



# Research on the Construction Path of Collaborative Innovation Ecosystem of “Universities in Tai’an + Parks + Industries”

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## Abstract

This study employs a mixed-methods approach integrating literature analysis, field investigation, and comparative research to systematically explore the practical basis of collaborative innovation, including key universities, innovation carriers, and local characteristic industries in Tai’an. It focuses on identifying prominent bottlenecks: structural mismatch between technological supply and demand, lack of pilot-scale incubation links, blocked university-enterprise information transmission, insufficient resource integration efficiency in parks, and imperfect collaborative governance mechanisms. The research aims to establish a closed-loop chain of “basic research-technology development-pilot test-industrial application” and provide theoretical references and practical paradigms for resource-based cities to transform sci-educational advantages into industrial competitiveness.

## Subject Areas

Educational Technology

## Keywords

Universities in Tai’an, Industrial Parks, Collaborative Innovation, Innovation Ecosystem, Achievement Transformation, Transformation of Resource-Based Cities

## 1. Introduction

China’s economic and social development has entered a high-quality development stage with innovation as the core driving force. Promoting the in-depth integration of the innovation chain, industrial chain, capital chain, and talent chain has

become a key measure to build a modern industrial system. As an important organizational form connecting knowledge production and industrial application, industry-university-research collaborative innovation integrates the resource endowments of multiple entities such as universities, research institutes, enterprises, parks, governments, and intermediary service organizations to realize the cross-border flow and efficient allocation of innovation factors, which plays an irreplaceable role in enhancing regional innovation capabilities and promoting industrial transformation and upgrading.

As a typical resource-based city, Tai'an has long been restricted by problems such as a high proportion of traditional industries, insufficient support from emerging industries, and weak accumulation of innovation momentum for sustainable economic development. The city is home to universities including Shandong Agricultural University, Taishan University, Shandong First Medical University, and Tai'an Campus of Shandong University of Science and Technology, forming a scientific and educational resource foundation covering agricultural science, mechanical engineering, materials and chemical engineering, biomedicine, electronic information, and other fields. Meanwhile, innovation carriers such as the national-level Tai'an High-tech Industrial Development Zone, Taishan Innovation Valley, and Taishan Economic Development Zone have been laid out, initially forming a spatial framework of "university agglomeration-park carrying-industrial landing". However, for a long time, there has been a significant deviation between the research orientation of universities and the market demand of industries; park carriers have single functions and insufficient professional service supply; and there is a lack of stable and effective collaborative channels and institutional guarantees among multiple entities. A large number of scientific and technological achievements remain in the laboratory stage and are difficult to transform into real productive forces, so the advantages of scientific and educational resources have not been effectively transformed into regional competitive advantages. In this context, systematically constructing a "Universities in Tai'an + Parks + Industries" collaborative innovation ecosystem to break through collaborative bottlenecks, smooth transformation channels, and improve innovation efficiency is not only an inevitable choice for Tai'an to implement the innovation-driven development strategy but also a practical need to promote the transformation of resource-based cities and realize the replacement of old growth drivers with new ones.

A "collaborative innovation ecosystem" refers to a complex adaptive system composed of multiple interactive entities (universities, industrial parks, industrial enterprises, government departments, and intermediary service organizations), innovation factors (talent, technology, capital, information, data), and external environments (policies, services, culture). In the context of "Universities in Tai'an + Parks + Industries", this ecosystem takes Tai'an's universities as the knowledge and technology supply core, industrial parks as the achievement transformation and resource integration carrier, and characteristic industries as the market appli-

cation and value realization terminal. It relies on the symbiotic interaction and resource complementarity among entities to realize the efficient flow and optimal allocation of innovation factors, and ultimately form a closed-loop operation mechanism covering “basic research-technology development-pilot test-industrial application”.

**Theoretical Significance:** Taking resource-based cities as a specific field, this study focuses on the interaction logic and collaborative mechanism of the three entities: “University-Park-Industry”. It integrates key links such as pilot-scale incubation, factor matching, financial empowerment, and talent mobility into a unified analytical framework, enriches the theoretical connotation of industry-university-research collaborative innovation ecosystems in small and medium-sized cities, and provides a new perspective and analytical tool for similar regional innovation system research.

**Practical Significance:** Based on the local innovation foundation and practical bottlenecks of Tai’an, this study proposes implementable, replicable, and generalizable collaborative innovation paths, which help improve the transformation efficiency of scientific and technological achievements of universities in Tai’an, strengthen the supporting function of park carriers, enhance the technological innovation capability of enterprises, and promote the high-end, intelligent, and green transformation of Tai’an’s characteristic industries. It provides a practical reference for resource-based cities across the country to activate scientific and educational resources and solve transformation dilemmas.

This study follows the logical main line of “theoretical foundation-current situation diagnosis-mechanism design-path construction”. At the theoretical level, it systematically sorts out core theories such as the Triple Helix Theory, it refers to a theory that emphasizes the interactive, infiltrative, and spiral development relationship among three types of entities: universities, industry, and government. These three entities form a collaborative innovation network through functional crossover and organizational integration. Innovation Ecosystem Theory, and Resource Dependence Theory, and defines the connotation, characteristics, and components of the collaborative innovation ecosystem. At the empirical level, through field investigations, interviews, and data sorting, it comprehensively grasps the development status of collaborative innovation among universities, parks, and industries in Tai’an, and accurately identifies key bottlenecks restricting collaborative efficiency. At the countermeasure level, drawing on the experience of advanced regions in China and combining with Tai’an’s local policy practices, it designs an integrated collaborative operation mechanism and proposes a systematic ecosystem construction path.

The main research methods include: literature research method, sorting out research results in the fields of industry-university-research collaborative innovation, innovation ecosystems, and resource-based city transformation at home and abroad to lay a theoretical foundation; field investigation method, conducting investigations in scientific research management departments of universities in

Tai'an, Tai'an High-tech Zone, Taishan Innovation Valley, and key enterprises to obtain first-hand data and practical information; comparative research method, benchmarking typical cases such as Taixing Industrial College of Nanjing Tech University and the university-surrounding innovation ecosystem in Hongshan District of Wuhan to extract transferable experience; systematic analysis method, regarding universities, parks, and industries as an organic whole interacting with each other, analyzing the collaborative mechanism, designing collaborative mechanisms, and constructing the ecosystem from a systematic perspective.

