientific Innovation Fund, Research and Innovation Bridge. The plan aims to support innovative cooperation between China and the UK in the field of transformation of scientific research achievements and provide solutions to specific challenges facing the two countries in their development process. The "Research and Innovation Bridge" project has built a bridge between the two countries for the cooperation in industry, education and research and the transformation of scientific research achievements, with a planned investment of £ 350 million. Through a series of projects, the scientific researchers of the two countries are encouraged to carry out a series of cross-disciplinary, full-chain and high-level scientific innovation cooperation research.

The Research and Innovation Bridge initiative advocates technology transfer cooperation, in which higher education institutions in China and Britain play an important role. British universities are keen on scientific and technological cooperation with China, and promote technology transfer between China and the UK through personnel training and technological exchanges. For example, the Oxford University Technology Transfer Company has constantly promoted technology transfer to China. At present, four joint ventures have been set up in Changzhou and other places. Bradford University and Sichuan University have jointly established the China-UK Advanced Materials Research Center.

The "Research and Innovation Bridge" program promotes the innovation and diversification of the Industry-University-Research cooperation. The two sides have established long-term scientific and technological cooperation or regular exchanges with scientific research institutions, universities or enterprises. The "one belt and one road" initiative encourages Chinese enterprises to "go out". Chinese enterprises, in addition to directly acquiring and developing strong R & D companies, cooperate with universities and research institutes in the UK to set up R & D centers and make use of advanced international scientific and technological resources to carry out industrial R & D and personnel training. For example, the China Aviation Industry Group has established joint R&D centers with the Imperial College of Technology and Nottingham University; China National Car Group and Birmingham University, Imperial College of Technology and Southampton University are planning to establish a joint R&D Center for rail transit technology between China and Britain, aiming at R&D cooperation in high-speed rail and other fields. The center will focus on the key areas of rail transit vehicle dynamics, structural strength, vibration reduction and noise reduction, with new technologies, new materials, new structures and new processes as the starting point, and will focus on the study of international rail transit "interconnection" technology and standard and normative system, in order to build a research and development base for new high-speed rail technology in Europe. These future achievements of industry-university-research cooperation will enhance the international R&D level of the two countries and lay a solid foundation for China to build an innovative country.

### **3.3. Sino-UK scientific and technological innovation leaps to a new level**

Year 2018 marked the 40th anniversary of the Sino-British scientific and technological cooperation, and the cooperation in scientific and technological innovation between the two countries will continue to thrive. This started with the intergovernmental agreement on scientific and technological cooperation, which laid the foundation for the two countries to move towards the era of innovative partnership. Not long ago, China and Britain jointly formulated the Sino-British Strategy for Scientific and Technological Innovation Cooperation for the first time, which achieved a leap in the bilateral scientific and technological cooperation. On December 6, 2017, China and the UK signed the Memorandum of Understanding on Science and Technology Innovation Cooperation, formally promulgating the China-UK Strategy for Science and Technology Innovation Cooperation. This is the first bilateral science and technology innovation cooperation strategy jointly formulated by China and other countries. China and Britain foresee that today's scientific and technological revolution and industrial change are brewing and rising, which is a major opportunity for the future prosperity and development of all countries in the world. Jointly formulating the scientific and technological innovation cooperation strategy will further tap into the potential of cooperation, enhance complementarity, and promote the development of cooperation in a multi-field, deep-seated, all-round and high-quality direction.

This joint strategy will open a new chapter of the Sino-British cooperation, which is a concrete reflection of the enhanced version of the "golden age" of Sino-British relations. In accordance with the objectives and requirements of the Sino-British Strategy for Scientific and Technological Innovation Cooperation, China and the UK are both responsible big powers. They will lead international scientific and technological innovation cooperation by raising the level of cooperation between the two countries. By gathering global intellectual resources, we can jointly meet global challenges with all countries in the world and build a community of human destiny for the benefit of all mankind. In the future, the achievements of scientific and technological innovation in China and Britain will shine brightly as we advance the construction of China-UK global partnership.

