Research on Countermeasures to Improve the Effectiveness of University Scientific and Technological Achievements Transformation

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Abstract. In response to the urgent need for scientific and technological innovation to lead the comprehensive revitalization of industries, how to fully revitalize scientific and technological and enhance the effectiveness of transforming scientific and technological achievements in universities is an important link in implementing the strategy of innovation-driven development. At present, the gap between the supply of scientific and technological achievements in universities and the needs of society and the economy still needs to be bridged. The professional management and transformation operation of scientific and technological achievementsently need to be strengthened, and relevant supporting policies need to be deepened and implemented. Universities need to further promote organized scientific research, strengthen the construction of professional institutions improve the long-term mechanism of transformation, and build a good innovation ecology.

Keywords: University; Transformation of scientific and technological achievements; Countermeasures

1 Introduction

To fully play the role of science and technology innovation, a key link is the transformation of scientific and technological achievements. As the main of basic research and the source of major scientific and technological breakthroughs, universities should take the initiative to connect with national strategic needs, fully play the important role of universities developing regional pillar industries and leading industries, adhere to goal-oriented, policy-driven, deeply implement the integration of science and education, integration of industry and education adhere to reform and innovation, continuously enhance the social service ability of university scientific and technological achievements, build a new type of collaborative scientific research mode with deepening educational reform the driving force, and create a platform for the integration of government, industry, education, research and application to serve the development of regional national economy, integrate and optimize educational innovation resources, and improve the efficiency of scientific and technological achievements

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transformation. Lead the comprehensive revitalization of the industry with scientific and technological innovation.

2 The Main Problems Faced by the Scientific and Technological Achievements Transformation in Universities

2.1 Service Capability of Higher Education Scientific and Technological Achievements on the Supply Side is Insufficient

The main manifestation of insufficient service capacity is the "three lacks" of scientific and technological achievements, namely, the lack of scientific and technological achievements with conversion value, the lack of patents with high commercial value, and the lack of achievements with high technical maturity.

First, there is a lack of scientific and technological achievements high conversion value. For example, in a certain province, there are three projects with a contract amount of more than 100 million yuan in 2023, three projects with a contract amount of 50 to 100 million yuan, and five projects with a contract amount of 30 to 50 million yuan. Among the 11 large-value transformation projects, only five were transformed within the province.

Second, there is a lack of high commercial value patents. There is a "bubble" phenomenon where patent achievements are disconnected from the market demand, and there is a lack of patent achievements with actual commercial value that can be transformed.

Third, there is a lack of results with high technical maturity. Most of the scientific and technological achievements of universities are limited to the stage of basic research and applied technology research, and only a small part of the results have completed technical breakthrough or small-scale trials; while enterprises are more concerned about results with high technical maturity and low investment risk points. Some small and medium-sized enterprises expressed their opinions when participating in the school-enterprise reception, "Compared with the results that need to invest cost and risk and stay at the laboratory stage, enterprises need processes that can be used immediately." The construction of pilot base in universities lacks funds, and the construction of pilot base by local and enterprises lacks enthusiasm, so technological achievements can not be tested and produced for proof, and are "locked in the deep palace".

2.2 The Professional Management of Scientific and Technological Achievements and the Level of Operation Need to be Strengthened

First, there is a severe shortage of professional management team members. Compared with the average number of patents served by each professional manager below 3 abroad, the average number of invention patents in domestic universities is in the thousands, and the number of managers is in the single digits. Second, there is a lack

institutions and platforms for technology transfer services. The existing technology transfer service institutions in universities mostly stay at the traditional service mode of providing information and organizing matching activities, and few provide a series of professional services such as invention evaluation, value-added cultivation, quality management, market analysis, selection and promotion, coordination and evaluation, transaction valuation, and signing according to the business model of technology transfer.[1]

2.3 Related Supporting Policies Still Need Further Coordination and Implementation

In terms of policy formulation, departments such as education, science and technology, finance, personnel, state-owned assets, and auditing have not yet established a collaborative mechanism to form a joint force, and some incentive situations have not yet received relevant policy support. In terms of equity incentive, the newly generated equity universities due to the pricing of scientific and technological achievements is held and managed by the university asset management company in accordance with the state-owned assets management procedures, and Formulate the equity exit mechanism in principle. This will have a significant impact on the equity incentive of university scientific and technological achievements, and the number of university scientific and technological incentive projects will inevitably continue to decrease. In terms of policy implementation, some universities do not pay enough attention to the implementation of related policies such as personnel incentive, performance, and fund management. Lack the motivation for reform, and the reform results are not obvious.[2]

3 Main Practices and Enlightenment of Scientific and Technological Achievements Transformation from Higher Education Institutions in Developed Countries[3]

Developed countries have gradually formed a relatively perfect scientific and technological achievements transformation system with universities and scientific research institutions as the main focus, especially in terms of institutional guarantee, institution building, and collaborative promotion, and have gained relatively rich experience.

