

# **Research on Countermeasures for the Transformation of Scientific and Technological Achievements in Universities and Research Institutes in Liaoning Province**

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**Abstract:** Universities and research institutions are crucial in conducting basic research and driving significant technological advancements. Liaoning Province boasts abundant resources in universities and research institutions, characterized by outstanding research abilities. Investigating the challenges related to the technology transfer of scientific research outcomes between universities and research institutes in Liaoning holds paramount importance for the region's revitalization. This study delves into the policies, measures, and current status of technology transfer of scientific research outcomes between universities and research institutes in Liaoning, revealing pressing issues such as inadequate quality and alignment of scientific research results with market demand, subpar service quality in technology transfer, and the necessity for enhancing the incentive mechanisms for technology transfer. The research proposes effective methods and recommendations tailored to boost the technology transfer efficiency of local universities, thus improving the quality of technology transfer in universities and research institutes in Liaoning. These efforts aim to stimulate the development of new productive forces in Liaoning and contribute to the comprehensive revitalization of the region.

**Keywords:** Universities and Research Institutes; Transformation of Scientific and Technological Achievements; Incentive Mechanisms; Technology Transfer Services

## **1. Introduction**

The "2023 China Patent Survey Report" highlights a consistent growth in the

industrialization rates of effective and invention patents in China from 2019 to 2023. The industrialization rate for effective patents escalated from 38.6% in 2019 to 54.3% in 2023, while the rate for invention patents rose from 32.9% to 39.6% during the same period, underscoring the potential for further enhancements in patent transformation in China [1].

Universities and research institutes are pivotal in driving technological advancement and industrial transformation, acting as the cornerstone of fundamental research and the genesis of significant technological breakthroughs. Harnessing the leadership of universities and research institutes in technological innovation through structured research endeavors can significantly enhance innovation capacities and foster sustainable economic and societal progress. The technological accomplishments of universities serve as key indicators of research prowess, with the speed of scientific and technological achievement transformation serving as a crucial metric for assessing universities' innovation and applicative capacities, particularly their contributions to local economies. Within China's higher education landscape, local research and development institutions affiliated with universities hold a substantial share, constituting a formidable force in generating scientific and technological breakthroughs, and should thus bear the weighty responsibility of bolstering regional economic growth [2]. While the government has initiated a suite of incentivizing policies to propel the translation of technology advancements in universities, the persistently low rate of technology transfer poses an enduring obstacle for local academic institutions. Only through the conversion of

technological breakthroughs into productive assets can we effectively steer the development strategy towards technological innovation and the fortification of a technologically advanced nation, thereby propelling comprehensive societal and economic progress.

The universities and research institutes in Liaoning Province possess ample resources and showcase exceptional research capabilities. This paper aims to boost the drive of university researchers, increase the technology transfer rate within Liaoning's universities, and enhance support to the local economy. By concentrating on the current state of technology transfer in Liaoning universities, the study explores underlying issues and performs a root cause analysis of technology transfer between universities and research institutes in Liaoning. Subsequently, it provides appropriate strategies and suggestions to elevate the technology transfer efficiency of local universities.

## **2. Literature Reviews**

As the nation places heightened emphasis on scientific and technological advancements, governmental backing and the synergistic integration of industry, academia and research have similarly intensified. A growing number of scholars have engaged in research on the conversion rate of scientific and technological accomplishments within universities, yielding substantial results.

Currently, literature has evaluated and analyzed technological innovation from different perspectives in various provinces, proposing corresponding strategies and suggestions based on the unique conditions of each province and city. Wang et al. (2022) [3] constructed an evaluation index system for agricultural technological innovation capability within a province from the perspectives of support factors, input factors, and output factors, and evaluated and analyzed the agricultural technological innovation capability. Hao et al. (2020) [4] proposed a model for cultural industry technological innovation capability based on the diamond theory and constructed an evaluation system for regional cultural industry technological innovation capability in the new era. Zhao et al. (2020) [5] used the improved perturbation series method to statically evaluate China's agricultural technological innovation capability, and from

an information aggregation perspective, constructed a dynamic comprehensive evaluation model with speed characteristics to conduct a multidimensional comprehensive evaluation of the cross-provincial change in agricultural technological innovation capability. Shi et al. (2020) [6] based on the ecological niche theory, constructed an evaluation index system for university technological innovation capability and evaluated and analyzed the technological innovation capabilities of universities in the six central provinces of China to reveal their development levels and trends.

