

Analysis of the Linkage Effect between Intellectual Property Management in Small and Medium-Sized Enterprises and University-Enterprise Achievement Transformation

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Abstract: This paper conducts an empirical study on the interactive relationship between intellectual property management in Small and Medium-sized Enterprises (SMEs) and the transformation of university-enterprise achievements. By constructing an evaluation index system for the linkage effect, it analyzes the mechanism of interaction between the two. The research indicates that there is a significant bidirectional promoting effect between the level of intellectual property management in SMEs and the efficiency of university-enterprise achievement transformation: a well-established intellectual property management system can enhance an enterprise's ability to absorb and transform scientific research achievements from universities; conversely, the practice of achievement transformation during university-enterprise collaboration promotes the optimization and upgrading of the enterprise's intellectual property management system. Based on the analysis results of the linkage effect, suggestions are proposed, including constructing a collaborative intellectual property management platform between universities and enterprises and optimizing the achievement transformation mechanism.

Keywords: Intellectual Property Management; University-Enterprise Achievement Transformation; Linkage Effect; Collaborative Innovation

1. Introduction

There exists a close interactive relationship between the intellectual property management capability of SMEs and the efficiency of scientific and technological achievement transformation between universities and enterprises. Analyzing their linkage effect is of great significance for leveraging the promoting

role of intellectual property management in achievement transformation and for enhancing enterprise intellectual property management levels through achievement transformation. Against the backdrop of the innovation-driven development strategy, an in-depth study of the mechanism and influencing factors of the linkage effect will provide theoretical support for constructing an efficient university-enterprise collaborative innovation system.

2. Theoretical Elaboration on Intellectual Property Management in SMEs and University-Enterprise Achievement Transformation

Intellectual property management theory emphasizes the systematic management process of intellectual property, including its acquisition, protection, utilization, and value realization. University-enterprise achievement transformation theory elucidates the laws and mechanisms of transforming scientific and technological achievements into productive forces, involving technology diffusion, value assessment, and commercialization. Industry-University-Research (I-U-R) collaborative innovation theory discusses the interactive relationships among innovation entities and their resource integration models. Applying the above theories to the SME context, intellectual property management enhances enterprise innovation capability by improving patent quality, strengthening protection awareness, and standardizing operational processes; university-enterprise achievement transformation promotes the flow of innovation elements through mechanisms such as market orientation, resource complementarity, and risk sharing[1]. The two mutually promote and co-evolve in innovation-driven development, forming a virtuous interactive development trend.

Currently, scholars both domestically and

internationally have conducted extensive research on intellectual property management and university-industry collaboration. Early foreign studies focused on the operational efficiency of university technology transfer offices (TTOs), academic entrepreneurship, and the role of intellectual property in open innovation, emphasizing the importance of legal frameworks, incentive mechanisms, and intermediary institutions [2]. Domestic research, on the other hand, has been more concentrated on macro-level policy guidance, innovation in industry-academia-research collaboration models, and case studies targeting large enterprises or universities. However, there remains a notable lack of systematic research specifically addressing small and medium-sized enterprises (SMEs) and exploring the bidirectional interaction between their internal intellectual property management systems and the external process of university-industry technology transfer. Most studies either treat SMEs merely as technology recipients, overlooking the proactive role of their internal management capabilities in enhancing transfer efficiency, or discuss enterprise intellectual property management in isolation, failing to adequately consider its evolution within the dynamic context of university-industry collaboration. Building on this research gap, this study aims to employ a combination of theoretical and empirical approaches to reveal the inherent interaction mechanisms between the two, thereby providing more targeted guidance for the innovation practices of SMEs.

3. Research on the Correlation Mechanism between Intellectual Property Management and University-Enterprise Achievement Transformation

3.1 Interactive Models between Intellectual Property Management Systems and Achievement Transformation

The intellectual property management system and university-enterprise achievement transformation form a bidirectional interactive relationship. The enterprise's intellectual property management system establishes a protective barrier for innovative achievements through patent portfolio development, trademark registration, and copyright protection, providing institutional guarantees for university-enterprise cooperation. During the achievement

transformation process, the enterprise's intellectual property management system performs functions such as screening, evaluation, and negotiation, thereby improving transformation efficiency. Simultaneously, the practice of university-enterprise achievement transformation reciprocally promotes the refinement of the enterprise's intellectual property management system, accumulating management experience, optimizing management processes, and enhancing management levels through project collaboration. The interaction between the two fosters diversified cooperation models such as patent operation, technology licensing, and intellectual property investment, promoting the optimal allocation of innovation resources.

3.2 Value Transfer Mechanism in the Linkage Process

The value transfer mechanism reflects the interest linkage between universities and enterprises in intellectual property transformation. Universities output innovative achievements to enterprises through forms such as technology transfer, patent licensing, and collaborative R&D, realizing the monetization of knowledge value. Enterprises, relying on production factors, market channels, and industrial chain resources, transform these innovative achievements into marketable products, generating economic benefits[3]. During the transfer process, the intellectual property valuation and pricing mechanism ensures fair value distribution, incentive and restraint mechanisms maintain cooperation stability, and risk-sharing mechanisms enhance mutual trust. The value transfer process involves various forms such as technology transactions, equity incentives, and revenue sharing, constructing a mutually beneficial and win-win collaborative relationship.

