An Analysis of Scientific and Technological Innovation Ability and Patent of Invention in Chinese Universities

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ABSTRACT

This paper analyzes the Chinese universities’ scientific and technological innovation ability from the aspects of patent output ability, patent transfer ability and patent licensing ability, based on the data source of publications and statistics of State Intellectual Property Office from 2008 to 2016. Colleges and universities’ patent output capacity growth is most obvious, patent transfer ability is inferior to that of patent output capacity growth, while the patent licensing capacity does not change much. The ability of patent output in colleges and universities is obviously stronger than the ability of patent transfer and patent licensing ability, and patent transfer ability is better than patent licensing ability. There still exists a big gap in scientific and technological innovation ability between our China’s colleges and universities and those of developed countries. The problems of Chinese universities’ scientific and technological innovation are mainly reflected in patent quality, university management and patent system. To enhance the ability of scientific and technological innovation in colleges and universities, we can proceed from the aspects of patent transformation recognition, the formulation of incentive policies, the cultivation and protection of high-value patents, the improvement of service invention system, and the construction of patent conversion promotion mechanism.

KEYWORDS

University, innovation ability, exploitation of patents, countermeasure.

INTRODUCTION

The patent is an exclusive right granted to an invention, and more than 80% of the invention is published in the form of patent [1]. The scientific and technical information approximately 90-95% is included in the patent literature [2]. The patents output ability and the patents exploitation ability can reflect the scientific and technological innovation ability of a country, region or an organization. University is an important gathering place for innovative talents and R & D institutions. It is an important base for carrying out scientific research and creating tens of thousands of patents each year. As an important platform for innovation and technology transfer, patent results of university are very important for promoting national economic development. In order to compare and analyze the scientific and technological
innovation ability of Chinese universities, this study intends to analyze the patent situation of Chinese universities from the perspective of patent analysis, and study the scientific and technological innovation ability of colleges and universities, so as to find out the existing problems of scientific and technological innovation in colleges and universities, to provide suggestions for the promotion of scientific and technological innovation ability of universities.

DATA COLLECTION

Based on data source of the publications and statistics of the State Intellectual Property Office of the P.R.C., this paper obtains the relevant information of colleges and universities’ patent and retrieves the patent status of Chinese universities from 2008 to 2016. This paper analyzes Chinese universities’ patent output ability, transfer ability and licensing ability with analysis tools of Origin and Excel, etc. And then, it analyzes the factors that affect the technological innovation ability of Chinese universities and puts forward corresponding countermeasures.

ANALYSIS ON THE INNOVATION ABILITY OF SCIENCE AND TECHNOLOGY IN COLLEGES AND UNIVERSITIES

Colleges and universities’ scientific and technological innovation ability can be subdivided into patent output ability, patent cooperation ability and patent transformation ability [3,4]. Patent transfer is the most typical way to transform the patent results in colleges and universities, and it represents the universities’ patent transformation ability to some extent. This paper chooses the total amount of patent application, the amount of patent for production and research cooperation, the amount of patent transfer as the evaluation factors, and makes a preliminary evaluation of the universities’ scientific and technological innovation ability.

Fig. 1 shows the total amount of patent applications for Chinese universities (2008-2016). It can be seen from Fig. 1 that the output of Chinese universities’ patents is increasing year by year (2008-2015), the total number of patent applications in 2008 is 45145, reaching 235,162 in 2015, which is five times more than that of 2008. The total amount of universities’ patents output in eight years (2008-2015) is 1015618 pieces. A slight decline was seen in 2016, the total amount of application was 184423 pieces.

Figure 1. Total amount picture of patent applications of Chinese colleges and universities.
Table 1. Service invention patents application amount of some countries (2008-2015).

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Table 1 shows ten countries’ eight years’ (2008-2015) patent application amount of service invention, including the United States, Britain and Japan. From Table 1, we can see that among the ten countries, the highest output of the invention is Japan, and the total amount is 346469 (2008-2015); followed by the United States, the number is 250601 (2008-2015); the third is Germany, the number is 105,185 (2008-2015); the tenth is Italy, the total amount of invention in eight years is 13870. Colleges and universities’ invention and creation is part of the service invention, the comparison shows that China's universities’ patent output is at the forefront in the world.

Fig. 2 reflects Chinese universities’ patent conversion conditions (2008-2016). It can be seen from Fig. 2, as of 2016 colleges and universities totally transferred 20626 pieces of patents, licensed 10637 pieces of patents, totally converted 31263 pieces of patents. From the angle of the distribution situation, the patent transformation shows a rising trend year by year mainly due to the increase of patent transfer. The amount of patents transfer in the recent four years is maintained at more than 3000, while the patent license is basically maintained at around 1000. It can be seen that the ability of patent transfer in colleges and universities is stronger than the license ability, and the gap is gradually increasing.