Regarding research on improving the conversion rate of scientific and technological achievements, Dong (2018) [7] believes that to increase the conversion rate of scientific and technological achievements in universities, collaboration with enterprises, government, and technological institutions is necessary. Wu (2020) [8] asserts that enhancing the conversion rate of scientific and technological achievements in universities requires support from policies and incentives from the government, enterprises, and universities themselves to create a conducive environment for the conversion of scientific and technological achievements in universities. Yue (2019) [9] believes that the prevalent phenomenon in local universities of emphasizing "papers over patents" and "research and development over transformation" is mainly due to the inadequate evaluation system and imperfect incentive mechanisms in local universities, leading to a focus on the number of papers by university researchers and indifference towards transformation, resulting in the idle nature of most technological achievements.

## **3. Policies and Current State of Technology Transfer in Universities and Research Institutes in Liaoning Province**

### **3.1 Policies and Measures Supporting Technology Transfer in Liaoning Province**

3.1.1 Adhere to demand orientation, and strengthen the supply of scientific and technological achievements. The foundation of technology transfer lies in the high-quality supply of scientific and technological achievements. With abundant technological resources and strong innovation capabilities,

Liaoning Province has seen a continuous stream of major technological achievements in recent years. To effectively promote the transformation and application of scientific and technological achievements within the province, the Liaoning Provincial Department of Science and Technology has extensively collected scientific and technological achievements from universities and research institutes in Liaoning Province, further enriching and improving the database of scientific and technological achievements in Liaoning Province. Meanwhile, the Liaoning Provincial Department of Science and Technology has organized research teams to conduct in-depth investigations across various regions and units, strengthened collaboration with universities and research institutes, and identified 4,016 high-quality and high-maturity technological achievements that can be converted from 104 universities and research units. In 2024, it is estimated that over 4,000 scientific and technological achievements will be transformed within the province, with a local transformation rate exceeding 57%.

3.1.2 Strengthen pilot testing, and smooth out key links in the conversion of achievements. Focusing on the construction and development needs of four trillion-level industrial bases and 22 key industrial clusters, Liaoning Province has arranged 36 provincial pilot bases and invested over 100 million yuan of provincial financial funds to strengthen the public service capabilities of pilot bases. Currently, Liaoning Province has a total of 1.66 million square meters of pilot test sites and over 10,000 pieces of equipment and instruments, with nearly 2,000 full-time pilot service personnel.

3.1.3 Establish a comprehensive service system to accelerate the implementation of achievements. Liaoning Province continues to build a full-process scientific service chain, creating laboratories, technology transfer demonstration institutions, university science parks, innovation spaces, technology enterprise incubators, high-tech zones, and various other science service institution platforms to meet the different development needs of technological enterprises in the "seed stage, start-up stage, growth stage, and maturity stage". As of June 2024, Liaoning Province has 638 key laboratories at or above the provincial level.

3.1.4 Strengthen policy support and ensure a

favorable environment for achievement transformation. It makes multiple efforts in legal support, working mechanisms, policy incentives, and other aspects for the transformation of scientific and technological achievements. In terms of legal support, Liaoning Province took the lead in promulgating the "Science and Technology Innovation Regulations of Liaoning Province," which includes a dedicated chapter on "achievement transformation and industrialization," clarifying the rights empowerment, rewards for the transformation of job-related scientific and technological achievements in higher education institutions and research institutions, and rewards for the transformation of scientific and technological achievements in state-owned enterprises, among others. In terms of policy incentives, corresponding financial support is provided to pilot bases with good operational performance and construction demands for pilot platforms. Financial support is also given to provincial-level and above technology transfer demonstration institutions, technology enterprise incubators, university science parks, and other scientific service institutions with excellent performance evaluations. Additionally, enterprises that absorb and transform achievement transformation projects will be given up to 2 million yuan in reward-based subsidies based on merit.

