Article

The Management Mechanism of Jiangsu's "Double-High Synergy Innovation" under the Triple Helix Theory: Dynamics, Operation, and Constraints

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Abstract: To overcome institutional barriers in industry-university-research collaboration, Jiangsu Province has launched a major reform initiative that promotes collaborative innovation between high-tech zones and higher education institutions (referred to as "Double-High Synergy Innovation"). Drawing on the Triple Helix theory, this paper develops an analytical framework encompassing dynamic, operational, and constraint mechanisms to systematically analyze the interactive logic among universities, industries, and government within this policy context. The findings indicate that the "Double-High Synergy Innovation" initiative generates multiple driving forces through development needs, policy incentives, resource sharing, and mutual benefits. It fosters deep interaction via "hybrid organizations" and "role-playing," which are manifested in organizational coordination, platform co-construction, project-driven collaboration, and talent mobility. Furthermore, institutional friction is mitigated through a constraint system composed of clarified responsibilities, process supervision, and performance evaluation. This institutional design and innovative practice not only highlight the Chinese characteristics of the Triple Helix model in a strong-government context-where the government functions as both "architect" and "initial driver"-but also enrich the empirical foundation of Triple Helix theory through the model of "organized research + organized transformation," offering valuable insights for understanding and optimizing regional innovation ecosystems.

Keywords: Triple Helix theory; Double-High Synergy Innovation; management mechanism; innovation ecosystem; industry-university-research collaboration

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1. Introduction

Competition among regional innovation systems is, in essence, competition among innovation ecosystems, the core of which lies in establishing effective channels for transforming knowledge, technology, talent, and industry. Jiangsu Province's "Double-High Synergy Innovation" initiative is strategically positioned at the level of building a new-era regional innovation system. It aims to deepen the synergy between high-tech zones and higher education institutions, dismantle institutional barriers, and promote the integration of education, science and technology, talent, and industry (from the following two policy documents: the Implementation Opinions on Promoting the Collaborative Innovation Development between High-tech Zones and Higher Education Institutions, Jiangsu Provincial People's Government, 2025; and the Notice on Issuing the "Double-High Synergy Innovation" Policy Guide List and Reform Guidance List, Jiangsu Provincial Department of Science and Technology, 2025). Against this backdrop, an important academic and practical question arises: how can the internal mechanisms of

"Double-High Synergy Innovation" be systematically interpreted through the lens of innovation theory so as to effectively unlock its synergistic potential?

The Triple Helix theory emphasizes the nonlinear interaction and functional coupling among universities, industry, and government, offering a classic analytical framework for collaborative innovation [1-4]. It transcends traditional linear transformation models and bilateral relationships by highlighting how the three actors-while retaining their core functions-form an evolving innovation spiral through "role-playing" and the creation of "hybrid organizations" [1,2,5]. Within this framework, high-tech zones, as composite platforms for industrial agglomeration and policy experimentation, and higher education institutions, as key carriers of knowledge innovation and talent development, are expected-under governmental strategic guidance-to build a more resilient and competitive innovation ecology, thereby advancing the deep integration of technological and industrial innovation. Consequently, applying the Triple Helix theory to analyze the operational logic and practical pathways of "Double-High Synergy Innovation" is of significant theoretical and practical value.

This study adopts a qualitative case study approach focusing on Jiangsu Province's "Double-High Synergy Innovation" policy. Research materials are primarily drawn from publicly released policy documents (including implementation opinions, notices, lists, and official media reports) and are systematically categorized through content analysis. Anchored in the Triple Helix framework, this paper examines the following questions within the specific policy context: What are the respective sources of motivation, interactive processes, and constraint conditions for collaborative innovation among universities, industry, and government? How do these components jointly form an effective governance mechanism? To address these questions, and drawing on systems theory and the "mechanism-function" analytical approach, this study constructs an analytical framework comprising dynamic, operational, and constraint mechanisms (as shown in Figure 1), with the aim of providing systematic answers [6].