## 2. Methods

To ensure the scientificity, authenticity, and comprehensiveness of the empirical research, this study adopts an integrated analytical approach integrating literature analysis, field investigation, and comparative research, with field investigation as the core empirical support. The specific, scope, and implementation details are clarified as follows to make the empirical basis of the bottleneck diagnosis and path construction traceable and assessable. It should be emphasized that this study does not adopt a formal mixed-methods design; instead, it adopts an “integrated sequential analytical approach” that takes field investigation as the core, uses literature analysis to provide theoretical guidance, and relies on comparative research to optimize research conclusions, forming a coherent and complementary analytical process.

### 2.1. Integration of Literature Analysis, Field Investigation, and Comparative Research into One Analytical Process

The three research methods are not applied independently but are integrated into a coherent analytical process following the logical sequence of “theoretical guidance → empirical verification → experience reference”, forming a closed loop that complements and supports each other, which is the core of the integrated sequential analytical approach adopted in this study. The specific integration process is as follows:

First, literature analysis lays the theoretical and practical foundation for the entire research and guides the direction of empirical investigation. Before carrying out field investigation and comparative research, this study systematically sorts out domestic and foreign literature on industry-university-research collaborative innovation, innovation ecosystems, and resource-based city transformation. On the one hand, it combs core theories such as the Triple Helix Theory, Innovation Ecosystem Theory, and Resource Dependence Theory, defines the connotation and component elements of the “Universities in Tai'an + Parks + Industries” collaborative innovation ecosystem, and establishes the theoretical framework of the study. On the other hand, it summarizes existing research achievements, identifies research gaps (such as the lack of systematic research on tripartite collaborative innovation in resource-based cities), clarifies the research focus and direction, and provides a theoretical basis for the design of field investigation plans (such as de-

termining the scope of investigation, the design of interview outlines, and the selection criteria of typical cases) and the selection of comparative cases. In this link, literature analysis plays a “guiding role” to avoid blindness in empirical research.

Second, field investigation provides first-hand empirical data to verify and supplement the theoretical framework, which is the core link of the entire analytical process. Based on the theoretical guidance of literature analysis, this study carries out targeted field investigations in Tai’an, covering key universities, core industrial parks, and characteristic industrial enterprises. Through semi-structured interviews, questionnaire surveys, and on-site observations, it collects first-hand data on the current situation of collaborative innovation, existing bottlenecks, and practical needs. These empirical data are used to test the rationality of the theoretical assumptions put forward based on literature analysis, identify the specific manifestations of collaborative innovation bottlenecks in Tai’an (such as the mismatch between achievement supply and demand, the lack of pilot links), and supplement the existing literature with practical problems found in the investigation, enriching the research on regional collaborative innovation. In this link, field investigation plays a “verification and supplement role”, making the research conclusions grounded in reality.

Third, comparative research provides reference experience to optimize the research conclusions and construction paths, and plays a “perfecting role” in the analytical process. On the basis of literature analysis (which sorts out the experience of advanced regions) and field investigation (which grasps the actual situation of Tai’an), this study selects typical cases with reference value (such as the university-surrounding innovation ecosystem in Hongshan District of Wuhan, the industry-university-research collaborative innovation pilot in Changchun, and Taixing Industrial College of Nanjing Tech University) for comparative analysis. By comparing the differences between Tai’an and advanced regions in terms of collaborative innovation models, platform construction, policy support, and talent mechanisms, it extracts mature experience and practices that are applicable to Tai’an’s reality. These experiences are integrated into the design of Tai’an’s collaborative innovation mechanism and construction path, avoiding the “localization bias” caused by only relying on field investigation, and improving the operability and promotion value of the research conclusions.

In summary, the three methods form a coherent analytical process: literature analysis provides theoretical guidance and research direction, field investigation provides empirical verification and realistic basis, and comparative research provides experience reference and optimization ideas. The three are closely linked, complement each other, and jointly support the completion of the research objectives, ensuring the scientificity and practicality of the study.

## **2.2. Fieldwork Scope**

The field investigation covers three core entities of the “Universities in Tai’an + Parks + Industries” collaborative innovation ecosystem, with a focus on Tai’an’s

main urban area and key industrial agglomeration areas. Specifically, the scope includes: 1) Key universities in Tai'an: Shandong Agricultural University, Taishan University, Shandong First Medical University, and Tai'an Campus of Shandong University of Science and Technology, focusing on their scientific research management departments, key laboratories, and research teams engaged in applied technology research; 2) Core industrial parks: Tai'an High-tech Industrial Development Zone, Taishan Innovation Valley, and Taishan Economic Development Zone, covering their management committees, innovation service centers, and settled enterprises; 3) Characteristic industrial enterprises: Key enterprises in Tai'an's advantageous industries such as modern agriculture, high-end equipment, biomedicine, new materials, and digital economy, including high-tech enterprises, specialized and sophisticated enterprises, and leading enterprises in industrial chains. The investigation covers 4 districts and 2 counties in Tai'an, ensuring the representativeness of regional and industrial coverage.

### **2.3. Participating Organizations and Cooperation Entities**

The field investigation was carried out in cooperation with relevant government departments, universities, parks, and enterprises to ensure the comprehensiveness of data collection. The participating organizations include: 1) Government departments: Tai'an Municipal Bureau of Science and Technology, Tai'an Municipal Bureau of Industry and Information Technology, Tai'an Municipal Bureau of Education, and Tai'an Municipal Bureau of Statistics, responsible for providing macro policy documents, statistical data, and industry development reports; 2) Universities: Scientific Research Office, Industry-University Cooperation Office, and key discipline laboratories of the four aforementioned universities, responsible for providing information on scientific and technological achievements, research teams, and university-enterprise cooperation projects; 3) Industrial parks: Management committees and innovation service centers of Tai'an High-tech Industrial Development Zone, Taishan Innovation Valley, etc., responsible for providing park operation data, enterprise settlement information, and achievement transformation cases; 4) Enterprises: 56 key industrial enterprises selected through stratified sampling, covering different scales (large, medium, and small) and industrial fields, responsible for providing technical demand information, cooperation experience, and bottleneck feedback.

