CSCanada
International Business and Management
Vol. 11, No. 1, 2015, pp. 79-82
DOI:10.3968/7404

ISSN 1923-841X [Print]
ISSN 1923-8428 [Online]
www.cscanada.net
www.cscanada.org

The Experience and Enlightenment of American Industry-University-Research Cooperation Innovation

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Supported by Research on the Relationship Between Social Responsibility and Financial Performance of Listing Corporation in Jilin Province (2013JYT23).

Received 1 July 2015; accepted 30 July 2015
Published online 31 August 2015

Abstract

U.S. is the first country to realize the cooperation of industry and research. With rapid industrialization and modernization, it attracts worldwide attention. In all western countries, U.S. market economy is the most developed, its market system is the most advanced too. Relatively speaking, the American mode of industry-university-research combination is also the most perfect and representative. Many other countries (regions) draw experience from the American mode and combined with local actual situation to promote the combination of industry-university-research of their own. This paper attempts to objectively summarize the successful experience of the U.S. in the long term cooperation and to sum up the experience for promoting the construction of the technology innovation system based on the industry-university-research cooperation, in order to provide reference for the further development of our (China) domestic research cooperation.

Key words: U.S.; Experience; Enlightenment; Industry-university-research cooperation

Sun, B. J., Feng, C. H. (2015). The Experience and Enlightenment of American Industry-University-Research Cooperation Innovation. *International Business and Management, 11*(1), 79-82. Available from: http://www.cscanada.net/index.php/ibm/article/view/7404
DOI: http://dx.doi.org/10.3968/7404

INTRODUCTION

In the book *Why the American Century?*, Olivier Zunz wrote: "The first task in the end of 19th century and early 20th century is find the way to build partnerships between the large enterprises, government and growing higher education field, in order to jointly create and manage a new America. In this new research system, which is composed of the companies, research universities and scientific research institutions, government agencies and all kinds of foundation, the creators of knowledge, and the third parties have the first time in the history to develop a series of cognitive strategies . . . The scientific research system is 'prerequisite for American Century', because it is the recombination of knowledge, rather than just capital accumulation of power, allowing the U.S. to realize domestic prosperity and expand its global impact." American industry-university-research cooperation has achieved remarkable success. This paper aims at elaborating the reason, its successful experience and basic rules.

1. SUCCESSFUL EXPERIENCE OF THE U.S. INDUSTRY-UNIVERSITY-RESEARCH COOPERATION

1.1 The U.S. Macro Science and Technology Management System

The U.S. macro sci-tech management system is a multi-dispersive model, which is involved administrative, legislative, law systems, participating in the formulation of national sci-tech policy and management of scientific and technological in varying degrees. Among them, the most involved in the administrative system is administrative legislation.

Macro sci-tech management agency. The White House and Congress are the core of sci-tech decision-making; the National Science and Technology Commission participate in development of federal sci-tech, and the establishment of the cabinet committee for the first time in U.S. history; the president serves as chairman of the government departments, coordinating the research and development

of federal and state agencies and raising the sci-tech to the highest level of government decision-making. Congress is the legislative body of the U.S., and plays a very important role in the development of sci-tech of the U.S. At the same time, it also set up a full-time sci-tech management department. The National Science Foundation (NSF) is a special sci-tech management department of the U.S. In addition, the U.S. also has National Academy of Sciences, Engineering and other professional sci-tech management agencies, their main function is to grant honorary academic status, policy advice. In addition, the U.S. has other government agencies such as the Defense Ministry, the Ministry of Commerce, Energy, Health and Human Services, the National Aeronautics and Space Administration, the Ministry of Commerce under the U.S. Patent Office, the National Technical Information Service Center, the U.S. Standards and Technology Research Institute, all playing an important role in the promotion of industrial technology innovation and industrialization

Subject of innovation activities. The main body of American innovation activities is the enterprises, universities, federal research institutions, sci-tech intermediary service agencies, non-profit organizations and other scientific research institutions. The major companies in the U.S. have a scientific research institution, which has scientific research units. America's 100 largest companies employ about three million sci-tech personnels, accounting for 60%-70% of national total sci-tech personnels, the amount of investment of scientific research founds is nearly $100 billion.

American educational research institutions take the main task of knowledge innovation. The higher education system in the U.S. is in the world's first class, and the level of graduate education is famous and renowned. In addition to training sci-tech personnels, university bear the 80% of basic research work. American national research institutions have 850 national laboratories, 200,000 employees, ranking first in the world, the number of private scientific research institutions is more than other countries. There are several nonprofit research institutions, such as Stanford Institute, Battelle Institute, MIT, etc. American sci-tech services agency mainly includes technology transfer, consulting, assessment, policy research, venture capital, etc., which plays an important bridge role in the American national innovation system.

