

Industry-university-research cooperation China's experience

JIAN Hua¹

BRAHIMI Houda²

Received : 28/03/2018 Revised : 15/04/2018 Accepted : 22/05/2018

Abstract: Industry-university-research cooperation plays an important role to promote technological innovation and economic development. Cooperation between enterprises, universities and research institutes is an important way to enhance market competitiveness of enterprises, accelerate the transformation of scientific and technological achievements and industrialize high-tech. It is an important part of the national innovation system in China. Industry-university-research cooperation in China has been strengthened and developed quickly in recent years. This paper first gives a brief introduction of the development path, the situation of industry-university-research cooperation in China. Then, it analyzes the main industry-university-research cooperation models such as engineering research center, universities and enterprises co-construction entities, university science and technology park, industrial technology innovation strategic alliance etc. Finally, this paper illustrates the collaborative innovation mechanism of industry-university-research cooperation in China. Promoting the industry-university-research cooperation can improve the capability of independent innovation, which is the one of the prime reasons to achieve rapid economic growth in China.

Key words: Industry-university-research, cooperation, China

Jel Classification Codes : O14, O31.

الملخص: يلعب التعاون بين الصناعة والبحث العلمي الجامعي دورا هاما في تعزيز الابتكار التكنولوجي والتنمية الاقتصادية، حيث قامت الصين بتعزيز وتطوير التعاون بين البحث العلمي الجامعي والصناعة في السنوات الأخيرة، من خلال هذه الورقة البحثية سيتم أولا عرض مقدمة موجزة لمسار التنمية وكذلك واقع التعاون بين البحث العلمي الجامعي والصناعة في الصين، ليتم بعد ذلك تحليل الأشكال الرئيسية للتعاون بين البحث العلمي في الجامعة والصناعة، مثل مركز البحوث الهندسية للجامعات ومؤسسات البناء، وكذلك حظيرة العلوم والتكنولوجيا للجامعة، التحالف الاستراتيجي للابتكار الصناعي التكنولوجي..... الخ. ليتم في الأخير توضيح آليات تطوير التعاون بين البحث العلمي الجامعي والصناعة في الصين، فتعزيز التعاون بين البحث العلمي الجامعي والصناعة يمكن أن يساهم في تطوير الابتكارات، وهذا الذي يعد من الأسباب الرئيسية لتحقيق النمو الاقتصادي السريع في الصين.

الكلمات المفتاحية : الصناعة- الجامعة- البحث، التعاون، الصين

1- Business School of Hohai University, China.

2- University of Djelfa, Algeria.

* first author: Jian Hua

1 .Introduction

Industry-university-research cooperation is a kind of cooperation between enterprises and universities (or research institutions). Cooperation between enterprises and universities can realize their own interests, obtain technological innovation and achieve the target of transferring scientific and technological achievements in to commercial uses. Through the development of universities or scientific research institutions' R&D and innovation, and then through the enterprise's marketing tools and market testing, the docking and coupling between universities and enterprises in technological innovation can be realized. From the perspective of business needs, the purpose of industry-university-research cooperation is to achieve the commercialization of research findings.

Government, universities, research institutions, enterprises, financial institutions and technology intermediaries are the key elements of industry-university-research cooperation. Universities and research institutions as the core of the national scientific system play an important role in educating and training technical staff, engineers, scientists and other innovative talents. They provide scientific research for enterprises to improve the overall quality of society as a whole, and also play an important role in improving the level of technological development. Enterprises are the main part of scientific and technological transformation in industry-university-research cooperation. The transformation and application of scientific research achievements, the obtaining of benefits rely on enterprises, so enterprise is the main body of innovation.

Cooperation between enterprises, universities and research institutes is an important way to enhance the market competitiveness of enterprises, accelerate the transformation of scientific and technological achievements and industrialize high-tech. It is an important part of the

national innovation system. With the help of universities' personnel training, scientific research and geographical advantages, universities and enterprises' joint innovation under industry-university-research cooperation model has becoming the core mode of cultivating innovation. Under this mode, the resources of universities and enterprises such as human resources, technology, platform and market can be used effectively to meet the local economic and social development needs. Now it has become an international consensus to establish a perfect innovation system of industry-university-research system under the trend of global economic integration.