### **2.4. Interview Sample Design**

Semi-structured interviews were conducted to obtain in-depth first-hand information, with a total of 89 interviewees selected through purposive sampling to ensure the diversity and representativeness of the sample. The interview sample is divided into five categories according to the identity of the interviewees: 1) University representatives (23 people): Deans of colleges, directors of scientific research offices, and leading researchers of key projects, mainly responsible for introducing the orientation of scientific research, achievements output, and diffi-

culties in university-enterprise cooperation; 2) Park representatives (18 people): Directors of park management committees, heads of innovation service centers, and technical managers, mainly responsible for introducing park service functions, resource integration capabilities, and achievement transformation support measures; 3) Enterprise representatives (32 people): Enterprise leaders, research design directors, and technical backbones, mainly responsible for reflecting enterprise technical needs, experience in cooperating with universities/parks, and bottlenecks in achievement transformation; 4) Government representatives (10 people): Staff from relevant departments in charge of science and technology, industry, and education, mainly responsible for interpreting policies, introducing macro management measures, and analyzing the overall situation of collaborative innovation; 5) Intermediary service representatives (6 people): Technical managers, intellectual property agents, and financial service personnel, mainly responsible for introducing the role of intermediaries in collaborative innovation and existing service gaps. Each interview lasted 40 - 60 minutes, and the content was recorded in real time and sorted out into text materials after the interview.

## 2.5. Data Sources

The data sources of this study include three categories: first-hand data, second-hand data, and comparative data, to form a mutually verified data system. 1) First-hand data: Obtained through field investigations, semi-structured interviews, and on-site observations, including interview records, enterprise technical demand questionnaires (120 valid questionnaires), university achievement statistics forms, and park service logs; 2) Second-hand data: Collected from official documents, statistical bulletins, and public reports, including Tai'an Municipal Bureau of Statistics' "Statistical Communiqué on National Economic and Social Development" (2024-2025), Tai'an Municipal Bureau of Science and Technology's "Work Report on Science and Technology of the Whole City" (2024), policy documents such as "Reply to Suggestions on Strengthening School-Enterprise Cooperation to Promote the Rapid Economic Development of Our City", and annual reports of universities and parks; 3) Comparative data: Collected from the implementation plan of Changchun's industry-university-research collaborative innovation pilot, the construction experience of Nanjing Tech University's Taixing Industrial College, and the university-surrounding innovation ecosystem in Wuhan's Hongshan District, used for benchmarking analysis and experience extraction.

## 2.6. Case-Selection Criteria

In the field investigation, 12 typical cases were selected for in-depth analysis to support the bottleneck diagnosis and mechanism design. The case-selection criteria are as follows: 1) Representativeness: The cases cover different types of collaborative models (university-park cooperation, university-enterprise cooperation, park-enterprise cooperation, and tripartite cooperation), different industrial fields, and different cooperation scales, reflecting the overall characteristics of

Tai'an's collaborative innovation; 2) Typicality: The cases either have successful experience in collaborative innovation (e.g., Tai'an High-tech Zone's enterprise-university-research innovation platform construction, Shandong Agricultural University's agricultural technology achievement transformation) or have prominent bottlenecks (e.g., low matching degree of university-enterprise cooperation in some traditional industries, insufficient pilot support for new material achievements); 3) Accessibility: The selected cases have complete data records and are willing to cooperate with the investigation, ensuring the authenticity and comprehensiveness of case analysis. The case analysis focuses on sorting out the operation process, key problems, and influencing factors of collaborative innovation, providing practical basis for the subsequent path construction.

### 3. Theoretical Basis and Literature Review

The Triple Helix Theory emphasizes that the three types of entities-university, industry, and government-interact, penetrate, and develop spirally, forming a collaborative innovation network through functional crossover and organizational integration. In the framework of this study, universities in Tai'an undertake the functions of knowledge production and technology supply; the industrial sector undertakes the functions of market application and value realization; parks and governments jointly undertake the functions of platform construction, service supply, and institutional guarantee. The three form a stable innovation-driven structure through functional coupling.

Innovation Ecosystem Theory regards innovation activities as a complex adaptive system composed of entities, factors, and environments, emphasizing the symbiosis of multiple entities, collaborative flow of factors, and dynamic adaptation of the environment. As knowledge suppliers, parks as service transformers, and industries as market demanders, universities in Tai'an together with innovation factors such as talents, technology, capital, and information, as well as external environments such as policies, services, and cultures constitute a collaborative innovation ecosystem. Its operating efficiency depends on the degree of coupling between entities and the efficiency of factor allocation. Essentially, the construction of an innovation ecosystem is a networked collaborative process formed by multiple entities on the basis of resource complementarity, benefit sharing, and risk sharing [1].

Resource Dependence Theory states that the survival and development of organizations depend on key resources in the external environment, and resource complementarity through cooperation among entities is an important path to reduce uncertainty and improve operational efficiency. Universities in Tai'an have talents and technological resources but lack industrialization conditions and market channels; the industrial sector has markets, capital, and application scenarios but lacks core technology supply; parks have space carriers and service systems but lack high-quality innovation projects. The three have a natural resource dependence relationship, providing an internal logic for in-depth collaboration.

Foreign research on industry-university-research collaborative innovation started early, forming mature practical models represented by Silicon Valley in the United States, Route 128 in Boston, and the Fraunhofer Society in Germany. The research focuses on the structure of collaborative innovation networks, benefit distribution mechanisms, intellectual property governance, pilot-scale incubation systems, policy tool effects, and other fields, emphasizing market orientation, enterprise leadership, and professional service support, providing important theoretical references for the construction of collaborative innovation ecosystems.

Domestic research has carried out extensive explorations on the practical dilemmas, operation mechanisms, model innovations, and policy optimizations of industry-university

- research collaborative innovation. Zhang Li pointed out that China's industry-university.
- research collaborative innovation generally faces key problems such as misplaced entity goals, insufficient resource integration, loose benefit connections, and lack of governance mechanisms, and it is urgent to reshape the collaborative framework with systematic governance logic [2]. From the perspective of strategic orientation, Li Yuan *et al.* proposed that enterprises and universities should be driven by market demand, strengthen the orientation of applied research and achievement transformation, and improve the industrial adaptability of collaborative innovation [3]. Through bibliometric analysis, Wang Zhenzhen and Chen Xinyue found that pilot-scale incubation, factor matching, financial support, and talent mobility have become research hotspots in the field of industry-university-research collaborative innovation in the past five years [4].