3.3 Intellectual Property Control Elements in University-Enterprise Collaborative Innovation

Intellectual property control elements are key influencing factors in university-enterprise collaborative innovation. Clearly defining ownership delineates the scope of rights and interests for both parties, ensuring clear intellectual property rights for innovative achievements. Confidentiality agreements and non-compete clauses prevent technology leakage

and protect core intellectual property. Contract management standardizes cooperation matters such as technology transfer, patent implementation, and benefit distribution. Intellectual property risk prevention mechanisms address infringement disputes and reduce cooperation risks[4]. Quality control systems ensure the effectiveness of innovative achievement transformation and enhance market competitiveness. The effective configuration and coordinated operation of these control elements play a crucial role in improving the effectiveness of university-enterprise cooperation.

From the perspective of Dynamic Capabilities Theory, the interactive process between intellectual property management in small and medium-sized enterprises (SMEs) and university-industry technology transfer is essentially a process through which enterprises build, integrate, and reconfigure internal and external capabilities to adapt to rapidly changing environments [5]. Intellectual property management capabilities (such as patent searching, portfolio development, and risk monitoring) constitute an important set of internal microfoundations for enterprises. University-industry collaboration, on the other hand, provides enterprises with channels to access and absorb new external knowledge and technologies. The strength of the linkage effect largely depends on the enterprise's absorptive capacity, which is closely related to its foundational intellectual property management capabilities—particularly the ability to identify, assimilate, and apply knowledge. At the same time, successful technology transfer practices can, in turn, enhance the enterprise's dynamic capabilities in intellectual property, enabling it to better adapt to future technological changes and market competition. Therefore, the linkage effect is not only reflected in static performance improvements but also in the dynamic evolution of the enterprise's innovation capabilities.

4. Evaluation of the Linkage Effect between Intellectual Property Management and University-Enterprise Achievement Transformation

4.1 Construction of Linkage Effect Evaluation Indicators

The linkage effect evaluation index system is constructed using the Analytic Hierarchy Process (AHP), covering two main dimensions:

intellectual property management effectiveness and achievement transformation performance. Intellectual property management effectiveness indicators include the number of patent applications, grant rate, maintenance rate, intellectual property protection investment, and the professionalism of management personnel, among others. Achievement transformation performance indicators involve factors such as the value of technology contract transactions, the industrialization rate of achievements, and revenue from new product sales[6]. Indicator weights are determined by the Delphi method, and the fuzzy comprehensive evaluation method is used to process qualitative indicators, establishing a scientific and reasonable evaluation standard. The evaluation index system emphasizes the correlation and complementarity among indicators to ensure the accuracy and reliability of evaluation results.

4.2 Quantitative Analysis of the Linkage Effect

Quantitative analysis of the linkage effect employs econometric models to measure the correlation and causality between intellectual property management and achievement transformation. A structural equation model is established to analyze the direct and indirect effects between the two. Mediating and moderating variables are introduced to reveal the mechanism of the linkage effect. Panel data regression analysis is used to explore the dynamic changes of the linkage effect over different periods. Principal component analysis is applied for dimensionality reduction of multi-dimensional indicator data to extract key influencing factors. The quantitative analysis results show a significant positive correlation between intellectual property management capability and achievement transformation efficiency, verifying the existence of the linkage effect.

4.3 Validation of the Linkage Effect Results

Multiple validation methods are adopted to ensure the reliability of the research conclusions regarding the linkage effect. Empirical analysis selects typical university-enterprise cooperation cases and uses comparative analysis to verify the universality of the linkage effect. The instrumental variable method is introduced to address endogeneity issues, improving the robustness of the research results. The Bootstrap

method is used for repeated sampling tests to validate the effectiveness of the econometric models. Parallel trend tests are conducted to rule out spurious correlation influences and confirm the authenticity of the linkage effect. The research results indicate that the linkage effect is significant across different industries and enterprises of varying sizes, demonstrating strong universality and promotional value.

Although the linkage effect is universal, its intensity and manifestations vary across different industry sectors. In technology-intensive industries such as biopharmaceuticals and high-end semiconductors, intellectual property (particularly patents) serves as the core barrier to competition. University-industry collaborations in these fields often revolve around core patents, with enterprises exhibiting a high degree of reliance on intellectual property management, making the linkage effect particularly pronounced. In contrast, in some traditional industries where process improvements or business model innovations dominate, intellectual property may more often take the form of trade secrets or software copyrights. In such cases, the linkage effect may be more evident in process optimization and market share expansion. This variability suggests that policymakers and enterprises, when promoting university-industry collaboration, must tailor their intellectual property strategies and partnership models to align with specific industry characteristics, rather than adopting a one-size-fits-all approach. Furthermore, the deepening of digital transformation in enterprises introduces a new variable into the linkage effect. The application of digital tools can significantly enhance the efficiency of intellectual property information management and collaborative R&D, thereby amplifying the linkage effect [7].