2The development path of industry-university-research cooperation in China

The industry-university-research cooperation in China began in 1980's; it is changed from industry-university-research cooperation, to industry-university-research-uses cooperation, industry-university-research collaborative innovation, and government-industry-university-research-uses-finance cooperation.

Since 1985, in order to solve the problem that is how to combine the scientific development with economic development, the Chinese government proposed to establish a system in order to push on scientific and technological progress. After then, Chinese universities began to explore the cooperation with enterprises.

In 1992, for the first time, the Chinese government organized the implementation of industry-university-research cooperation in the ministries level, which is organized by the former State Economic and Trade Commission, the Chinese Education Commission and the Chinese Academy of Sciences

In 1993, to encourage enterprises, universities, and research institutions to carry out cooperation, industry-university-research

cooperation was included in the "People's Republic of Science and Technology Progress Law".

In 1995's National Science and Technology Conference, it made an important decision that is to implement the strategy of developing the country through science and education, which encouraged qualified universities and scientific research institutions to cooperate with enterprises in different forms, and push further the industry-university-research cooperation.

In 2006, the National Outline for Medium and Long-term Science and Technology Development Plan also emphasized the need to build an enterprises-dominant technological innovation system as a breakthrough to comprehensively promote the construction of the national innovation system.

In 2012, in the suggestion file of deepening the scientific development system reform and speeding up the construction of the national innovation system, the CPC Central Committee and State Council further proposed to speed up the establishment of industry-university-research-uses cooperation system, which is an enterprises-dominant and market-oriented system. The first meaning of the word "use" in industry-university-research-uses cooperation is application. The law of scientific development shows that technological innovation is the first commercial application of new technology, and there is no innovation without application. The second meaning of the word "use" in industry-university-research-uses cooperation is the users. Users are important participants and stakeholders in scientific and technology innovation. A large number of practice shows that users directly involved in research cooperation, not only can shorten the new product from R&D to the market, but also can effectively reduce the risk and cost of scientific and technological innovation. The development of

China's large hydroelectric generating units is in large part due to the close cooperation of industry-university-research-uses.

In recent years, collaborative innovation in industry-university-research is putting forward based on China's implementation of collaborative innovation-driven strategy (Pan etc. 2014). Industry-university-research collaborate innovation adapts to the trend of the times. Nowadays, the innovation mode of the world is undergoing significant changes. Collaborative innovation of industry-university-research has become a new trend (Lan 2014). Silicon Valley in the United States, which gives birth to Apple, Hewlett-Packard, Intel and other high-tech enterprises, is a paradise for entrepreneurs largely due to the collaborative innovation and interactive among enterprises, universities, research institutes in this region. Cooperative innovation in industry-university-research emphasizes on strengthening the national innovation capacity, especially enhancing the enterprise's technological innovation ability, as the main task of the cooperation. It declares that industry-university-research cooperation must take the road of collaborative innovation, and maximize the complementary advantages and resource sharing between members.

“Government-industry-university-research-uses-finance cooperation” six-in-one is an extension of cooperation between universities and enterprises. The realization of technological innovation requires each innovation member to play his important role. With the development of technology and the evolution of innovation, the government plays a more and more important role in organizing and coordinating the construction of innovation platform. The special position of users in the innovation process are further highlighted, finance has become increasingly significant. With the bridge role of financial institutions and markets, industry, universities, research institutions, finance, users can be gathered in order to promote smooth

and successful cooperation. Universities and enterprises as the core of the industry-university-research cooperation can provide inexhaustible power to scientific and technological innovation and national economic development under the efforts of government, industry, universities, research institutes, users, financial institutions and markets.