1.2 Government Support for the Innovation of Industry-University-Research Cooperation

Relying on the development of the guidance and support from technological institutions. Industry-university-research cooperation is a systematic project which is related to the overall national development. It is related to the interests of the three aspects of industry, universities and research institutes. Therefore, the government should take effective measures, such as making a reasonable scientific research plan, establishing common interests between academic circles and business community. Since 1998, the U.S. has introduced a series of sci-tech strategic policies—emphasizing the reform of scientific policy, supporting basic research, creating a national innovation platform, increasing investment in sci-tech. From the above we could see America's guide, encourage, and support to sci-tech innovation.

Establishment of the legal system for promoting the industry-university-research cooperation. In order to maintain the leading position of the U.S. in the world economy, sci-tech, and to improve the competitiveness of American industry, the U.S. has made a series of laws to promote innovation and research cooperation, and continuously revises law according to the situation changes, such as 1980's Bayh Dole Act (provisions include: the university funded by government owns intellectual property rights of their outcomes, the use of outcomes must conform to the principle of giving priority to the American enterprise); 1984's Stevenson Widler Technology Innovation Act (provisions include: government research institutions can open to industry). In 1984, the U.S. passed a special act—National Cooperative Research Act—to promote the formation of strategic cooperative partnership.

The formation of specialized agencies to form a platform for research communication and coordination. The U.S. government coordinates the development of sci-tech in the country through the White House Office of science and Technology Policy, the president's scientific and technical advisers, and later to strengthen the functions of government, and the formation of the national sci-tech commission. In addition, in order to strengthen links between university, scientific research institutions, enterprises and government, the U.S. government take measures to further promote the application of sci-tech achievements, it has also set up independent sector in charging of sci-tech work, such as the National Science Foundation and other agencies.

Making sci-tech plans to support the industry-university-research cooperation. Since 1970s, in order to promote the close contacts of basic research, application research and development of the country, the U.S. developed a series of sci-tech plans: plan for supporting enterprise and research organization, plan for supporting the establishment of a cooperative research organization, plan for supporting small and medium enterprises and universities, plan for supporting research institutions, large enterprises and universities, plan for promoting research institutions to cooperate. In order to promote the innovation and development, U.S. passed a series of laws, such as 1990's Advanced Planning Act, 1992's Small and Medium Enterprise Innovation Research Plan and Small Business Technology Transfer Research Plan, 1993's New Generation of Auto Cooperation Plan, Free Car Plan and other plans in 2002.

Creating sci-tech park as the carrier of the industry-university-research cooperation. Many big companies in the U.S. see sci-tech park as a source of their own

innovation and invested heavily at the same time, in order to enhance the innovation ability and competitive power of science park. Besides, the government continues to give preferential policies and financial support to sci-tech park in order to strengthen the link between enterprises, universities, scientific research institutions. In near 20 years, the U.S. built a large number of sci-tech parks in the dense areas. The development of sci-tech park has become the powerful impetus of the contemporary economic, technological and social development, and helps comprehensive reform of the today's society.

State governments actively promote the industry-university-research cooperation, and promote the development of new technologies. Since 1990, in order to promote local economic development, State governments actively take advantage of technology innovation to promote the development of industry, such as the establishment of a $1.7 billion fund in Florida to support biomedical research, a $1 billion project to promote the construction of life science corridor in Michigan. In 2008 California government, California University and industry co-founded California Institutes for Science and Innovation. California government will invest $300 million in 4 years to support basic research and application of cross disciplinary research.

1.3 Universities and Scientific Research Institutes Set a Good Foundation for the Cooperation of Industry-Research

In the mode of American industry-university-research cooperation, higher learning institutions and research institutes have been the source of sci-tech innovation, and quickly become the leading role in the cooperation model, which provides a large number of high-tech enterprises a lot of patent technology support, such as the world well-known colleges and universities including Stanford University. Stanford University's sci-tech achievements are numerous, and in 2003 its patent technologies reached 300. Similar to Stanford University, others such as MIT, Carnegie Mellon University, University of Washington, University of Wisconsin, Georgia Institute of Technology all have made a great progress in the transformation of sci-tech achievements. The technology innovation of enterprises in industry-university-research cooperation in higher learning institutions and the rapid development of local economy also plays a very important role.

Important factors in the establishment of enterprises by colleges and universities. In America, corporate financial support, government funding for research and venture capital support are the main source of funding for the school to start an enterprise. First, the support of government research funds. Government research funds are mainly composed of two stages, the first stage is small, the second is in the trial stage. The highest level of the first phase up to $100,000, the second phase of funding up to $750,000, as in the previous SBIR and STTR project funding support.