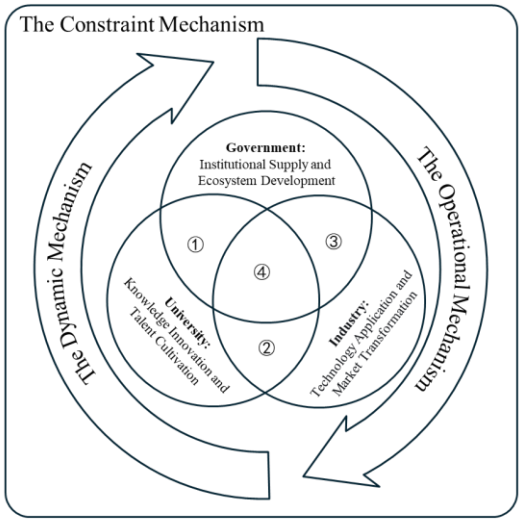

Figure 1. Analytical Framework of the Dynamics, Operation, and Constraints of "Double-High Synergy Innovation" under the Triple Helix Theory.

2. Triple Helix Theoretical Framework

The Triple Helix theory, proposed by Henry Etzkowitz and Loet Leydesdorff in the 1990s, analyzes the dynamic evolution of university-industry-government relations in the knowledge economy era [1-5]. The theory classifies the collaborative states of different economies into three ideal models-*the laissez-faire model, the etatistic model, and the Triple*

Helix model-as illustrated in Figure 2**.** Specifically, some Latin American countries exemplify the laissez-faire model; the Soviet Union's innovation system represents the etatistic model; and regions such as Silicon Valley and Zhongguancun embody the Triple Helix model [2,4,5].

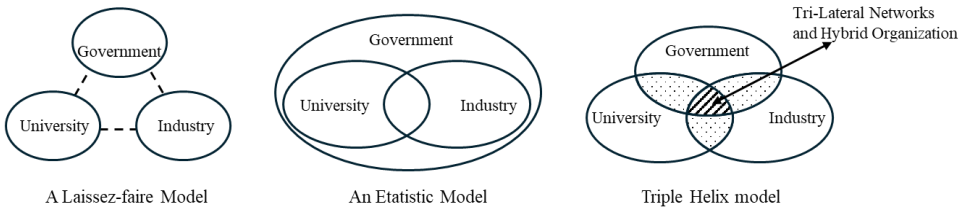

Figure 2. Three Ideal Models of the Triple Helix.

This theory breaks away from the traditional dual-helix relationship patterns of university-industry, university-government, and industry-government. In this framework, the three actors in the innovation process are no longer isolated or connected through simple linear relationships. Instead, they form a spirally intertwined structure-much like a DNA molecule-through continuous interaction, mutual penetration, and collaboration. In addition to fulfilling their primary functions, the actors also "play each other's roles," catalyzing the emergence of new "hybrid organizations" through collaborative engagement. These developments further promote technological innovation, knowledge transformation, and regional economic growth, thereby driving the upward spiral of the innovation system [1].

This paper argues that the Triple Helix theory provides a useful analytical lens for deconstructing the "Double-High Synergy Innovation" initiative. Its core concepts-role-playing, hybrid organizations, and the overlap space-are particularly relevant for explaining the mechanisms underpinning this policy.

2.1. Role-Playing (Taking the Role of the Other)

Role-playing constitutes the fundamental behavioral mechanism driving the dynamic evolution of the Triple Helix model. It refers to universities, industry, and government beginning to assume aspects of each other's roles while still performing their traditional functions. Universities, in addition to talent cultivation and scientific research, also take on "quasi-firm" roles by actively promoting knowledge capitalization-such as founding spin-off companies and conducting collaborative research. Industry is not merely a user of technology or producer of goods; it also undertakes "quasi-educational" and "quasi-research" roles by co-establishing laboratories with universities, co-cultivating talent, and funding exploratory basic research. The government, beyond its traditional role as rule-setter and regulator, assumes "quasi-market" functions by participating in and guiding the innovation process-for example, through establishing venture capital funds, formulating innovation policies, and building platforms for cross-sector collaboration [1]. This behavior provides the cultural and cognitive foundation for the formation of the dynamic mechanism.