### **3.2 The Situation of Technology Transfer in Universities in Liaoning Province**

In 2023, a total of 40 ordinary universities in Liaoning Province transformed 7,638 scientific and technological achievements, with a total transformation amount of 4.026 billion yuan, representing an increase of about 56% and 90% respectively compared to the previous year. The provincial conversion rate was approximately 60%, with a year-on-year growth of about 77% in the transformation amount. By fully tapping into the scientific creativity of universities and research institutes in Liaoning, enhancing the efficiency and quality of technology transfer in universities and research institutes will undoubtedly contribute to the development of new quality productivity and promote the comprehensive revitalization of Liaoning.

### **4. Challenges Faced in the Transformation**

## **of Scientific Research Achievements at Universities and Research Institutes in Liaoning**

### **4.1 Low Alignment of Scientific and Technological Achievements with Market Demand in Universities and Research Institutes**

Research projects in universities and research institutes often diverge from market demand. Driven by the university's title evaluation and appointment system, researchers tend to concentrate more on academic research within their fields, neglecting an understanding of market demand. During project initiation, the market-oriented outcome is frequently overlooked. The systematicity of scientific and technological achievements in universities and research institutes is insufficient. Most researchers lack a comprehensive grasp of the frontiers of industrial development, leading to research that addresses only certain aspects of industrial development without offering systematic solutions to practical problems. The maturity of scientific and technological achievements in universities and research institutes is also low, with many achievements remaining conceptual or at the laboratory stage, far from being ready for industrial application.

### **4.2 Inadequate Quality of Technology Transfer Services in Universities and Research Institutes in Liaoning**

This issue is primarily manifested in two ways: In one perspective, universities and research organizations largely facilitate technology transfer through the autonomous efforts of their technical staff, with technology transfer departments merely addressing the tasks of registration and data compilation. Conversely, there is a significant deficit in specialized technology transfer personnel within Liaoning's educational and research establishments, as about 67% of these entities are below the national average in terms of personnel numbers. Additionally, the dedicated technology transfer personnel in Liaoning's universities and research institutes have other responsibilities, which makes it challenging for them to focus fully on technology transfer duties.

### **4.3 Imperfect Incentive Mechanisms for Technology Transfer**

Currently, the incentive systems in various universities and research institutions are mainly designed to motivate technology developers, with fewer incentive policies for other organizations and individuals involved in the technology transfer process. These policies, when they exist, are often incomplete and unclear.

### **4.4 Low Local Transformation Rate of Scientific and Technological Achievements in Universities and Research Institutes in Liaoning Province**

In 2023, the local conversion turnover rate of scientific and technological achievements in universities and research institutes in Liaoning Province was a mere 40.1%. Moreover, the alignment between the scientific and technological achievements of universities and research institutes with the local economic development needs was relatively low.

## **5. Recommendations**

### **5.1 Improve the Supply Mechanism at the Source and Strengthen Collaboration between Universities Research Institutes and Enterprises**

First, the government should refine the market-oriented project initiation mechanism. This includes improving the demand- and problem-oriented scientific planning project formation mechanism, promoting the participation of enterprises in the whole process of project condensation, development guidance, and research and development implementation.

Second, the government must strengthen the enterprise-led in-depth integration of production, science and research to improve the quality of scientific and technological achievements. This can be achieved by promoting a collaborative innovation mechanism in which "market questions arise, enterprises make demands, universities answer questions, and the government supports research". This mechanism supports universities, research institutions and enterprises to jointly solve key common industry problems.

Third, the government should foster the creation of research and development entities by enterprises in partnership with universities and research institutes. By fully utilizing enterprises' understanding of industry trends

and market demand, the government can focus project initiation on industrial development or enterprise needs, making research results more easily applicable to actual production.