3 The situation of industry-university-research cooperation in China

3.1 University research funding in industry-university-research cooperation

The research funding of universities can be divided into three parts from the structure of funding sources: (1) Government funding, such as research funding subsidized by education sector and government special funding for scientific research, etc. (2) Entrusted funding from enterprises and institutions. (3) Other funding, such as scientific expense from university income.

In 2014, there were 1128 ordinary colleges and universities in China, with a total research funding of 124,427,351,000 Yuan. In which, 42,236,009,000 Yuan are entrusted funding from enterprises and institutions, which ranks the second and accounts for 33.95% of all the funding.

Entrusted funding from enterprise and institution refers to the funding which universities obtain from enterprises and institutions outside the universities. This index can be used as a measurement of industry-university-research cooperation scale.

Therefore, this article use the proportion of entrusted funding from enterprises and institutions to the research funding of universities as industry-university-research funding intensity. Because China's higher education system is multi-level, according to different types of colleges and universities, this article studies the industry-university-research funding, see Table 1.

Table 1 :The entrusted funding from enterprises and institutions obtained by colleges and universities in 2014
(by colleges and universities type)

University type	Number of universities	Number of universities as a ratio of total universities (%)	Total research funding (1000 Yuan)	Entrusted funding from enterprises and institutions (1000 Yuan)	Entrusted funding from enterprises and institutions as a ratio of total funding (%)
Comprehensive universities	253	22.4	40 798 912	11 770 141	28.8
Engineering universities	450	39.9	61 953 998	27 748 489	44.8
Agricultural and forestry universities	70	6.2	7 981 706	1 272 324	15.9
Medical universities	114	10.1	6 952 191	353 015	5.1
Normal universities	150	13.3	5 757 535	925 129	16.1
Other	91	8.1	983 009	167 001	17

Source: Calculate according to the Chinese "2015 High School Science and Technology Statistics Compilation".

From Table 1, we can see that, according to the universities type, Entrusted funding from enterprises and institutions as a ratio of total funding for engineering universities represents 44.8% is much higher than the national average and other universities. In other hand this ratio represents only 5.1% for medical universities.

3.2 University and enterprises cooperative R&D institutions

Building universities and enterprises cooperative R & D institutions are the higher level of industry-university-research cooperation. Cooperative institutions are the important manifestation of the long-term industry-university-research cooperation mechanism. Cooperative institutions make universities and enterprises closer. The number and proportion of cooperative R&D institutions in 2014 is showed in Table 2.

Table 2: Cooperative R&D institutions in 2014
(By disciplines)

Disciplines	Total	Number of scientific research institutions owned by universities	Number of cooperative R&D institutions	The proportion of cooperative R&D institutions (%)
Total	7114	6299	815	11.5
Science	1293	1207	86	7.1
Engineering	3713	3107	606	16.3
Agriculture	771	700	71	7.1
Medicine	1234	1187	47	7
Economics and management	50	46	4	8
Literature history and philosophy	53	52	1	1.9

Source: Calculate according to the Chinese "2015 High School Science and Technology Statistics Compilation".

It can be seen from Table 2, engineering disciplines' proportion of cooperative R&D institutions (16.3%) is significantly higher than other disciplines, also higher than the average (11.5%).Inengineering disciplines, subjects like mechanical engineering, materials science,

electronics and communication technology, computer science and technology account rank the top one.

3.3 Technology transfer of universities

As an important part of the national innovation system, the important embodiment of the social function of the university is to transform its scientific research achievements into real productive forces through technology transfer. Therefore, university technology transfer is an important indicator to measure university production and research activities. Since the reform and opening up, Chinese universities' number of technology contracts signed, technology transfer income, and the number of patent transfer have increased significantly. Enterprises are not satisfied with obtaining technology through the simple way of technology trade, but more emphasis on industry-university-research cooperation with universities, and other higher level of cooperation to enhance their technological strength and innovation. In 2014, the number of technical contracts signed by universities reached 10,517, with a total amount of RMB 401,570,000,000 Yuan. In which, engineering universities ranked the first in the proportion of contract number (52%) and contract amount (60%). See Table 3 for details.