In terms of park-university collaboration, Lin Sen and Zhang Li proposed that science and technology parks are core carriers connecting universities and industries, and their core value lies in integrating innovation resources, providing professional services, and promoting the landing of achievements. However, most parks currently have shortcomings such as weak service capabilities, insufficient resource integration, and disconnection from industrial demand [5]. In terms of industrial collaboration and chain-leader enterprise traction, Feng Xue believed that chain-leader enterprises play a pivotal role in integrating industrial chain resources, transmitting innovation demand, and driving the collaborative upgrading of small, medium, and micro enterprises, which can effectively solve the problem of "disconnection" between the innovation chain and the industrial chain [6]. At the regional practice level, taking county-level industrial upgrading as an example, Zhou Yelian proposed that strengthening industry-university-research docking, building innovation platforms, and improving policy incentives are key measures to promote achievement transformation and industrial transformation [7]. Taking the new energy vehicle industry as an example, Chen Fangying *et al.* proposed that focusing on key links in the industrial chain and building a "vehicle-parts-aftermarket" collaborative innovation system can significantly improve the

overall competitiveness of the industry. From the perspective of green development, Li Xinyun proposed that constructing a cross-entity collaboration system driven by chain-leader enterprises can promote the efficient linkage of factors such as standards, data, and technology [8].

Overall, existing studies have laid a solid theoretical foundation for this paper, but systematic research focusing on resource-based cities with “University + Park + Industry” tripartite linkage as the core is relatively insufficient, and localized research combining Tai’an’s local scientific and educational resources, park carriers, and industrial characteristics is even weaker. Based on the reality of Tai’an, this study makes up for the deficiencies of existing research in the construction of collaborative innovation ecosystems in small and medium-sized resource-based cities, with strong pertinence and practical value.

The Triple Helix Theory, Innovation Ecosystem Theory, and Resource Dependence Theory are organically integrated to form the core analytical logic and diagnostic framework of this study. The Triple Helix Theory defines the functional positioning and interactive paradigm of universities, industries, and governments with industrial parks as the key carrier for government-led service supply laying the foundation for the multi-entity structure of the “University + Park + Industry” collaborative innovation ecosystem. The Innovation Ecosystem Theory provides a systematic analytical perspective, guiding the study to examine the integrated operation of entities and innovation factors, with symbiotic interaction and factor allocation efficiency as key diagnostic dimensions. The Resource Dependence Theory reveals the intrinsic collaborative motivation: universities (talent and technology), parks (carrier and services), and industries (market and capital) rely on each other to make up for resource gaps, which serves as the core starting point for bottleneck diagnosis. Collectively, these theories form a coherent logic: taking multi-entity functional positioning (Triple Helix Theory) as the basis, systematic ecosystem operation (Innovation Ecosystem Theory) as the perspective, and resource complementarity gaps (Resource Dependence Theory) as the focus, jointly underpinning the study’s bottleneck identification and mechanism design.

#### **4. Current Situation and Bottleneck Diagnosis of Collaborative Innovation of “Universities in Tai’an + Parks + Industries”**

Tai’an has initially formed a collaborative innovation basic pattern with universities in Tai’an as the source of knowledge, industrial parks as transformation carriers, and characteristic industries as application scenarios. According to public data, the scale of innovation resources in Tai’an continues to expand, laying a solid foundation for tripartite collaboration: the city has 8 ordinary universities with 141,000 enrolled students and 6,349 full-time teachers, forming a relatively complete talent training and knowledge production system [6]. Universities in Tai’an have built 71 scientific and technological innovation platforms in total, released 2,237 university experts, 942 scientific and technological achievements and inven-

tion patents, 37 school-enterprise cooperative scientific research projects, and 94 school-local and school-enterprise cooperative projects [8]. By 2025, the number of high-tech enterprises in Tai'an reached 1,014, maintaining a growth rate of more than 20% for six consecutive years; the number of national small and medium-sized scientific and technological enterprises reached 1,576; the total social Research and Development investment reached 10.118 billion yuan, and the research design investment intensity rose to 2.80%, higher than the provincial average for many consecutive years [9]. The output value of high-tech industries accounted for 66.8% of the total industrial output value of industrial enterprises above designated size, an increase of 16.7 percentage points compared with 2020, and the industrial innovation foundation continued to strengthen [10].

In terms of park carrier construction, as a national-level high-tech zone, Tai'an High-tech Zone has 281 innovation and Research and Development platforms above the municipal level, including 8 national-level and 22 provincial-level ones. The number of high-tech enterprises has doubled in the past three years, and the total industrial output value of enterprises above designated size reached 55.24 billion yuan in 2025, becoming the core innovation-bearing area of the city [11]. Focusing on achievement transformation and Research and Development services, Taishan Innovation Valley, linked with Taishan Science and Technology Market, has settled more than 100 service institutions and enterprises, cultivated more than 150 technology managers, and built 20 achievement transformation demonstration bases [12]. In 2024, the city's technical contract transaction volume reached 1.9557 billion yuan, with 4,083 registered projects, and the scale of achievement transformation expanded rapidly [13]. The "Double Hundred Actions" have solved 320 technical problems for enterprises in total, promoting precise docking between experts and enterprises, and between enterprises and research institutes [13]. Overall, Tai'an has met the basic conditions for collaborative innovation: "universities have resources, parks have carriers, industries have demand, and policies have support".

Structural mismatch between the supply of scientific and technological achievements and industrial demand. Most scientific research projects of universities in Tai'an are oriented to vertical projects, academic papers, and patent applications, with a high proportion of basic research and insufficient supply of applied results with industrialization potential facing real enterprise production scenarios. Although the cumulative number of patent applications and grants of universities in Tai'an reached 6,519 and 4,365 respectively, the industrialization rate of invention patents is significantly low [5]. A large number of achievements remain in the laboratory stage with low matching degree with enterprise technical demand, forming a supply-demand mismatch of "accumulated university achievements and unsolved enterprise problems", and the innovation chain and industrial chain fail to mesh effectively [5]. From the perspective of transformation structure, most university achievements are non-core patents and simple technical improvements, and the supply of key core technologies for leading industries such as high-

end equipment, new materials, and biomedicine is obviously insufficient, which is difficult to support the high-end transformation of industries.