Fourth, the government ought to institute a "deploy-before-transfer" policy for technological innovations and set up a risk mitigation system to cover the potential failures in technology transfer that may arise during joint research and tech transfer activities. This approach will promote more effective use and protection of intellectual property rights.

### **5.2 Establish a High-Level Technology Transfer Service System**

First, the government should encourage universities and research institutions to establish specialized technology transfer organizations to promote the market development, promotion and industrialization of technological achievements. By combining the introduction of outstanding technology service institutions from other regions with the cultivation of local technology service institutions, the government can improve the professional level of technology intermediary institutions. These institutions will provide professional services such as intellectual property rights, legal advice, asset evaluation, and technology assessment for technology transfer, and build a brand for technology transfer services.

Second, the government must promote the high-quality development of local technology transfer institutions. Leveraging the demonstration and radiation role of provincial technology transfer institutions will facilitate the regional transfer and transformation of scientific achievements. Strengthen the construction of Liaoning provincial technology transfer demonstration institutions will provide professional services such as technical screening, transaction docking and intellectual property transformation for technology transfer [10]. The government should explore the implementation of a technology transfer institution registration management system.

Third, the government need to cultivate and develop a team of technical managers. Fully utilizing the role of existing technology transfer talent development bases will cultivate and strengthen the talent pool in Liaoning for technology transfer personnel. Providing

relevant business training for technology managers and offering business support in areas such as legal advice, financial loans, asset valuation, technology assessment, intellectual property rights and contract registration will enhance the professional service capabilities of technology transfer personnel. This will promote their full participation in the whole process of transforming scientific achievements.

Fourth, the government should establish guidance and management mechanisms for technology management enterprises and certification training mechanisms for technology managers. Ensuring clear promotion channels will cultivate a group of technology transfer talents who understand technology, market, finance and management.

### **5.3 Strengthen the Incentive and Restraint Mechanisms to Promote the Efficient Transformation of Scientific and Technological Achievements**

First, it is imperative for the government to create a system that facilitates the conversion of job-related scientific and technological innovations into practical applications. Scientific and technological achievements supported by financial funds from universities and research institutions are required to carry out autonomous licensing, transfer, pricing and investment, and they should submit annual reports on the transformation status to relevant departments. Application technology scientific achievements that have not been transformed within a certain period of time after obtaining intellectual property rights and without justifiable reasons will be listed on the "use before transfer" implementation list, and their transformation will be legally enforced through methods such as public listing on the "Liaoning Technology Trading Market".

Second, the government should intensify the appraisal process for technological achievements transfer. It is vital for higher education and research entities to take into account the practical outcomes and societal benefits brought about by the transfer of technological achievements as fundamental measures in evaluating researchers' titles, positions, and performance assessments.

Third, the government must improve the service system for the transformation of scientific and technological achievements. It

should support the construction of concept verification centers for various innovative units, which provide secondary development, process verification and trial maturity services for scientific and technological achievements.

Fourth, the government can institute a fault correction mechanism for the commercialization of scientific and technological advancements. It should enhance the error correction mechanism for the commercialization of scientific and technological advancements within universities, research institutions, and other entities by delineating error scenarios, negative lists, and responsibility mandates. For scientific and technological personnel and managers who diligently perform their duties, they may be exempted from decision-making responsibilities after evaluation, arising from changes in the value of achievements after transformation, lack of asset evaluation during transformation, losses in pricing investments, or errors in exploratory reform measures, with approvals, income distribution, etc., serving as important considerations for correcting errors in the transformation of scientific and technological achievements. The government should refine the origin supply mechanism and boost cooperation between universities, research institutes and enterprises.