Table 3 Universities' technology transfer contracts in 2014

University type	The proportion of contract number (%)	The proportion of contract amount (%)
Comprehensive universities	27.7	25
Engineering universities	52	60
Agricultural and forestry universities	12.5	8.2
Medical universities	1.8	4
Normal universities	4.8	2.5
Other	1.2	0.3

Source: Calculate according to the Chinese "2015 High School Science and Technology Statistics Compilation".

4. The cooperation models of industry-university-research cooperation in China

There are many innovation modes of cooperation in China, the main modes of cooperation include engineering research center, universities and enterprises co-construction entities, university science and technology park, government-industry-university-research-uses-finance six-in-one industrial technology innovation strategic alliance, etc.

4.1 Engineering research center

This mode refers to set up a joint engineering research center which relies on a university group. By selection of universities or disciplines which have the technology advantage under the guidance of the state. The engineering research center integrates teaching, research and production together, it can also integrate the advantages of universities and enterprises to achieve complementary advantages of resources, and strengthen the weak links of the transformation from scientific research achievements to the production. By integrated multi-power, it can concentrate multi-force to breakthrough scientific and technical problem, and improve China's industrial production of science and technology competitiveness. Engineering research center as an open engineering R&D platform, it can provide products of technology to the society, and gradually upgrade the industrial technology by further research and industrialization. Through "innovation → prototype → incubator base → industrialization → product" process and industry-university-research cooperation, a series of high-tech companies can be incubated, this in turn will contribute to the development of national economy.

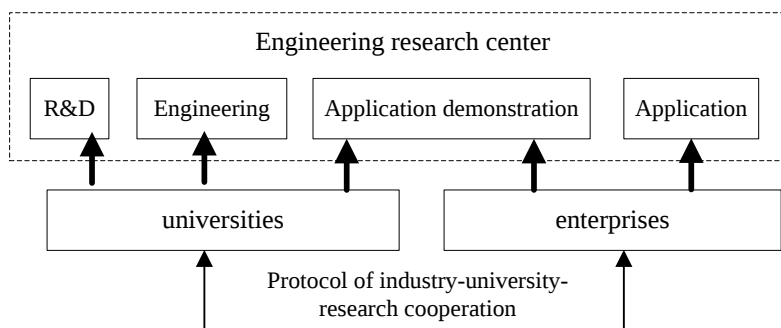


Figure 1 The Engineering research center mode

4.2 Universities and enterprises co-construction entities

This model combines the advantages of the industrial sector, enterprises and universities to build a college, research institute or R&D base. It is market-oriented and social demand-oriented. The combination of universities and enterprises can not only provide a large number of outstanding scientific research talents for R & D, cultivate qualified laborers and skilled talents who can meet the needs of the market economy, but the R & D achievements can also meet the demand of the market rapidly and accurately. Nowadays, many enterprises have established such cooperation relationship with universities in China, such as "*Geely-Tongji Automobile Engineering Research Institute*" jointly built by Tongji University and Zhejiang Geely Holding Group, "*Peking University Founder Technology College*" established by Peking University and Founder Group, etc.

4.3 University science and technology park

University science and technology park is based on local high-tech industry development needs. It relies on a university which has strong scientific research strength, and combines the university's comprehensive intellectual resources advantages with other social

advantages. It is the platform and service agencies for transforming universities' scientific and technological achievements, incubating high-tech enterprises, cultivating innovative talents, and providing support for industry-university-research cooperation.

University science and Technology Park is a combination of universities, scientific research institutions and enterprises, it adopts the mode of university-enterprise cooperation and multi-university-in-one-park. Its main function is to make full use of universities' advantages in talent, discipline and technical force in order to incubate small hi-tech enterprises, accelerate the transformation and industrialization of scientific and technological achievements of the universities, and at the same time cultivate high-level technical, managerial and administrative talents by carrying out entrepreneurial practice.

The mode of university science and Technology Park has four characteristics: first, it carries out social operations by government, universities and enterprises together. Second, it initially for mats the organic link among research bases, incubator bases, and industrial bases. Third, its capital operation mode is that it uses its own small amount capital to leverage the large amount of social capital. Fourth, it vigorously introduces venture capital to improve the high-tech enterprises' R&D.