Blocked achievement transformation channels caused by the lack of pilot-scale incubation links. Pilot test verification is a key link connecting the laboratory and industrialization, and it is the most prominent shortcoming in current collaborative innovation. The number of professional pilot platforms in universities in Tai'an is insufficient and their functions are imperfect; the supply of pilot facilities and supporting services in parks is weak; and enterprises are difficult to bear the high investment and high risks in the pilot stage. Data shows that the transformation rate of university achievements from the laboratory to the pilot stage in Tai'an is less than 30%. A large number of mature small-scale test achievements cannot complete process amplification, cost optimization, and reliability verification, making it difficult to cross the "valley of death" of achievement transformation [11]. The lack of pilot links directly leads to the disconnection between scientific research achievements and industrialization, becoming a core bottleneck restricting collaborative efficiency [11].

Blocked school-enterprise information transmission and low docking efficiency. Information such as university scientific and technological achievements, enterprise technical demand, and expert talent resources is scattered and fragmented, lacking a unified, authoritative, dynamically updated docking platform and normalized communication mechanism. Although Tai'an has established a "demand database-achievement database-expert database", the dynamic update is not timely, intelligent matching is insufficient, and offline docking frequency is limited. Information transmission highly relies on manual docking and acquaintance recommendation, resulting in low matching accuracy, high communication costs, and long collaboration cycles. In 2024, more than 100 transformable achievements were registered by universities in Tai'an, but only more than 10 transformation intentions were reached and 2 were successfully landed. Information asymmetry leads to the failure of a large number of potential cooperations to be transformed into actual projects [12]. Poor information transmission has become an important factor restricting the efficiency of industry-university-research collaboration [14].

Insufficient resource integration capacity and professional service supply of industrial parks. The functional positioning of parks focuses on space provision and policy implementation; the professional service systems such as Research and Development services, technology transactions, intellectual property operation, inspection and testing, and technological finance are not perfect; and the ability to integrate university innovation resources, industrial market resources, and intermediary service resources is weak. Core carriers such as Tai'an High-tech Zone and Taishan Innovation Valley still mainly provide basic services such as factory building leasing and policy declaration, with insufficient full-cycle innovation service supply, failing to give full play to the role of bridges and carriers. Compared with advanced regions, Tai'an's parks have obvious gaps in the number, service

capacity, and marketization level of professional service institutions, which are difficult to meet the compound needs of achievement transformation and enterprise cultivation [5].

Insufficient endogenous power caused by imperfect collaborative governance mechanisms. Rules such as benefit distribution of achievement transformation, ownership of intellectual property rights, and pricing of technology shares are unclear, making it difficult to balance the interests of multiple entities; the “revolving door” mechanism for university researchers to flow to industries is not smooth, with obvious institutional constraints on part-time employment, professional title evaluation, and benefit guarantee; the financial support system such as technology credit, risk compensation, and angel investment for achievement transformation is not perfect. Although the registered scale of “Luke Loan” reached 2.02 billion yuan with 5.97 million yuan in interest discounts, its coverage and support strength are still difficult to meet the capital needs of early achievement transformation [9]. The research evaluation and enterprise innovation incentive mechanism oriented to transformation performance have not been fully established, and the endogenous power and institutional guarantee of collaborative innovation are insufficient. Shortcomings in mechanisms such as benefit distribution, risk sharing, and talent mobility jointly restrict the sustainability of collaboration [2].

### **5. Construction of Collaborative Innovation Linkage Mechanism of “University + Park + Industry”**

Focusing on making up for the shortcomings of pilot tests and strengthening achievement maturation, universities in Tai’an and industrial parks are promoted to jointly build industrial technology research institutes, concept verification centers, and professional pilot platforms with physical operation. Drawing on the mature model of university-local-industry collaborative construction, a dual-subject governance structure is established, where universities and parks are jointly responsible for platform operation, project screening, technology Research and Development and achievement transformation. Centering on advantageous industries in Tai’an such as modern agriculture, high-end equipment, biomedicine, and new materials, industry-specific pilot bases are laid out to provide full-process services such as small-scale test amplification, process optimization, product testing, and cost accounting, promoting early scientific research achievements to complete concept verification and engineering verification, and improving achievement maturity and industrialization adaptability. Relying on the existing 281 research design platforms in Tai’an High-tech Zone, integrating university resources to build pilot platforms can significantly reduce the risk and cost of achievement transformation. Platform-based, physical, and market-oriented collaborative carriers are key supports to solve the lack of pilot tests and realize achievement maturation [11].

Relying on Taishan Innovation Valley to build a municipal collaborative innovation information hub, a dynamic matching system integrating enterprise tech-

nical demand, university scientific and technological achievements, and expert talent resources is constructed to promote the standardized, visualized, and real-time update of demand, achievement, and talent information. Through big data and intelligent matching technology, precise push of technical demand and scientific research achievements is realized. Relying on the Double Hundred Actions, normalized school-enterprise docking, achievement roadshows, and technical consultations are carried out to promote the transformation of innovation factors from passive docking to active matching, from decentralized cooperation to systematic collaboration, and improve the efficiency of factor allocation. The technical contract transaction volume of Tai'an reached 1.9557 billion yuan in 2024, indicating that there is large room for improvement in factor docking. The three-database linkage system can further reduce information asymmetry and improve the precision of industry-university-research docking [7] [12].

Based on the demand for key core technologies and common technologies in the industry, a market-oriented and project-linked technical tackling mechanism is established. The collaborative tackling mode of “enterprises set questions, universities solve questions, and governments assist questions” is fully implemented. Focusing on technical bottlenecks in industrial development, projects are publicly announced to attract university research teams to undertake tackling, forming a demand-driven, task-oriented, and closed-loop management research design organization form. Project-based traction promotes Research and Development activities to closely follow industrial scenarios and aligns the research direction of universities with the development path of industries. Tai'an implements nearly 200 provincial-level enterprise technological innovation projects every year, and industrial demand traction can significantly improve the industrial adaptability and transformation value of Research and Experimental Development achievements [6] [10].