## **4 Innovation Strategic Partnership between China and Switzerland**

In April 2016, the China-Switzerland relations were upgraded to innovative strategic partnerships, which became a major initiative in the development of China-EU relations and underlined the "innovation highlights" of China-Switzerland relations. Switzerland has become China's first innovative strategic partnership country and the first foreign relations country named after China's five major development concepts. The development process of Sino-Swiss relations on the 67th anniversary of the establishment of diplomatic relations shows that Sino-Swiss cooperation can be regarded as a model of friendly cooperation among countries of different social systems, different stages of development and different sizes, and it has become a new benchmark for Sino-European bilateral scientific and technological innovation cooperation.

### **4.1 The development of Sino-Swiss relations has created many first places**

Switzerland has set many "world records" in its contacts with New China: Switzerland was one of the first European countries to recognize the founding of New China and formally established diplomatic relations with China on September 14, 1950; Switzerland is one of the Western countries actively participating in the process of China's reform and opening up, and the Swiss Schindler Group has become the first joint venture to enter the Chinese market. In contrast to the European Union's reluctance to recognize China's market economy status, Switzerland took the lead among European countries in 2007 and recognized China's full market economy status; Switzerland attaches great importance to its cooperation with China in a more open manner at a time when economic growth in European countries is weak and trade protectionism is on the rise. Switzerland became the first Continental European country to sign a free trade agreement with China in 2013. In April 2016, China and Switzerland established a strategic partnership for innovation, which is the first time that China has established a partnership named "innovation" with foreign countries. This series of milestones will set an example for the opening, inclusive and win-win cooperation between different systems in the East and the West, and provide positive energy for China-EU pragmatic cooperation in various fields.

### **4.2 Innovative cooperation: highlighting the strategic relationship between China and Switzerland**

The cooperation between China and Switzerland in the field of scientific and technological innovation plays a leading role. In April 2016, Article 5 of the Joint Statement on the Establishment of Innovation Strategic



Partnership between China and Switzerland clearly stated that bilateral cooperation in all fields, from basic scientific research to scientific and technological innovation, had achieved remarkable results. The two sides have established a joint working group mechanism for scientific and technological cooperation between China and Switzerland to provide a platform for China's innovation-driven development strategy and Switzerland's docking of innovation advantages. We will work together to enhance innovation capabilities and support and actively promote innovative cooperation between the enterprises, universities and scientific research institutions of the two countries.

Compared with land area, per capita GDP level and international innovation capability ranking, Switzerland and China have many advantages in complementary cooperation between a highly innovative country and a fast developing country to achieve the long-term goal of science and technology innovation-driven development. Switzerland is a small country in Europe, with an area of only 40,000 square kilometers, but relying on fine developed industries such as machinery and electronics, metals, medicine and chemical industry, clocks and watches, finance and so on. Switzerland ranks among the top 20 in the global economy, and the per capita wealth of its residents ranks first in the world. Switzerland attaches great importance to innovation. The annual investment in scientific and technological innovation R&D accounts for more than 3% of GDP. Swiss clocks and watches, Swiss army knives and other industrial innovation achievements with the "Swiss label" are well known all over the world. Among the global competitiveness rankings issued by the World Economic Forum, Switzerland ranks first in the world competitiveness rankings of the World Economic Forum for nine consecutive years<sup>6</sup>, ranks first in the global innovation index issued jointly by the World Intellectual Property Organization for seven consecutive years, and is known as the "country of innovation"<sup>7</sup>.

China is a large developing country. In 2017, the per capita GDP was equivalent to USD 8583 (IMF, 2017) (in terms of market exchange rate), which is about one tenth of that of Switzerland's<sup>8</sup>. As the second largest economy in the world, China's GDP and R&D investment rank second in the world. In 2017, the total R&D investment was CNY 1.75 trillion, accounting for 2.12% of GDP<sup>9</sup>. Our country's innovation ability does not match the world's second largest economy, R&D investment is less than half that of the United States, and science and technology innovation ability ranks low in the world. In 2017, China ranked three places higher in the global innovation index and was 23rd in the world. Although it was the first middle-income country to enter the world ranking of less than 25, there was a huge gap between China and Switzerland. Switzerland ranked first for seven consecutive years. In the future, strengthening innovation cooperation between China and Switzerland will help to improve China's manufacturing level and innovation capability, and gradually narrow the income gap between China and developed countries (Zhang, 2017).