To compare Fig. 1 with Fig. 2, we can see that the total number of patent applications for the nine years of 2008-2016 is 12,00050; the total amount of patent transfers is 19810, accounting for 1.65% of the total application amount; the total amount of patent licenses is 10788, accounting for 0.9 %; the patent conversions totally accounts for 2.55%. It can be found that the capacity of patent output in our country is obviously stronger than that of patent transfer ability and patent licensing ability. Patent transfer ability and patent licenses ability are also different.
Universities’ conversion rate of 2.55% is significantly lower than that of the domestic enterprises’ 20%, and nearly 97% of the patents in universities and colleges are idle. From the view of individuals, the vast majority of universities’ patent conversion rate is less than 5% according to the data from "China's universities’ intellectual property report <2010>", while the conversion rate in foreign universities is more than 30%. Cambridge University, for example, the patent licenses rate only (2004-2008) reached 47%, far more than that of the domestic colleges and universities. And this further shows Chinese universities lack of patent conversions ability.

PROBLEMS IN THE INNOVATION OF SCIENCE AND TECHNOLOGY IN COLLEGES AND UNIVERSITIES

Patent Quality.

Ministry of Education statistics show that the total number of patent applications of China's colleges and universities in 1986-1992 was less than 2000, and as of 2008 reached 45,000, accounting for nearly 3.6% of the total number of patent applications. The patent applications amount of colleges and universities to 2016 reached 184423, accounting for 13.7% of the total number of patent applications. Obviously, university can be described as an important contributor to China's patent output. But the quality is generally low, the core patent amount is particularly small, the core patents amount which can form patent portfolio is particularly small. And it is difficult to provide the necessary technical system and intellectual property rights for China's economic restructuring and upgrading of industrial technology.

Colleges and Universities.

First of all, the university system is insufficient for the determination of patent results. The patent assessment usually only consider the number of patent applications, and rarely consider the weight of patents transformation and cooperation in corresponding assessment, resulting in the inventor’s blind pursuit for patent applications, and ignoring the patent conversions which can well reflect scientific and technological innovation ability and cooperation factor. Secondly, most of universities’ patents originate from scientific research projects, and the majority of projects are basic research. And this leads to the universities’ emphasis on theory in the patent field and further makes theoretical model part of a patent. Of course, it causes that most of patents cannot be applied to the production, resulting in the majority of the patent idle. As shown in Table 1 and Table 2, total patent applications of university patents reached 184423 in 2016, while the total number of patent conversions is only 5690. This shows the low quality of patents in Chinese colleges and universities.

System Field.

The lack of system is mainly reflected in the distribution the rights and interests of the service invention and incentives for conversions. First, the uneven distribution of rights and interests lead to the inventors’ lack of power to implement patents. In addition to the enterprises, colleges and universities are the second largest service
inventor, and its patents are mostly the service invention. Both the practice research data from our research group and related research literatures about domestic service invention patents show that China's invention patent conversions situation is not satisfactory. The situation that the market value of patents cannot be made full of use has much to do with the unreasonable rules about the distribution of rights and interests of service invention. Second, the benefits distribution rules have different sources, and so some rules conflict with the others. Regulations about certain contents from "Patent Law", "Implementing Regulations on Patent Law", "Contract Law" and "Law on Promoting the Transformation of Scientific and Technological Achievements" are not the same, and even conflict with each other. For example, "Implementing Regulations on Patent Law" provides that the inventor can draw no less than 2% from the operating profit as remuneration from the organization which implements invention itself, while the similar in "Law on Promoting the Transformation of Scientific and Technological Achievements" is not less than 5%; if the organization transfers the patent or authorizes others to implement patent, the former provides that not less than 10% of the royalties should be granted to the inventor as remuneration, while the later provides that not less than 50% of the royalties should be granted to the one who plays an important role in accomplishing or transforming the service invention as remuneration. Thirdly, policies in colleges and universities despise the input and loss of patents, as well as them emphasize on patent output and award-winning. Promotion work of titles also ignores the achievements promotion staff, and harms the enthusiasm of the staff for promoting achievements.

COUNTERMEASURES ANALYSIS ON PROMOTING THE INNOVATION ABILITY OF SCIENCE AND TECHNOLOGY IN COLLEGES AND UNIVERSITIES

Strengthening the Recognition of Patent Conversions by Patentee and Inventor in Colleges and Universities.