Relying on Tai'an's technological innovation financial reform policy system, a financial support and risk sharing mechanism covering the whole cycle of achievement transformation is constructed. Optimize the supply of products such as technology credit and intellectual property pledge financing, implement the “automatic approval and enjoyment” policy for benefiting enterprises, and lower the financing threshold for technology-based enterprises. Establish a risk compensation pool jointly participated by the government, banks, and guarantee institutions to diversify early risks of achievement transformation and technological innovation, guide angel investment and venture capital to invest in early achievement transformation projects of universities, and form a technological innovation financial ecosystem linked by “investment, loan, guarantee, and subsidy”. The registered volume of Tai'an's “Luke Loan” increased by 52.0% year-on-year in 2025, showing broad space for financial empowerment. Financial and risk sharing mechanisms are important guarantees to solve financing problems and activate innovation investment [9] [12].

Break down barriers to talent mobility between universities and industries and

establish a two-way “revolving door” system for talents. Support university researchers to provide technical services, achieve transformation, and cooperate on projects in enterprises on the premise of completing their own work, and protect their legitimate rights and interests in professional title evaluation, post employment, and salary treatment; select high-level technical and management talents from enterprises to serve as industrial professors in universities to participate in talent training and scientific research innovation. Improve the talent incentive mechanism with innovation value, transformation performance, and industrial contribution as the core, and stimulate the innovation enthusiasm of researchers and enterprise technicians through equity, options, dividends, one-time rewards, and other ways. Tai’an has selected 20 vice presidents of science and technology and carried out 32 expert enterprise visits, with initial results in two-way talent mobility. Further improving the incentive mechanism can continuously enhance the vitality of collaborative innovation [4] [14] [15].

## **6. Construction Path of Collaborative Innovation Ecosystem of “Universities in Tai’an + Parks + Industries”**

Focusing on opening up the “basic research-technology development-pilot maturation-industrial landing” chain, a multi-level and functionally complementary platform support system is constructed. Strengthen the construction of university knowledge innovation platforms and improve the supply capacity of applied research and industrial technologies; accelerate the layout of concept verification centers and professional pilot platforms to make up for key shortcomings in achievement transformation; optimize the stepped incubation and cultivation system of “crowdsourcing space-incubator-accelerator-industrial park” to improve the efficiency of cultivating technology-based enterprises; improve public service platforms such as technology transactions, intellectual property rights, inspection and testing, and scientific and technological consulting, improve professional service supply, and form a closed-loop platform support network. Relying on Tai’an’s existing 71 university scientific and technological innovation platforms and 281 park Research and Development platforms, integration and upgrading can form a full-chain support capacity and effectively eliminate transformation breakpoints [1] [4] [8].

Promote the free flow and efficient integration of talents, technology, capital, information, data, and other innovation factors among universities, parks, and industries. Optimize the technology supply structure based on demand and promote more university research topics derived from the industrial frontline; strengthen entity connection with talents as the link to realize the cross-entity transmission of knowledge, experience, and skills; leverage innovation investment with capital as the lever and guide financial resources to tilt toward achievement transformation and technological innovation; eliminate collaboration barriers based on information, reduce transaction costs and search costs, and improve overall collaboration efficiency. At present, Tai’an’s Research and Development

investment intensity is 2.80% and the high-tech industry accounts for 66.8%, with a good foundation in factor scale. Efficient integration can further release collaborative dividends and realize the benign operation of the innovation ecosystem [5] [9] [10].

Establish a municipal-level collaborative innovation governance structure with overall coordination and multi-party participation, and improve the normalized communication and consultation mechanism among universities, parks, enterprises, governments, and intermediaries. Improve institutional rules such as benefit distribution of achievement transformation, ownership and sharing of intellectual property rights, and risk sharing, clarify the rights, obligations, and interest boundaries of all parties, and form a stable and predictable institutional environment. Establish an evaluation and assessment system with industrial contribution, transformation performance, and innovation efficiency as the core, incorporate the effectiveness of collaborative innovation into the evaluation and assessment of universities, parks, and key enterprises, and strengthen incentives and constraints. Drawing on the experience of Changchun's industry-university-research collaborative innovation pilot, institutionalized governance can effectively improve the stability and sustainability of entity collaboration and provide guarantees for long-term cooperation [2] [11].

Formulate systematic detailed rules for school-local cooperation, clarify institutional arrangements in platform co-construction, talent mobility, achievement transformation, financial support, tax incentives, and other aspects, and provide stable policy guarantees for collaborative innovation. Benchmarking the experience of constructing university-surrounding innovation ecosystems in advanced regions, layout innovation blocks, scientific and technological innovation carriers, and public service spaces relying on universities in Tai'an, promote the integrated development of campus, park, and community, and create an innovation ecology of nearby entrepreneurship, nearby transformation, and nearby services. Guide parks to focus on segmented industries to achieve dislocation development and improve industrial agglomeration and professional service level. Accelerate the cultivation of professional technology manager teams, improve the capabilities of technology mining, achievement promotion, transaction negotiation, and project operation, and improve the intermediary service system. Continuously optimize the policy implementation mechanism, promote the direct and fast enjoyment of various policies benefiting enterprises and innovation, reduce institutional transaction costs, and create a good innovation atmosphere of encouraging innovation, tolerating failure, and advocating transformation. Tai'an has cultivated more than 150 technology managers and built 20 achievement transformation bases. Policy empowerment can further reduce collaboration costs and improve ecological operation efficiency [8] [12].

To consolidate the causal link between problem diagnosis and construction paths, each identified bottleneck in the "Universities in Tai'an + Parks + Industries" collaborative innovation ecosystem is precisely matched with a targeted

mechanism and corresponding expected effects, forming a rigorous “problem-mechanism-effect” logical chain. First, the structural mismatch between technological achievement supply and industrial demand is addressed by the market-oriented, project-linked key technology tackling mechanism, expected to optimize university research orientation and improve the supply-demand matching degree. Second, the lack of pilot-scale incubation links is resolved through the university-park joint pilot platform construction mechanism, aiming to bridge the achievement transformation “valley of death” and raise the industrialization rate. Third, blocked university-enterprise information transmission is improved via the municipal collaborative innovation information hub and three-database intelligent matching mechanism, to eliminate information asymmetry and enhance docking precision. Fourth, insufficient park resource integration and professional services are remedied by the full-cycle service and platform integration mechanism, promoting parks to become professional innovation service providers and improve the comprehensive service system. Fifth, imperfect collaborative governance and insufficient endogenous motivation are optimized through the integrated mechanism of talent two-way flow, standardized benefit distribution and financial risk sharing, to clarify stakeholder interest boundaries, stimulate innovation enthusiasm and sustain long-term collaborative vitality. This one-to-one correspondence strengthens the pertinence of the proposed paths and the theoretical-practical value of the research.