2.2. Hybrid Organization (Or Triple Helix Interface Organization)

Hybrid organizations are new types of organizational entities catalyzed by the interaction and overlap of the three actors. They serve as the materialized carriers of Triple Helix relationships and typically emerge at the boundaries of universities, industry, and government. Such organizations possess hybrid and networked characteristics, and their core function is to facilitate resource exchange among the three parties, reduce transaction costs, and accelerate the flow and transformation of knowledge. Common forms of hybrid organizations include technology business incubators, university science parks,

technology transfer offices, industrial technology research institutes, and collaborative innovation centers. These organizations play a pivotal role in promoting resource exchange, reducing transaction costs, and accelerating knowledge transformation [1,2]. As such, hybrid organizations constitute the physical and institutional carriers of the operational mechanism.

2.3. Overlap Space

It's a dynamic, open field for innovation. Overlap Space is not a physical space but a relational network and ecosystem jointly constituted by the continuous interaction, collaboration, and resource flow among universities, industry, and government. In this space, innovation elements such as knowledge, technology, talent, capital, and information can circulate and integrate relatively freely. They can also grow in value across traditional organizational boundaries. The formation and expansion of the overlap space signify the maturation and deepening of Triple Helix relationships and represent an important manifestation of regional innovation vitality and competitiveness [1]. A regulatory guarantee ensures the orderly and efficient evolution of this space.

Role-playing, hybrid organizations, and the overlap space together form a coherent analytical chain from micro-level behavior, meso-level organization, to macro-level ecology. This chain provides an appropriate conceptual toolkit for deconstructing "Double-High Synergy Innovation," a concept highly aligned with the Triple Helix theory in resolving functional isolation among innovation actors. The dynamic-operation-constraint analytical framework constructed in this paper systematically reveals how this Triple Helix model operates, is driven, and sustained in the Chinese context.

3. The Dynamic Mechanism of "Double-High Synergy Innovation"

The dynamic mechanism reveals the internal and external driving forces that motivate and enable universities, industry, and government to continuously participate in collaborative innovation.

3.1. Development Demand Drive

Development demand is the primary driver at the strategic level. First, there is national strategic traction. "Double-High Synergy Innovation" is Jiangsu Province's direct response to implementing the innovation-driven development strategy and developing new quality productive forces, providing strong political legitimacy and policy direction for all parties' actions [7]. Second, there is industrial upgrading pressure. Facing global technological competition and domestic economic transformation, Jiangsu's high-tech zones and enterprises urgently need to break through key core technologies and cultivate emerging industrial clusters. Finally, there is an internal demand for university reform. Against the backdrop of intensifying competition in higher education, universities urgently need to strengthen ties with industry to enhance the transformation of scientific research achievements, improve social service capability, build new models for university-enterprise collaborative education, accelerate comprehensive higher education reform, and thereby enhance talent cultivation quality and achieve deeper development.

3.2. Policy and Institutional Drive

The government drives collaborative innovation-central to "Double-High Synergy The government drives collaborative innovation-central to "Double-High Synergy Innovation"-through policy adjustments and restructuring of incentive mechanisms. Policies alleviate participating parties' concerns and create new benefit expectations. For example, measures such as retaining personnel relationships during entrepreneurial leave and counting industrial contributions toward professional title promotions guide universities to reshape talent evaluation and faculty incentives. Supporting pilot high-tech zones and paired universities in industry-university-research collaboration projects, with

eligible projects incorporated into provincial science and technology plan management, guides faculty to focus on key industrial technology challenges and participate in significant collaboration projects *(Xinhua Daily, 2025, "Two Lists Precisely Boost 'Double-High Synergy Innovation")*. Recognizing students' practical achievements in "Double-High Synergy Innovation" for credit or as thesis replacements guides universities to extend talent cultivation from the classroom to the industrial frontline, train more industry-aligned engineers and innovative talents, and restructure talent cultivation models. Financial support tools such as concept verification funds and Jiangsu Science and Technology Loan ("Suke Dai") significantly reduce early risks and financing costs in university-enterprise cooperation. Listing collaboration results separately in provincial university quality assessments and recognizing disciplines with significant collaboration results as provincial key disciplines turns collaborative innovation from a "soft task" into a "hard indicator." These institutional arrangements collectively form an interlocking driving system, embodying the systematic thinking of "organized research + organized transformation."