#### **5.4 Encourage the Local Conversion of Scientific and Technological Advancements**

First, the government ought to promote the local application of scientific and technological innovations from academies and research entities. To resolve the problem of a low rate of local application of scientific and technological innovations, a thorough incentive framework should be put in place. This mechanism will include assessment incentives for universities and research institutes in Liaoning, benefit incentives for achievement owners, incentives for local companies undertaking transformation, incentives for entrepreneurship with achievements, and financial support incentives to encourage local transformation of scientific and technological achievements. Second, the government must support the transformation of domestic and foreign scientific and technological achievements in Liaoning province. It must emphasize the introduction of scientific and technological achievements from

other provinces. It must also support deep collaboration between Liaoning's technology transfer intermediary organizations and well-known domestic and foreign technology intermediaries. It should accurately introduce and actively introduce achievements from different provinces to meet the industrial needs of Liaoning. The government can encourage companies in Liaoning province to establish strategic alliance relationships with overseas and out-of-province advanced technology enterprises, technology intermediaries, universities, and research institutes to prioritize the transformation of technological achievements.

#### **5.5 Strengthen Efforts to Promote the Transformation of Scientific and Technological Achievements**

First, the government should categorize and integrate scientific and technological achievements, increase their publicity, and seek opportunities for cooperation. Firstly, it should promote these achievements on the official websites of universities and research institutes or on the professional platforms of state-owned enterprises. Secondly, it should promote the achievements at various exhibitions of scientific and technological achievements. Finally, it should promote technological achievements directly in enterprises and industries.

Second, the government should publicize typical cases and individuals of technological achievement transformation to attract more people to actively participate in various stages of technological achievement transformation work. By showcasing success stories and highlighting the contributions of key individuals, the government can inspire more commitment and enthusiasm in the field of technology transfer and commercialization.

First, refine the market-oriented project initiation mechanism. Improve the demand and problem-oriented scientific planning project formation mechanism, promote the participation of enterprises in the entire process of project condensation, guide development, and research and development implementation. Second, strengthen enterprise-led in-depth integration of production, academia, and research to enhance the quality of scientific and technological achievements. Promote a collaborative innovation mechanism

where "market questions arise, enterprises put forward requirements, universities answer questions, and the government assists in inquiries," supporting universities, research institutions, and enterprises to jointly tackle key common industry problems. Third, support enterprises in establishing research and development institutions with universities and research institutes. Fully utilize enterprises' understanding of industry trends and market demand to focus project initiation on industrial development or enterprise needs, making research results more easily applicable to actual production. Fourth, establish a "use before transfer" model for scientific and technological achievements and set up a risk compensation mechanism for unsuccessful technology transfer in collaborative research and technology transfer.

## 6. Conclusion

Universities and research institutions, as the cornerstone of basic research and the cradle of major technological advances, have rapidly strengthened their innovation capabilities and made significant contributions to fostering an innovative nation. The transmission of scientific research outcomes from these institutions to local areas holds the potential to foster regional economic and social advancement, reinforce the connection between the commercialization of research findings and the exchange of talent, integrate technological innovation with local industries, facilitate the upgrading of industrial structures, and promote high-quality economic growth. This study provides a comprehensive analysis of the existing challenges in technology transfer within universities and research institutions, with a focus on government perspectives. The proposal aims to enhance the source supply mechanism, bolster collaboration between universities, research institutions, and businesses, establish a sophisticated technology transfer service system, refine incentive and regulatory mechanisms, and intensify efforts to promote technology transfer. These initiatives aim to improve the efficiency and quality of technology transfer in academic and research institutions.

The limitations of this paper may encompass the dependence on publicly accessible government report data instead of statistical

yearbooks, which could lead to statistical inconsistencies. The analysis of technology transfer issues in universities and research institutions may lack thoroughness, focusing primarily on the macro level with insufficient attention to the micro level. In addition, the proposed strategies tend to be government-centric, providing less insight from the perspective of firms and universities.

Future research directions include focusing on the innovation unit perspective of universities and research institutions to effectively address innovation challenges at all stages and thus increase technology transfer rates. In addition, prioritizing the development of incentive mechanisms to facilitate localized technology transfer could greatly contribute to promoting high-quality economic development in local regions.

## Acknowledgments

This work was supported by the Liaoning Provincial Social Science Fund General Project (No. L19BJY043).

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