Zhejiang University National Science Park as an example, it was jointly built by Zhejiang Provincial government, Hangzhou municipal government and Zhejiang University. It enjoyed a series of preferential policies from the National High-tech Industrial Development Zone in Hangzhou, Zhejiang provincial government and municipal governments. Zhejiang University National Science Park sets up Zhejiang University Science Park Development Co., Ltd.as the operation carrier. Zhejiang

University National Science Park Development Co., Ltd. developed, constructed and managed Zhejiang University National Science Park in socialization way. After the establishment of Science and Technology Park Research Institute, improvement of the incubator base, development of industrial base, and other series of deployment, Zhejiang University, gradually formed the organic link among three bases, and further for mead science and technology park industry group, entrepreneurial group, which produces the scale agglomeration effect .At the same time, Zhejiang University developed new disciplines, and further promoted the industry-university-research cooperation related policies.

Zhejiang University National Science Park adopted the scale that is first self-hatching and then obtaining social capital to realize the expansion of enterprise capital. When it was mature enough, it promoted the enterprises to enter the capital market, and gradually formed a super-conventional developed high-tech industry group by rapid capital expansion, thus, cultivated a number of famous high-tech enterprises.

Zhejiang University Science and Technology Park introduced many investment partners who have rich experience and background in high-tech field, and at the same time it improved the service system in which the venture capital service is the core. In order to better operation the venture capital funds, it also set up a venture capital management company.

4.4Industrial technology innovation strategic alliance

Industrial technology innovation strategic alliance is a cooperative mode of industry-university-research cooperation, which is carried out in a wider scope, higher level and wider field. It is an effective form to

enhance the competitiveness of enterprises and industries. (Wang etc. 2016)

For example, the four major industrial technology innovation strategic alliances established by the Coordination Group for the Promotion of Industry-University-Research Cooperation have concentrate 26 leading enterprises, 18 first-class universities and 9 backbone scientific research institutions, and have established an integrity chain of technological innovation which closely links scientific research, design, engineering, production and marketing. It is an effective solution to those outstanding problems in China such as industrial concentration scattered, lack of innovation in the field of technology, lack of common technology supply, the core competitiveness subject to other countries etc.

The integration and development of information and communication technology has abolished the barriers of information and knowledge sharing, abolished the boundaries of innovation, promoted the formation of the innovation 2.0 form and further promoted the ablation of various social organizations and activities. Innovation 2.0 is a service-oriented, user-centric, people-oriented innovative form which is adapt to the information age and knowledge-based society.

In the information era, the transformation of the innovation form under the knowledge society has also promoted the transformation of the scientific and technological innovation power from industry-university-research to the industry-university-research-uses, and then to government-industry-university-research-uses-finance collaborative development.

Industrial technology innovation strategic alliances, adopts the mode of government-industry-university-research-uses-finance six-in-

one. Under this mode, government builds a platform, finance is the bridge, and users are the main body in the innovation process. Universities, enterprises, and research institutions often carry out regular industrial technology training seminars, practical training, industry technology consulting to help the member enterprises and users to solve technical problems. It promotes the scientific and technological achievements of alliance members, promotes the communication among the government, industry, universities, and research institutions, promotes regional economic structural adjustment and enhances regional technological innovation capability.

For example, Jiangsu Science and Technology Network (the school fruit network) is a Science and technology achievement transformation platform of Jiangsu University established by Jiangsu Provincial Department of Education and Jiangsu University Science and Technology Development Center. It collects and integrates the achievements, patents, experts, investment and financing, and other resources of all the famous universities and scientific research institutes inside and outside Jiangsu Province, and guides enterprises and universities to realize the docking of industry-university-research cooperation. Also, it has an online intelligence matching function. Each university in the school fruit network has its own independent pages and space, universities and research institutions can easily publish their latest achievements, and easily realize the technology docking to enterprises. Enterprises and individuals can also publish technical problems and demands directly in the school fruit network. Thus, it really meets the demand, docking the problem. The school fruit network's online intelligent matching network helps universities know the market demand in time. This line matchmaking industry-university-research service model has been widely accepted by the society. The problem is that

universities focus only on laboratory research, and don't care about the enterprise's market-oriented technology which is greatly improved.