3.1 Main Practices of the United States

First, based on the Bayh-Dole Act, the United States enacted a series of science and technology promotion acts, building a legal framework institutional system that combines incentives and regulations. The Bayh-Dole Act clearly stipulates that universities can retain the intellectual property rights of the achievements generated by the federal government scientific research funds, but they need to disclose inventions and commercialize them within two years, otherwise the government has the right to re-

cover the rights, which made the conversion rate of scientific and technological achievements in American universities soar from 5% to 80% in 10 years.

Second, Stanford University pioneered the OTL model, where OTL is responsible for the management and operation of intellectual property, with self-financing. All its office expenses come from the income of intellectual property operation, which accounts for about 15% of the intellectual property operation income. The “inventor participation system”is adopted, with technology managers (with an average of 12 years of work experience) responsible throughout the process, including value assessment patent layout, and commercial negotiation. Inventors and their departments participate in sharing patent licensing income, and the benefit distribution is: inventors 1/3, departments 1/3, and the school 1/3. In 2023, Stanford University had 115 patent licenses for the whole year with a total income of $59 million (about 430 million yuan), incubated 27 startup companies, and reached 210 industrial-academic-research cooperation agreements.

Third, concept validation centers have been established in universities, operated jointly by various organizations, institutions, and universities, focusing on transformation elements such as talents, and the market providing activities such as seed funding, business consulting, and entrepreneurial education. By the first half of 2022, the number of concept validation centers in American universities had reached 42.

3.2 Main Practices of Germany

First, a series of policies, regulations, and agreements have been enacted. In 2002, Germany amended the Employee Invention, specifying that the ownership of inventions belongs to the employer unit of the inventor (i.e., universities), and 30% of the benefits from achievements transformation must be distributed to the inventor, which greatly increased the number of patent applications from German universities. In 2019, the German Science Conference issued Research and Innovation Convention IV, Future Agreement: Strengthening University Learning and Teaching, and University Teaching Innovation Agreement. The three agreements plan to invest about 62.5 billion euros in 2021-2030 to improve the overall quality of scientific research and innovation capacity of German universities.

Second, it has formed the Fraunhofer R & D model. The Fraunhofer Society applies an industry-oriented scientific system to the innovation of applied research. It has 76 institutes, 70% of whose funding comes from corporate contracts and 30% from basic grants. In corporate contracts, 50% are customized R & D projects for SMEs. The research process implements a "dual-helix R & D path": in the stage of demand definition, enterprise engineers and researchers jointly formulate technical parameters; in the stage of prototype development, after the laboratory verification is completed by the institutes, it is necessary to carry out at least 3 months of pilot test on the enterprise production line; in the stage of technology transfer, a “technology package ”(including process documents and training videos) is provided to ensure that enterprise engineers can operate independently. At the same time, a two-way talent flow mechanism is established and a dual-track employment system is adopted. Researchers can choose the "academic track" (engaged in basic research in universities)

or the "industrial" (engaged in applied projects in institutes), and the promotion criteria for the two types of positions are separated.

Third, create a unique science and technology park. With the promotion of the government, the "West Berlin Innovation and Entrepreneurship Center" near the University of Berlin has been able to effectively integrate the strengths of the government, universities, and enterprises, and comprehensively improve the efficiency of transforming scientific and technological achievements in universities.

3.3 Main Practices of Japan

First, build an integrated ecosystem of government, industry, academia, research, and finance in the Tsukuba Science City. The law drives spatialglomeration, and the "Tsukuba Science City Construction Law" stipulates that enterprise R&D centers must be located within a 5 km radius of the universities, and that the government bears 50% of the laboratory construction costs in the park, but enterprises need to commit to hiring at least 30% of local graduates. Toshiba Corporation and the University of Tsukuba cooperate to develop quantum computers, shortening the R&D cycle by 40% through the " lab" model (universities provide theoretical algorithms, and enterprises are responsible for hardware integration).