3.3. Resource and Interest Drive

The Triple Helix theory posits that resource complementarity and sharing among universities, industry, and government are fundamental drivers of collaborative innovation. "Double-High Synergy Innovation" promotes deep interest binding and mutual benefit by constructing an open resource-sharing system, driving efficient allocation of innovation elements and bilateral openness of innovation carriers (from the following two policy documents: the Implementation Opinions on Promoting the Collaborative Innovation Development between High-tech Zones and Higher Education Institutions, Jiangsu Provincial People's Government, 2025; and the Notice on Issuing the "Double-High Synergy Innovation" Policy Guide List and Reform Guidance List, Jiangsu Provincial Department of Science and Technology, 2025). Universities gain support for discipline construction, revenue from achievement transformation, and a practical "testing ground" for talent cultivation; high-tech zones and enterprises obtain continuous technology supply, a talent pool, and an "accelerator" for industrial upgrading; the government benefits from enhanced regional innovation capability, optimized industrial structure, and replicable reform experience. This multi-party win-win interest distribution mechanism ensures the stability and sustainability of the collaborative relationship.

4. The Operational Mechanism of "Double-High Synergy Innovation"

The operational mechanism describes how motivation is translated into action, i.e., the ways in which universities, industry, and government achieve deep interaction and collaboration. According to the Triple Helix theory, an effective operational mechanism needs to break traditional boundaries and form an "overlapping" spiral innovation space.

4.1. Organizational Synergy and Governance Innovation

"Double-High Synergy Innovation" has established a "province-city-zone-university" multi-level working mechanism, jointly promoted by multiple departments such as the Provincial Department of Science and Technology and the Department of Education. This is not merely a list of departments but an innovation in governance structure. It breaks traditional departmental fragmentation through top-level design, providing institutional channels for information communication, resource coordination, and joint decision-making among the three parties. The implemented "pilot-summary-promotion" model is a dynamic, learning-oriented policy process. It accumulates practical experience through limited pilots and transforms this experience into transferable knowledge through systematic summarization. Ultimately, it achieves comprehensive policy optimization and effective diffusion, serving as a vivid example of adaptive governance in modern science and technology innovation.

4.2. Platform Co-construction and Hybrid Organization Generation

Building on organizational governance, the focus then shifts to the platforms and hybrid organizations that operationalize the Triple Helix model. Supporting the co-construction of concept verification centers, pilot-test platforms, and joint laboratories is a typical manifestation of the tripartite "overlap." These hybrid organizations, serving as physical spaces and institutional interfaces for innovation, effectively blur the boundaries between universities, industry, and government, becoming core carriers for knowledge transformation, technology tackling, and talent aggregation. They are not only platforms for resource sharing but also "innovation enclaves" that catalyze new rules, cultures, and capabilities.

4.3. Project-Driven Collaboration and Achievement Transformation

Centering on industrial demands, the joint tackling model of "enterprises posing problems, universities solving them" and the relay mechanism of "university science park incubation + high-tech zone transformation" are promoted. This mechanism translates the interaction of the three parties into concrete projects, providing a clear focus for collaboration. The supporting financial system (angel funds, S funds, science and technology insurance, etc.) provides capital assistance throughout the project lifecycle, forming a virtuous cycle of "project-capital-policy" and ensuring that collaboration addresses industrial challenges and produces measurable outcomes.

4.4. Talent Flow and Role-Playing

Talent is the core element of innovation. "Double-High Synergy Innovation" actively promotes talent co-cultivation and two-way flow through various methods. Dual-appointment mechanisms such as the "Double Training Plan," "Science & Technology Vice President," and "Industry Professor" are vivid manifestations of "role-playing." University faculty entering enterprises act as "innovation engineers," while corporate experts entering the classroom serve as "practical mentors." This institutionalized two-way flow of talent not only transfers explicit knowledge but also promotes the integration of tacit knowledge, thinking modes, and innovation culture, representing the most dynamic dimension of Triple Helix collaboration.