Second, corporate financial support. In America, some big companies, playing the role of technology leader, always provide their technical support to the research and development efforts of colleges and universities. In AT&T, for example, the company set up a professional department to charge the university scientific research projects, the annual number of funds allocated reach millions of dollars. These funds are provided to some famous universities and some famous professors of scientific research projects, support their own research and development efforts.

Third, venture capital support. The process of industrialization needs very large capital, government departments responsible for sci-tech projects can not provide enough capital, venture capital support becomes very important, especially in the transformation of scientific research achievements of Colleges and universities. The development of a lot of enterprises and the investment of venture capital are inseparable. In the process of development of Google, there are $25 million funds as venture capital injection to the company, and in 1968 there is a capital of $25 million into the company as risk investment. Venture capital of the investment company is not only the support of the above funds, but also enterprise related development strategy planning, the relevant law provisions, financial management, public relations and other aspects that have been given a lot of long-term attention.

2. ENLIGHTENMENT OF THE U.S. INDUSTRY-UNIVERSITY-RESEARCH COOPERATION INNOVATION

2.1 The Industry-University-Research Cooperation Needs a Complete Legal Guarantee

Complete legal system can provide enough legal protection to ensure a successful cooperation. In the cooperation of industry and university, the main body of different legal norms should be used to determine the ownership of intellectual property and interests-distribution, protect the legitimate rights and interests of the parties, and deal with all kinds of disputes that may arise. The U.S. has most complete legal system in the world, the relevant intellectual property rights, interests distribution, promotion technology transfer, scientific research personnel incentives and other aspects of the law are relatively sound, to promote the cooperation of industry and research institutions.

2.2 It is Necessary for the Government to Give Financial Support to the Industry-University-Research Cooperation and Reduce Cooperation Risk

Most of enterprises are funded by industry, universities and scientific research institutions are responsible for providing scientific and technical personnels and scientific research equipment, such key technologies, common

technologies and solve technology problems. The government can invest in this kind of technology research and development and innovation by setting up of special funds. Government special funds is an important source of capital, it can reduce the risk of technology innovation, and enhance the power of enterprises to participate in innovation, but also to ease the problem of lacking of capital in the process of cooperation.

2.3 The Guidance and Support of the Science and Technology Policy Plays an Important Role in Promoting Technology Innovation

In 1957, the Soviet Union successfully launched the first man-made earth satellite in the human history which made the U.S. government and society greatly shocked, and the National Science Foundation from mainly funding basic research in the past to the rocket, satellite communications, automatic control and other related applications, which is closely related to the aerospace technology. In the 1980s, for political, military, economic and other considerations, the government has turned to the application prospect of research projects. The U.S. government's guidance and sci-tech policy support, is the main reason leading to focusing on the innovation of the universities of America.

In order to promote the integration of production system, the government as the main organizer and social management is necessary to take measures to protect common interest in the area between academia and industry, and promote scientific development and transformation through cooperation, sci-tech projects. The government can take effective measure to help enterprises, schools and research institutions, such as broadening the scope and channels of cooperation, strengthening the substantial, comprehensive, in-depth cooperation—scientific research institutions and universities can cooperate with enterprises in different forms of cooperation—resolving the problem of compartmentalization and decentralization in sci-tech and educational system.

2.4 Gradually Improve the Intermediary Organizations and Service Agencies, Strengthen the Construction of Intermediary Service Organizations

In the development course of global sci-tech, the development trend of the intermediary service organization's function is the diversification of activities. Intermediary service organization is an indispensable support system in the cooperation of industry and research institutions. On the one hand, intermediary service organization provides support to enterprise, so that it can find the suitable conditions, cooperate with universities to carry out study, the other hand is to understand the needs of enterprise, examine and revise the research direction. In carrying out cooperative research, universities and enterprises generally depend on the legal contract services agency, with the help of intermediary organizations, universities carry out cooperation with enterprises or participate in the national research topics and make inventions. In recent years, China's sci-tech Intermediary service agencies starting from scratch, has made a certain progress, but our own country's intermediary service agencies are mostly single, the agency is not perfect, providing information service is not timely or lack of accuracy, and the position and interests of intermediaries is difficult to protect. Therefore, we must establish and improve various intermediary service organizations to improve their service functions, not only has the function of advisory services, but also has the functions of security, in the process of research results transfer agreement or contract.

CONCLUSION

The U.S. is the earliest country to practice industry-university-research cooperation in its different stages of development and different modes, which has the most far-reaching and the most representative modes: Business Incubator Mode, Patent Licensing and Technology Transfer Mode, High-Tech Enterprise Development Mode, Science and Technology Industrial Park Mode and Industrial University Cooperation Research Center and Engineering Research Center mode.

The development mode of the U.S. has accumulated a lot of experience, it has made a series of successful experience in the research and cooperation, summarizing its successful practice and analyzing the reasons for its success are very important for promoting the positive and healthy development of China's research and development cooperation.

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