5. The collaborative innovation mechanism of industry-university-research cooperation in China

With the increasing uncertainty of the business environment, the shortening period of product life cycle, the intensify competition in the market, it is then required to transform the scientific and technological achievements more efficiently and rapidly to provide enterprises more effectively support. This requires the establishment of a system that brings universities, research institutions, enterprises etc. together to share information and resources, and links education, research, technology development and industrialization as a whole (Feng 2014). The system also needs to focus on collaborative innovation, keeps effective communication with outside world, and expands and optimizes the partners, the level and scale of cooperation, in order to speed up the process of scientific and technological innovation and industrialization.

Figure 2 shows the collaborative innovation mechanism of industry-university-research cooperation.

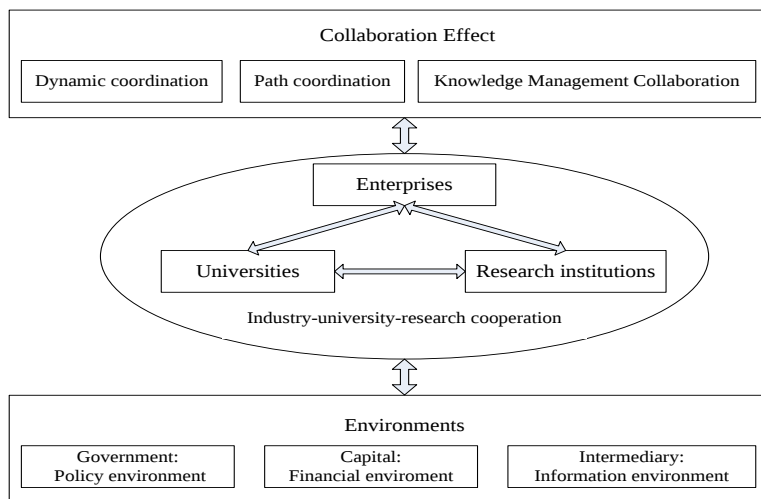


Figure 2 Collaborative innovation mechanism of industry-university-research cooperation

It can be seen from Figure 2, collaborative innovation of industry-university-research cannot be separated from the policy, financial and information environment. Government provides appropriate policies, which play a decisive role in improving the policy environment. Government can promote collaborative innovation through policy guidelines. Financial market provides the necessary capital for collaborative innovation; a good financial environment can accelerate the transformation of scientific and technological achievements, and promote the development of enterprises. Collaborative innovation requires technical intermediary "matchmaking". The service provided by technology intermediary is the key link in innovation chain, and is the important condition for the mutual understanding, communication and cooperation among different parties in collaborative innovation. The

maturity of the technology intermediary service system is related to the improvement of the information environment, which has a great significance to strengthen the communication and exchange of information between universities, research institutions and enterprises.

In the industry-university-research cooperation, enterprises obtain the technical innovation; and then obtain the market benefit through technological transformation. Universities and research institutions obtain the funding support, in order to train the scientific personnel and backup technical force. This requires enterprises, universities and research institutions to strengthen cooperation so that they could be more competitive.

The collaborative innovation effect of industry-university-research can be reflected in three aspects: dynamic coordination, path coordination and knowledge management collaboration.

Dynamic coordination is the booster of industry-university-research collaborative innovation. The motivation of the collaborative innovation system includes internal and external power. External power is mainly from the development of science and technology and market competition. Internal power is mainly from the pursuit of own interests of enterprises, universities and research institutes. Under the joint action of internal and external power, the system of collaborative innovation of industry-university-research will develop from chaotic disorder to order, and make the cooperation more closely, steadily and continuously.