Second, the technology licensing office is diversely developed. There are three types of technology licensing offices in Japan. The first type is an internal that is independently operated and managed by the university itself. The second type is an external organization established by the university with Capital holding. The third type is an organization with full legal personality that is independent of the university. The technology licensing office transfers the achievements of the university researchers to the enterprise for use through legal means and plays the role of a third-party supervisor. It has an important role in the development and evaluation of research results and the protection of patents. It has become the standard model for technology and intellectual property management in Japanese universities.

Third, innovating financial instruments. JST established a "Bridge Fund" with a total amount of $5 billion to make "risk compensation" investment in early-stage technologies from universities. In 2021, among the 120 projects funded, 32 percent entered the industrial stage, and the follow-up investment ratio of social capital reached 1:8.

3.4 Main Practices of European Countries

First, government, enterprises and universities cooperate to build a platform for industry-education-researchthe. The British government has introduced policies and measures such as the "Connection Plan" and the "Institutional and Enterprise Partnership Plan" to comprehensively and multi-level improve the consistency of scientific and technological achievements in universities and the development of economy and society. At the same time help university teachers and students gain more experience in enterprise production and operation. The British government has launched "Science and Enterprise Challenge Plan", investing 25 billion pounds to establish 8

entrepreneurship centers in British universities to support the commercialization of new ideas research of university scientific researchers. The French government has proposed the "University Innovation Center Plan", which integrates multiple participants to jointly formulate innovation strategies such as intellectual property rights technology transfer, and enterprise startup, and provides support in the links of project conception, invention creation, technology maturation, entrepreneurship training, and enterprise creation, and achieved successful pilot results in Sorbonne University, Clermont Auvergne University, Montpellier University and Strasbourg University.

Second, establish a technology transfer company. The University of Oxford in the UK has established a wholly-owned technology transfer company. All scientific and technological are first transferred to the technology transfer company by the university's research service department through licensing. Then, the technology transfer company transforms them into three modes, namely, spin-off companies and joint investment, according to the commercialization characteristics of the achievements. More than 100 licensing agreements are reached every year, and over 70 spin-off companies have been established.

3.5 Relevant Experience Enlightenment

First, through strengthening the top-level design of laws and regulations and encouraging policies, further clarify the ownership of scientific and technological achievements in universities, and ensure the legitimacy and flexibility of the support for the disposal and distribution of achievements in universities from the source, breaking the institutional and mechanism barriers for the transformation of scientific and technological achievements in universities.

Second, set up diversely specialized technology transfer departments. Establish specialized technology transfer departments such as technology licensing offices, technology transfer companies, and concept validation centers to bridge the gap between scientific and technological achievements in universities and achievements that can be commercialized, empower early-stage projects to the maximum extent, reduce early risks from fundamental research to industrial incubation, eliminating the phenomenon of "two faces" of science and technology and economy from the source.

Third, efforts have been made to create a full-link service system. The combination of national research plans, the advantages of university R&D, and the technical needs of enterprises has been emphasized. Emphasis has been placed on establishing a full-link model of “R&D-incubationindustry”, so as to form an ecosystem of transformation of scientific and technological achievements, which has shown unique advantages in the cooperation of industry, university, and research and has perfected the scientific and technological innovation ecosystem of the region where it is located.

4 Suggestions on Improving the Effectiveness of the Transformation of Scientific and Technological Achievements in Universities

4.1 Continuously Strengthen Organized Scientific Research, and Serve the Transformation and Upgrading of Key Industries

The improvement of scientific and technological achievements and service capacity is the premise of transformation. To improve the quality of scientific and technological achievements and service capacity, we should focus on key industries, continuously strengthen the organized scientific and technological innovation through the two carriers of "project+platform", and promote the construction of platforms through organized scientific research, so as to provide support for improving the modernization level of industrial and supply chains and promoting high-quality development of industries. Taking the revitalization of the old industrial bases in Northeast China as an example, we can collect the needs of bottleneck Technology from the enterprises according to the construction of the traditional industry clusters and the strategic emerging industry clusters, set up projects to compete for the name of the champion, study and propose the main attack direction of organized scientific research, promote the formation of more new qualitative productive, and cultivate and develop new momentum.

4.2 Strengthen the Construction of Professional Institutions, and Deepen the Full-Chain Management of Scientific and Technological Achievements

Strengthening the construction of professional institutions and deepening the full-link management of scientific and technological achievements are necessary means to achieve the transformation achievements, and are key links to connect the "first mile" of scientific and technological achievements out of the laboratory, pave the "high-speed road" of achievement, and enter the "last mile" of the production line.[4]

First, strengthen the construction of technology transfer institutions in universities. Universities are encouraged to set up professional technology transfer institutions without increasing staffing, and strengthen development, marketing promotion, and after-sales service for scientific and technological achievements. This includes providing professional services such as scientific research literature retrieval and patent navigation to help scientific researchers choose research directions; providing professional intellectual property management services throughout the process of scientific and technological project operation; and providing comprehensive services such as business negotiation, legal consultation, transformation review for scientific researchers throughout the process of scientific and technological achievement transfer and transformation.