### **4.3 Connecting "Made in China 2025" with "Swiss Industry 4.0"**

From January 15 to 18, 2017, President Xi Jinping visited Switzerland for the first time in the New Year and for the first time in the new century. During the visit to Switzerland, the two countries signed 10 Sino-Swiss cooperation agreements. In the field of scientific and technological innovation, the most important item of cooperation is to establish a practical cooperation platform for Sino-Swiss scientific and technological innovation docking, strengthen the docking between "Made in China 2025" and "Swiss Industry 4.0", and further highlight the innovative meaning of Sino-Swiss strategic partnership for innovation. This is also an

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<sup>6</sup> In the Global Competitiveness Report 2017-2018 issued by the World Economic Forum, Switzerland ranked first in global competitiveness for nine consecutive years.

<sup>7</sup> On June 15, 2017, the World Intellectual Property Organization (WIPO) released the tenth edition of its Global Innovation Index 2017: Innovation Feeding the World. Through 81 indicators, the report assesses the innovation capacity and measurable results of 127 economies worldwide. Switzerland continues to lead the global innovation list with a high score of 67.69, which is the seventh consecutive year that Switzerland ranks first in the global innovation index.

<sup>8</sup> Switzerland's GDP per capita in 2017 is equivalent to USD 80,837 (at market exchange rate).

<sup>9</sup> According to the preliminary results of the annual report of comprehensive science and technology statistics, the total investment in R&D in China in 2017 was CNY 1750 billion, an increase of 11.6% compared to the previous year, and a percentage point higher than the previous year, according to the data released by the National Bureau of Statistics on February 13, 2018. At present, the total investment is second only after the United States, ranking second in the world. In addition, the intensity of R&D investment (the R&D expenditure to GDP ratio) in China is 2.12%, which is 0.01 percentage points higher than the previous year.

important innovation platform for technological docking with European countries, which is clearly promoted by our country after Germany.

Made-in-China 2025 is the first ten-year action plan for China to implement the strategy of strengthening the country. In the future, manufacturing capacity will be comprehensively enhanced in ten key areas. The "European Industry 4.0" Industrial Revolution will provide strong technical support for the transformation from Made-in-China to Created-in-China and from Chinese products to Chinese brands. "Swiss Industry 4.0" is embodied in: Switzerland gives full play to its advantages in traditional fine manufacturing of machinery, textiles, tools and watches, vigorously promotes intelligent manufacturing, transfers information of machines, raw materials and products through the "Internet of Things" and cooperates to complete production tasks.

In the future, "Made in China 2025" and "Swiss Industry 4.0" will closely and effectively cooperate. Through a series of technical cooperation in intelligent manufacturing, digital economy, environmental protection and energy, we will absorb and draw lessons from Switzerland's "craftsmanship" and "brand awareness", which will help build a "golden signboard" of Chinese manufacturing based on the world and enjoying global reputation.

## 5. Conclusions

The above three levels represent the latest development direction of scientific and technological innovation cooperation between China and Europe. They have strategic, forward-looking and breakthrough characteristics. The China-EU scientific and technological cooperation highlights the "R&D innovation" dimension and plays a leading role in the cooperation between China and other European countries in the field of scientific and technological innovation. Europe-EU relations will be upgraded to "China-EU Comprehensive Innovative Strategic Partnership" in the future<sup>10</sup>. Making full use of external scientific and technological innovation resources is one of the important ways to enhance the driving force of innovation in China. Strengthening cooperation in scientific and technological innovation with European countries and different EU member countries will help China to catch up with the latest frontier of world scientific and technological development, accelerate the upgrading of the scientific and technological innovation capacity, and provide theoretical and practical guidance for the construction of innovative power. Therefore, at this stage and in the future, we should learn from the experience of China-EU scientific and technological innovation cooperation to provide theoretical and practical support for the construction of a modern economic system and achieve the strategic goal of China's innovative power.

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<sup>10</sup> The basic orientation of China-EU relations is the "China-EU Comprehensive Strategic Partnership" established in 2003. In 2013, the two sides signed the Strategic Plan for China-EU Cooperation 2020, which identifies the common goals of strengthening cooperation in the fields of peace and security, prosperity, sustainable development and cultural exchanges, and promotes the deepening of the development of China-EU comprehensive strategic partnership. In 2014, China and Europe jointly built four major partnerships of peace, growth, reform and civilization.