5. The Constraint Mechanism of "Double-High Synergy Innovation"

As universities, industry, and government possess different institutional logics and value orientations, collaborative innovation can potentially cause institutional friction. The constraint mechanism aims to effectively circumvent potential institutional friction and ensure that "Double-High Synergy Innovation" operates efficiently on its intended track.

5.1. Institutional Constraints through Clear Definition of Responsibilities and Rights

Issuing a series of documents such as implementation opinions, policy guidelines, and reform guides clearly defines the division of responsibilities and reform boundaries for each actor. This clear delineation of responsibilities and rights itself constitutes a fundamental constraint, avoiding ambiguity and buck-passing, and providing stable rule expectations for collaborative interaction.

5.2. Process Constraints through Strengthened In-Process Management and Risk Control

"Double-High Synergy Innovation" sets clear task lists and reform paths, which provide the basis for in-process management and supervision. The "dual-track advancement" model of policy and reform, wherein the 24-item "Policy Guide List" provides currently actionable measures and the 15-item "Reform Guide List" focuses on future exploratory reforms, makes the reform process controllable, achieving a balance

between exploratory reform and risk control, ensuring that innovation does not cross boundaries and exploration does not lose its way *(Xinhua Daily, 2025, "Two Lists Precisely Boost 'Double-High Synergy Innovation")*.

5.3. Outcome Constraints through Key Node Performance Evaluation and Incentives

Linking collaboration outcomes directly with valuable policy resources, financial support, and academic honors. For example, incorporating the effectiveness of "Double-High Synergy Innovation" as an important indicator in the evaluation of provincial universities and key laboratory performance evaluations; conducting special assessments upon the expiration of the pilot period, with results directly linked to subsequent support. This "rewarding excellence" mechanism creates a powerful positive constraint, driving pilot units to promote work pragmatically and efficiently, achieving incentive compatibility.

6. Conclusion and Outlook

Based on a qualitative analysis of the policy texts of Jiangsu's "Double-High Synergy Innovation," this paper systematically analyzed its management mechanism within the Triple Helix theoretical framework. The research shows that "Double-High Synergy Innovation" activates the three main actors through a composite dynamic system, achieves deep interaction through generating "hybrid organizations" and promoting "role-playing," and safeguards collaborative effectiveness through an embedded constraint system, vividly exemplifying the Sinicized practice of the Triple Helix theory. Its dynamic mechanism activates the willingness of all parties to participate; the operational mechanism translates this willingness into concrete organizations and actions; and the constraint mechanism ensures that actions operate efficiently on a controllable track, with feedback in turn optimizing policies (dynamics) and adjusting operational modes.

Theoretically, "Double-High Synergy Innovation" highlights that within a strong-government context, the government plays a more critical role as the "architect" and "initial driving force" during the initiation and shaping stages of the Triple Helix model, enriching the understanding of the Triple Helix formation path. The model of "organized research + organized transformation" provides a new paradigm for understanding how the government strategically and systematically constructs an innovation ecosystem.

Practically, "Double-High Synergy Innovation" constructs a set of institutional arrangements that make universities, industry, and government "incentive compatible, action synergistic, and risk sharing." Its experience holds significant reference value for other regions seeking to promote deep industry-university-research integration.

Potential risks and challenges: Excessively strong policy drive may lead to path dependence, weakening the market's endogenous collaborative drive; complex assessments may induce formalism of "collaboration for collaboration's sake"; furthermore, the inherent logical conflicts among universities (academic freedom), industry (business secrets), and government (administrative procedures) may become prominent in deeper reforms, requiring continuous debugging and improvement in practice regarding detailed issues such as intellectual property ownership and benefit distribution.

Research limitations and future directions: This paper is primarily based on policy text analysis, constituting preliminary theoretical exploration. Future research could select one or two typical paired cases of "high-tech zone - university" to empirically test the effectiveness of the aforementioned mechanisms through in-depth interviews and participatory observation.

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