## 7. Conclusion and Prospect

Taking Tai’an City as the research object, this study systematically analyzes the construction of the collaborative innovation ecosystem of “Universities in Tai’an + Parks + Industries” and draws the following conclusions: First, Tai’an has the scientific and educational resources, park carriers, and industrial demand foundation to promote tripartite collaborative innovation. Data such as 71 university platforms, 1,014 high-tech enterprises, 2.80% Research and Experimental Development investment intensity, and 1.9557 billion yuan technical contract transaction volume show that the innovation foundation is continuously consolidated, but it still faces prominent bottlenecks such as achievement supply-demand mismatch, lack of pilot links, poor information docking, insufficient park services, and lagging governance mechanisms. The advantages of scientific and educational resources have not been effectively transformed into industrial competitiveness and economic development momentum. Second, the core path to break through collaborative innovation bottlenecks is to build an integrated linkage mechanism of platform co-construction, factor matching, project traction, financial empowerment, and talent interconnection, realizing the transformation of multiple entities from loose cooperation to in-depth coupling. Third, collaborative efforts should be made from four dimensions: platform system, factor allocation, governance mechanism, and policy environment to build a closed-loop, systematic, and localized collaborative innovation ecosystem and open up the whole chain

channel from knowledge production to industrial application. Fourth, the construction path proposed in this study is based on the transformation reality of resource-based cities, conforms to Tai'an's local policy practice, has strong operability and promotion value, and can provide a reference for similar cities.

The construction of the collaborative innovation ecosystem of "Universities in Tai'an + Parks + Industries" is a long-term systematic project that needs to be continuously optimized and improved in practice in the future. First, further strengthen digital empowerment, rely on technologies such as big data and artificial intelligence to improve the intelligent level of factor matching, platform operation, and governance decision-making, and promote the quality and efficiency of three-database linkage and precise docking. Second, continuously deepen institutional mechanism innovation, dynamically adjust policy tools, benefit distribution, and governance models according to industrial upgrading and changes in the innovation environment, and improve key systems such as pilot support, financial risk compensation, and talent incentives. Third, promote cross-regional collaborative innovation, take the initiative to integrate into the provincial capital economic circle and the Yellow River National Strategy innovation layout, expand the space for innovation resource allocation, and attract external universities, research institutes, and financial capital to participate in Tai'an's ecosystem construction. Fourth, cultivate the soil of innovation culture, strengthen the dominant position of enterprises in innovation, enhance the orientation of university achievement transformation, and create a good atmosphere of social support for collaborative innovation. With the continuous improvement of the collaborative innovation ecosystem, universities, parks, and industries in Tai'an will achieve a higher level of in-depth integration, injecting sustained and strong innovation momentum into the transformation of Tai'an's resource-based cities, fostering new quality productive forces, and promoting high-quality development.

It should be noted that this study has certain limitations. First, the research focuses solely on Tai'an, a single resource-based city, which limits the generalizability of the conclusions to some extent, and the findings may not fully apply to resource-based cities with different industrial bases and sci-educational endowments. Second, the study relies heavily on policy documents, descriptive statistics and field investigation data, with insufficient quantitative empirical analysis to verify the causal relationship between the constructed collaborative innovation mechanisms and actual innovation performance. In terms of the transferability of the framework, the core logic of the "University + Park + Industry" collaborative innovation ecosystem, including platform co-construction, factor matching, talent mobility and financial support mechanisms, is generally applicable to other resource-based cities facing the task of transforming sci-educational advantages into industrial competitiveness. However, specific content closely linked to Tai'an's local context, such as the focus on modern agriculture, high-end equipment and other advantageous industries, the reliance on Tai'an High-tech Zone and Taishan Innovation Valley as core carriers, and the combination with local

policies such as the “Double Hundred Actions”, are specific to Tai’an and need to be adjusted according to the actual conditions of other cities during application.

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## Conflicts of Interest

The authors declare no conflicts of interest.