Second, accelerate the expansion of the talent pool for technology transfer with innovative qualities and technical management capabilities, improve the professional

talent training model for technology transfer and establish a mechanism for the introduction, training, and exchange of technology transfer talents.

Third, encourage universities to join hands with external specialized third-party institutions to establish a result-operation system with clear benefits, flexible mechanisms, and diverse models. Jointly carry out services such as pre-patent application results disclosure, transformation assessment, transformation path design, and technology financing.

4.3 Establish a Long-term mechanism for the Transformation of Scientific and Technological Achievements in School-enterprise collaboration[5]

Establishing a long-term mechanism for the transformation of scientific and technological achievements in school-enterprise collaboration is key to achieving dual-chain interaction, scientific and technological innovation to lead and serve the comprehensive revitalization, and stimulating and driving scientific and technological innovation to form a virtuous cycle.

First, innovate the work promotion mechanism for school-enterprise collaborative innovation in science and technology. Make full use of means such as "Internet+" , establish and improve the normalized mechanism of school-enterprise docking, promote the establishment and improvement of information bases for scientific and technological achievements of universities, intellectual property information, patent literature information, expert information, and enterprise technological demand information, innovate the normalized mechanism of school-enterprise docking, promote the integration of supply and demand the transformation of scientific and technological achievements, reduce the cost of docking, improve the efficiency of docking, and promote collaborative innovation.

Second, a mechanism for channeling existing patents should be established. Existing patents of universities and research institutions are sorted out and revitalized, and market-oriented selection and evaluation of existing patents, supply and demand docking, popularization and application, and tracking and feedback should be established. Institutions of higher and professional institutions are encouraged to select existing patents with potential market value in a planned way, and to build a stratified database of patent resources that can be transferred, to push them to enterprises according to industrial subdivided fields, so as to promote supply and demand docking.

Third, a diversified service mechanism should be established. Mobilize social forces, guide various technology transfer centers, SME service agencies, intellectual property agencies, and industry associations to strengthen services for the cooperation between universities and enterprises in scientific research.

4.4 Strengthen Policy Guidance and Financial Incentives, and Continuously Stimulate the Internal Driving Force of University Science and Technology Services

Strengthening policy guidance and financial incentives, and continuously stimulating the internal driving force of university technology services, is an important guarantee to enhance the effectiveness scientific and technological achievements.

First, strengthen the incentive mechanism for the transformation of scientific and technological achievements and patent authorization in universities. Explore a new mode of management for the transformation scientific and technological achievements in universities, improve the mechanism for exemption from liability and tolerance for the transformation of achievements, and promote universities to accelerate the implementation of a pre-essment system for patent application based on industrialization prospects.

Second, strengthen the policy guidance to improve the quality of scientific research results and patent authorization. Guide all universities to take the level of scientific research results and the benefit of patent transformation as an important evaluation criterion in the work of project evaluation, institution evaluation, talent evaluation, and professional title determination.

Third, support qualified institutions of higher learning to establish new R&D institutes for pilot production and concept validation, the models of the cooperation between universities and local governments in Shandong, Guangdong and Wuhan. The institutes will adopt flexible staffing mechanisms and provide R&D space, policy support and financing.

Fourth, improve the mechanism for attracting diversified investment. We will support higher education institutions in setting up funds for intellectual property management and for the operation of the results of scientific and technological research through various means.

5 Conclusions

In the face of the world problem of scientific and technological achievements transformation, we should insist on "adapting foreign things to our use, and adapting ancients to the present". We should not only actively draw on the advanced international experience, but also base ourselves on the reality of China, explore and find a new mode of scientific and technological achievements transfer and transformation that is truly in line with China's national conditions and social conditions. Promote the efficient docking of the university's advantage disciplines with regional advantage industries, break the boundaries of schools and regions, and gather the national university's scientific and technological innovation resources to support the improvement of the core competitiveness of the industry. The regional industrial advantages can also lead to the reform of applied innovative personnel training and scientific research mode in colleges and universities, achieve the benign interaction between Colleges universities and the region, and the precise matching of supply and demand, and support the construction of talent centers and innovation highlands.

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