Path coordination is the innovative link of industry-university-research collaborative innovation. It represents a series of alternative routes, which are chosen according to their own characteristics, technical characteristics and environmental characteristics after the cooperative parties start the cooperation. From an enterprise perspective,

the purpose of cooperation among enterprises, universities and research institutions is to pursue the competitive advantage and obtaining profits. And the important means of realizing competitive advantage and obtaining profits is to gain scientific and technological advantages, or known as "intellectual property advantages." Therefore, enterprises should be the leader to choose the collaborative innovation path of industry-university-research cooperation and play an important role in innovation and cooperation coupling.

Knowledge management collaboration is the creator of collaborative innovation. Knowledge management collaboration is the core of collaborative innovation of industry-university-research cooperation, which bears the knowledge increment and application of collaborative innovation. The knowledge management collaboration emphasizes the interaction between the parties. The interaction between enterprises, universities, research institutes in the collaborative innovation of industry-university-research cooperation makes them cooperate closely in the aspects of knowledge resource sharing, information timely communication and new knowledge application. It essentially enhances the ability of cooperation and innovation.

6. Conclusion

Cooperation between enterprises, universities and research institutes is an important way to enhance the market competitiveness of enterprises, accelerate the transformation of scientific and technological achievements and industrialize high-tech. The industry-university-research cooperation in China began in 1980's; it changes from industry-university-research cooperation, to industry-university-research-uses cooperation, industry-university-research collaborative innovation, and government-industry-university-research-uses-finance cooperation.

In 2014, there were 1128 ordinary colleges and universities in China, with a total research funding of 124,427,351,000 Yuan. In which, 42,236,009,000 Yuan are entrusted funding from enterprises and institutions, which ranks the second and accounts for 33.95% of all the funding. The intensity of industry-university-research funds of engineering universities (44.8%) is much higher than the national average and other universities. Engineering disciplines' proportion of cooperative R&D institutions (16.3%) is significantly higher than other disciplines, also higher than the average (11.5%). In engineering disciplines, subjects like mechanical engineering, materials science, electronics and communication technology, computer science and technology account for more. In 2014, the number of technical contracts signed by universities reached 10,517, with a total amount of 401,570,000,000 Yuan.

There are many innovation modes of cooperation in China, the main modes of cooperation include engineering research center model, universities and enterprises co-construction entities, university science and technology park, government-industry-university-research-uses-finance six-in-one innovation strategic alliance, etc.

Collaborative innovation mechanism of industry-university-research cooperation consists of environment such as policy, financial and information. Government provides appropriate policies for improving the policy environment. Financial market provides the necessary capital for collaborative innovation. Technical intermediary is a matchmaker. In the industry-university-research cooperation, enterprises obtain the technical innovation and market benefit through technological transformation. Universities and research institutions obtain the funding support and reputation in technical field. The collaborative innovation effect of industry-university-research can be

reflected in three aspects: dynamic coordination, path coordination and knowledge management coordination.

Promoting the industry-university-research cooperation can improve the capability of independent innovation, which is the one of the prime reasons to achieve rapid economic growth in China. Promoting the cooperation and innovation of industry-university-research and improving the mechanism of industry-university-research cooperation innovation system is a common choice for China and other countries to promote technological innovation and economic development.

References

1. FengHaiyan(2014). Production, Learning, and Research Innovation of Cooperation Mechanism between University and Enterprise. China Higher Education Research. (8).pp:74-78.
2. LanXiaoxia(2014),Industry-University-Research Cooperative Innovation in the United States: Models, Characteristics and Its Implications.China Higher Education Research(4).pp:50-53.
3. Pan Xiyang, Li Jianqing(2014). A New Paradigm for Regional Innovation Development GIU Collaborative Innovation.Science and Technology Management Research, (21). pp:70-75.
4. Wang Zhiqiang, Li Fei(2016), Paradigm Transformation and Formation Path of Industry-university-research Collaborative
5. Innovation: From the Perspective of Innovation Cluster, Journal of Lanzhou University(Social Sciences), (3). pp:159-168.