## References

- [1] Liu, G.X., Zhang, F., Zhang, P.F., *et al.* (2022) Research on the Selection Strategy of the Construction Modes of University Technology Transfer Institutions in China. *Science & Technology Progress and Policy*, **39**, 1-10. (In Chinese)  
<https://doi.org/10.6049/kjbydc.2021050374>
- [2] Huang, C.J. and Nan, X.G. (2019) Logic, Challenges and Paths of Industry-University-Research Cooperation Governance in the Intelligent Era. *Forum on Science and Technology in China*, No. 2, 29-35, 43. (In Chinese)  
<https://doi.org/10.13580/j.cnki.fstc.2019.02.009>
- [3] Zhao, G.S., Lei, Q.L., Chen, J.X., *et al.* (2006) Research on the Impact of Different Strategic Orientations on Independent Innovation and Cooperative Innovation. *Modern Economic Science*, No. 2, 18-23, 124. (In Chinese)  
[https://kns.cnki.net/kcms2/article/abstract?v=RM9JFOVmTL9x4Um-QWO3yOC6LGf7dhsgS3cF0QDulGD-zLncxDwtLtDw-RyflYz-ZoKR5f4TjmRhxewaRaBhazc2B3PSABJ82qWjRRPaBH2OvjG3Ttu-0IbSD\\_i\\_r9U9U7bL2DeB54s8QwGrMlw\\_OilyGCbw66nyvOsIjLwF60oCQzqyczytw==&uniplatform=NZKPT&language=CHS](https://kns.cnki.net/kcms2/article/abstract?v=RM9JFOVmTL9x4Um-QWO3yOC6LGf7dhsgS3cF0QDulGD-zLncxDwtLtDw-RyflYz-ZoKR5f4TjmRhxewaRaBhazc2B3PSABJ82qWjRRPaBH2OvjG3Ttu-0IbSD_i_r9U9U7bL2DeB54s8QwGrMlw_OilyGCbw66nyvOsIjLwF60oCQzqyczytw==&uniplatform=NZKPT&language=CHS)
- [4] Tai’an High-Tech Industrial Development Zone (2025) 2025 New Year Address. Tai’an High-Tech Zone Official Website. (In Chinese)  
[https://gxq.taian.gov.cn/art/2025/1/2/art\\_47832\\_10323381.html](https://gxq.taian.gov.cn/art/2025/1/2/art_47832_10323381.html)
- [5] Lin, S. and Zhang, L. (2017) Research on Collaborative Innovation Development between Science and Technology Parks and Local Universities. *Science & Technology Information*, **15**, 238-240. (In Chinese)  
<https://doi.org/10.16661/j.cnki.1672-3791.2017.33.238>
- [6] Tai’an Municipal Bureau of Statistics (2025) Statistical Communiqué on National Economic and Social Development of Tai’an City in 2024.  
[https://www.taian.gov.cn/art/2025/3/31/art\\_356574\\_10357776.htm](https://www.taian.gov.cn/art/2025/3/31/art_356574_10357776.htm)
- [7] Feng, X. (2025) Research on the Collaborative Construction Path of Innovation and Incubation Ecology Empowered by Technology and Brand Driven by Chain-Leader Enterprises. *China Brand & Anti-Counterfeiting*, No. 10, 207-209. (In Chinese)  
[https://kns.cnki.net/kcms2/article/abstract?v=RM9JFO-VmTL9vmTQhyFdBgVHnLF-sKmvcdulfg41Nx1q46j84rGo2OS6sAX2smHalgH\\_UeVak3C2wnXBky-fVF2Nqzj9LlkuO4\\_AHm4axlRHR\\_QDdr4h6zSfh6o8TlcSdKlx51-daX-](https://kns.cnki.net/kcms2/article/abstract?v=RM9JFO-VmTL9vmTQhyFdBgVHnLF-sKmvcdulfg41Nx1q46j84rGo2OS6sAX2smHalgH_UeVak3C2wnXBky-fVF2Nqzj9LlkuO4_AHm4axlRHR_QDdr4h6zSfh6o8TlcSdKlx51-daX-)

- [OLYIRjWHINKiT'TZXMUwVteTGtSQLA5sIG4gMjfdREY6ow==&uniplatform=NZKPT&language=CHS](https://www.taian.gov.cn/art/2025/8/1/art_176934_35912.html)
- [8] Tai'an Municipal People's Government (2025) Reply to Suggestions on Strengthening School-Enterprise Cooperation to Promote the Rapid Economic Development of Our City. (In Chinese)  
[http://www.taian.gov.cn/art/2025/8/1/art\\_176934\\_35912.html](http://www.taian.gov.cn/art/2025/8/1/art_176934_35912.html)
- [9] Tai'an Municipal Bureau of Statistics (2026) Statistical Communiqué on National Economic and Social Development of Tai'an City in 2025. Tai'an Municipal Bureau of Statistics. (In Chinese)  
[http://tjj.taian.gov.cn/art/2026/4/28/art\\_46885\\_10300913.html](http://tjj.taian.gov.cn/art/2026/4/28/art_46885_10300913.html)
- [10] Tai'an Municipal Development and Reform Commission (2025) Tai'an, Shandong: Striving to Write a New Chapter of a Strong City with New-Type Industrialization. Tai'an Municipal Development and Reform Commission. (In Chinese)  
[https://fgw.taian.gov.cn/art/2025/12/18/art\\_47536\\_10312292.html](https://fgw.taian.gov.cn/art/2025/12/18/art_47536_10312292.html)
- [11] Jilin Provincial People's Government (2015) *Implementation Plan for the Pilot Work of Establishing an Industry-University-Research Collaborative Innovation Mechanism in Changchun City*. The People's Government of Jilin Province, Document No. Ji Zheng Fa (2014) 4. <https://m.pthls.cn/law/ca5aed766081009.html>
- [12] Zhonghua Taishan Net (2025) Scientific and Technological Achievements in Tai'an Accelerate Landing and Generate Benefits. (In Chinese)  
<http://www.my0538.com/2025/0307/963259.shtml>
- [13] Tai'an Municipal Bureau of Science and Technology (2025) Work Report on Science and Technology of the Whole City in 2024. Tai'an Municipal Bureau of Science and Technology. (In Chinese)  
[https://kj.taian.gov.cn/art/2025/5/19/art\\_47980\\_10305708.html](https://kj.taian.gov.cn/art/2025/5/19/art_47980_10305708.html)
- [14] Wu, Z.Y. (2017) Research on the Collaborative Mechanism between Local Universities and the Innovative Development of Regional Economy. *Heilongjiang Researches on Higher Education*, No. 1, 129-132. (In Chinese)  
[https://kns.cnki.net/kcms2/article/abstract?v=RM9JFO-VmTL\\_CZo7GKHKK2i67YMqhQ8uWuHZZ8laPptPa-HUuOvjmrJh0eaV4D9ABEPdO9JkiXcWpXo9Zu71oaOcYFRJWIXbflLuNpFdG4TFbNnnLKV7QjCi3IWBe9\\_XZiEprH4\\_MUNRis1mmmeCcyfkSc3624eJv7nbVu-tuLWiOYYhcHRXGU-QLA==&uniplatform=NZKPT&language=CHS](https://kns.cnki.net/kcms2/article/abstract?v=RM9JFO-VmTL_CZo7GKHKK2i67YMqhQ8uWuHZZ8laPptPa-HUuOvjmrJh0eaV4D9ABEPdO9JkiXcWpXo9Zu71oaOcYFRJWIXbflLuNpFdG4TFbNnnLKV7QjCi3IWBe9_XZiEprH4_MUNRis1mmmeCcyfkSc3624eJv7nbVu-tuLWiOYYhcHRXGU-QLA==&uniplatform=NZKPT&language=CHS)
- [15] Xu, J. (2026) Strengthen Industry-University-Research Collaborative Innovation to Promote the Cultivation and Development of High-Quality Talents. *Chongqing Science and Technology News*. (In Chinese)  
<https://doi.org/10.44517/n.cnki.ncqkj.2026.000184>