Some work can be done from the angle of researchers and managers in colleges and universities. For researchers in colleges and universities, we should encourage them to participate in research projects and lead them to apply for high quality patents; for managers, especially leaders in colleges and universities, we should strengthen their understanding of patent conversions and help them to pay attention to the long-term impact of patent conversions on colleges and universities and the social development. The leaders should carry out the patent conversions work from the angle of implementing innovation-driven development strategy, and develop corresponding measures to promote the smooth operation of patent conversion work [5].

Formulate Incentive Policies and Award Promoters for Patent Results.

This countermeasure is mainly for the managers of colleges and universities. First of all, colleges and universities should develop appropriate policies, and focus on the support of scientific projects with potential mainly from the funds, scientific research staffing so as to enhance the output of high-level patents. Secondly, according to the disciplines situation, colleges and universities should screen patents have been applied for so as to be converted for applications and prevent the loss of patents? Thirdly, for
the balance of patent conversions and scientific research, it is necessary to incorporate the transformation of invention patent into the consideration of scientific research work. Promotion of title or reward should reflect the recognition to the results transformation personnel, and colleges and universities should take a variety of ways to stimulate the transformation of patents. Fourth, colleges and universities, if possible, can set up foundations to promote or convert the results, as well as set up bases, effectively to convert the scientific and technological achievements into productive forces.

**Strengthening the Cultivation and Protection of High-value Patents in Colleges and Universities.**

High-value patents refer to patents those are not only of high technical level but also an important lead in the technological advancement of the industry [6]. High-value patents cultivation is very complex system engineering. Whether for inventors, or for colleges and universities, they should carry out research and development according to the needs of economic and social development. The research results should solve the key technology or core technology which is urgently needed or needed to be resolved. And through high-value patents, promote high-value products production, high-value industries development, and high-value market growth. In addition, we should pay attention to the protection of high-value patents. For colleges and universities, to strengthen the protection of high-value patents, it is necessary to have the government's attention, improve the system, and to increase the inventors’ awareness of patent protection.

**Improving the System of Service Invention in Colleges and Universities.**

Colleges and Universities are very important science and technology R & D organizations in China, with the legal positioning of the public and the intensity of R & D personnel, so its service invention has its own particularity. The main purpose of patent legislation is to encourage inventions, and ultimately "use", so as to promote the progress and development of science and technology. From the angle of relevant provisions of patent conversions, the system of service invention is committed to safeguarding the legal rights and interests of inventors, to stimulate innovation and to create conditions for the transformation applications of patent. Taking into account the special attributes of universities and the characteristics of body, colleges and universities should not adhere to the principle that the right of service patents should belong to organizations, but should carry out special provisions on the ownership of the invention rights of the universities and assign the right to the appropriate subject which can maximize the value of patents with the principle of improving the application of patent conversions in colleges and universities.

It is important to note that patents from the invention of state-supported scientific research projects should be given priority to the project. The right of patents should be given to the inventor if the organization does not choose to keep the right. And that will be beneficial for reducing or removing the barrier of state-owned projects patent conversions. This disposing method is also helpful for promoting patent conversions and preventing the obstruction of the rights attribution and patent disposal due to the uncertainty of the project undertaker.
Constructing the Perfect Mechanism of Patent Conversions in Colleges and Universities.

Universities’ patent conversions promotion mechanism is a diversified system, and the content should be comprehensive rather than single. In order to build a sound promotion mechanism to protect the effective conversion of universities’ patents into productivity and promote the regional economic growth, the system should combine with the regional economy and the characteristics of colleges and universities. The perfect universities’ patent conversions mechanism should include: perfect policy guarantee, overall information strategy, perfect reward incentive system, full venture capital, professional intermediary service, complete resource integration and strict transformation review.

SUMMARY

Colleges and universities’ scientific and technological innovation ability can be subdivided into patent output ability and patent conversions ability, and patent conversions ability can be subdivided into patent transfers ability and patent licensing ability too. Patent analysis shows that China's university scientific and technological innovation ability is on the rise, but it should be further improved compared with the developed countries. At present, the problem of scientific and technological innovation ability of Chinese universities is mainly reflected in the fact that the number of patent applications is high, but the quality is relatively low and especially lacks of high-value core patents; The colleges and universities’ patent identification system is not perfect and its patents are theoretically strong, which both decrease the ability to cooperate with the enterprises and resulting in most of the patents idle; rights and interests distribution system is imperfect, which results in the low efficiency of patent conversions and serious loss of patents. The improvement of scientific and technological innovation ability in colleges and universities can be carried out from five aspects: strengthening the recognition of patentees and inventors of patents in universities; formulating incentive policies and promoting promoters of patent achievements; strengthening the cultivation and protection of high-value patents in colleges and universities; improving the service invention system; establishing a perfect promotion mechanism for patent conversions in colleges and universities.

REFERENCES