5. Construction of University-Enterprise Collaborative Development Mechanisms Based on the Linkage Effect

5.1 Intellectual Property Collaborative Management Mechanism

The intellectual property collaborative management mechanism is established based on the complementary resource advantages of universities and enterprises. An intellectual property information sharing platform is constructed to achieve interconnection of patent

databases, technology demand information, and achievement transformation cases. A professional intellectual property service team is set up to provide specialized services such as patent analysis, infringement early warning, and value assessment. Intellectual property classification management standards are formulated to clarify the protection levels and management strategies for core patents, general patents, and trade secrets. An intellectual property asset operation center is established to coordinate operations such as patent portfolio management, technology property rights transactions, and intangible asset securitization. A collaborative mechanism throughout the entire chain of intellectual property creation, utilization, protection, and management between universities and enterprises is thus formed.

5.2 Achievement Transformation Efficiency Enhancement Mechanism

The achievement transformation efficiency enhancement mechanism focuses on the deep integration of the innovation chain, industrial chain, and value chain. A Technology Readiness Level (TRL) evaluation system is established to scientifically assess the feasibility of transforming scientific research achievements. The position of technology manager is created, responsible for achievement screening, market alignment, negotiation coordination, etc. The system for pricing scientific and technological achievements as equity contributions is improved, and paths for intellectual property securitization are explored. A risk-sharing and benefit-sharing mechanism is constructed to reasonably distribute transformation benefits. University-enterprise cooperation models are innovated to promote the integrated development of industry, academia, research, and application. Third-party professional service agencies are introduced to provide services such as intellectual property hosting, technology evaluation, and transaction matchmaking.

5.3 University-Enterprise Deep Integration Promotion Mechanism

The university-enterprise deep integration promotion mechanism emphasizes the construction of long-term cooperative relationships. Joint university-enterprise R&D centers are established, along with shared laboratories and research bases, to achieve resource sharing in R&D. A two-way talent flow

mechanism is set up to promote the temporary assignment of researchers to enterprises and further education for enterprise technicians in universities. The performance evaluation system is improved by incorporating achievement transformation performance into evaluation indicators. Multi-level cooperation platforms are constructed to promote the establishment of industry-academia-research strategic alliances. Measures for intellectual property ownership and benefit distribution are formulated to clarify the rights and responsibilities of all parties in collaborative innovation. The operational models of scientific and technological achievement transformation funds are explored to provide sustained financial support for innovative projects.

Despite the significant linkage effects and clear directions for mechanism building, numerous challenges remain in practice. Firstly, small and medium-sized enterprises (SMEs) commonly face internal difficulties such as weak intellectual property awareness, a shortage of specialized talent, and insufficient capital investment [8]. Secondly, university research outcomes often lean towards basic research, with low technological maturity, creating a "valley of death" between them and market demands. Thirdly, differences in culture, objectives, and evaluation incentives between the two sides can easily lead to communication barriers and a lack of trust. To address these challenges, additional measures are required beyond the aforementioned mechanisms: First, strengthen government guidance by implementing policies such as special IP subsidies for SMEs and university-industry collaboration guidance funds to reduce the costs and risks of enterprise participation [9]. Second, promote reforms in university evaluation systems to increase the weighting of technology transfer and industry-academia-research collaboration, thereby incentivizing faculty to engage in application-oriented research. Third, vigorously develop the technology transfer intermediary service market, fostering a professional cohort of technology managers proficient in both technology and the market, to build bridges between the parties [10]. Fourth, encourage the establishment of "innovation communities" based on long-term trust rather than one-off project transactions. Successful collaborative innovation relies on constructing a multi-stakeholder ecosystem involving

enterprises, universities, governments, financial institutions, and intermediary agencies, optimizing the allocation of innovation resources and enabling value co-creation [11]. In this process, clarifying legal regulations and benefit distribution schemes for specific aspects such as valuing technological achievements for equity participation is essential for ensuring smooth cooperation [12].

6. Conclusion

The research on the linkage effect between intellectual property management in SMEs and university-enterprise achievement transformation reveals the internal laws of synergistic interaction among innovation elements. The enhancement of intellectual property management capability strengthens an enterprise's ability to absorb and transform scientific and technological achievements, while university-enterprise cooperation practices reciprocally promote the optimization of the enterprise's intellectual property management system. Quantitative analysis of the linkage effect shows a significant positive correlation between the two, with universality across different industries and enterprise sizes. Strengthening the construction of intellectual property information sharing platforms, improving benefit distribution mechanisms, and innovating cooperation models will continuously drive the enhancement of innovation capabilities in SMEs and industrial technological progress.

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