

Korea's Industrial Technology Research Association: An Open Innovation Platform for Industry-Academia- Research Cooperation and Policy Learning

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Abstract This study analyzes Korea's Industrial Technology Research Association (ITRA) as a unique institutional platform for open innovation. Addressing rising R&D costs and SME entry barriers, ITRA bridges the "Valley of Death" by pooling resources and fostering trust. This paper makes a distinct contribution to the STI policy debate by conceptualizing ITRA as an "ambidextrous platform" that uniquely integrates efficiency-focused "Cooperative Research" and synergy-oriented "Collaborative Research." While prior studies often view these as separate stages, we argue that ITRA enables a dynamic transition between them through its industry-led governance. Empirical evidence from diverse industries, analyzed through a comparative framework of governance and IP regimes against US, German, and Japanese models, demonstrates the uniqueness of the Korean approach. The study concludes that ITRA offers valuable policy lessons for nations seeking to strengthen innovation ecosystems by balancing efficiency and creativity.

Keywords Industrial Technology Research Association (ITRA), Open Innovation, Ambidextrous Platform, Industry-Academia-Research Collaboration, Cooperative vs. Collaborative Research

I. Introduction: Innovation Challenges in the Era of Open Knowledge

1. The Paradigm Shift to Open Innovation

The global economy of the 21st century is undergoing a fundamental shift from a growth model based on labor and capital inputs to a knowledge-based paradigm where knowledge and technology are the primary sources of value

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creation. In this environment, the competitiveness of firms and nations increasingly depends on the ability to sustain innovation amid complexity, rapid technological convergence, and accelerated knowledge diffusion. For a significant period of the industrial era, the dominant innovation model was “Closed Innovation,” characterized by vertically integrated R&D, internal technology development, and proprietary commercialization. While effective in relatively stable environments, this model has become unsustainable in the current era characterized by shortened technology life cycles, surging R&D costs, and the globalization of knowledge flows. As Henry Chesbrough (2003) argued, “Open Innovation,” which intentionally utilizes knowledge inflows and outflows to accelerate internal innovation and expand external markets, is emerging as a more viable strategy.

2. SME Challenges and the “Valley of Death”

These challenges are particularly acute for small and medium-sized enterprises (SMEs). Compared to large corporations, SMEs face severe resource constraints in terms of funding, research infrastructure, and human capital. These limitations not only hinder their ability to perform advanced R&D but also exacerbate the “Valley of Death” phenomenon, where promising research results fail to lead to commercialization due to a lack of funding, technical difficulties, and market entry barriers. The failure of SMEs to bridge this gap leads to a significant loss of potentially valuable technologies, consequently weakening national innovation capabilities.

3. Purpose of Study: The ITRA Solution

In response, joint research has emerged as a strategic solution to pool resources, distribute risks, and access complementary knowledge. However, existing literature often dichotomizes joint research into cost-sharing or knowledge-creating activities. This study advances the debate by proposing an “ambidextrous” framework where Korea’s Industrial Technology Research Association (ITRA) system functions simultaneously as a mechanism for “Cooperative Research” (efficiency/exploitation) and “Collaborative Research” (synergy/exploration).

Methodologically, this study adopts a qualitative case study approach. We analyzed government documents, legal statutes (specifically the Industrial Technology Research Cooperatives Support Act), and secondary data to examine the institutional evolution of ITRA. Furthermore, we selected representative cases from the steel, pharmaceutical, and machinery sectors to provide empirical evidence of how this platform facilitates the transition from

passive cooperation to active collaboration. This paper highlights how institutional design can lower transaction costs and cultivate social capital, offering a novel perspective on intermediary organizations in national innovation systems.

II. Theoretical Basis of Joint Research: Dual Models of Open Innovation and Cooperation

1. Defining Open Innovation and Joint Research

The concept of Open Innovation has become a core paradigm in Science, Technology, and Innovation (STI) policy. Unlike the closed model that relies entirely on internal R&D, open innovation emphasizes accelerating the innovation process by breaking down organizational boundaries to enable knowledge inflows and outflows. Its core principles include collaboration, external inputs, knowledge sharing, shared risk-taking, and customer-centric development. Conceptually, open innovation can be classified into three types: “Inbound (Outside-in),” “Outbound (Inside-out),” and “Coupled” innovation. The coupled approach is particularly suitable for industry-academia-research cooperation as it facilitates both the exploitation of existing knowledge and the exploration of new technological opportunities.

2. Cooperative vs. Collaborative Research

While the term “joint research” broadly refers to R&D conducted by two or more entities, the intensity and mode of interaction among participants can vary widely. Drawing on the framework of collaboration modes such as those proposed by Pisano and Verganti (2008), this paper distinguishes two ideal types of joint research to clarify the ITRA’s dual functions.

First, “Cooperative Research” is an efficiency-oriented model based on the division of labor. In this model, tasks are partitioned, and each participant contributes relatively independently. Interaction is limited to the coordination and integration of results. The objective is to reduce costs, avoid duplication, and spread risks, producing results equivalent to the “sum of the parts” ($1+1=2$). This mode is effective for solving well-defined problems where the path to the solution is relatively clear.

Second, “Collaborative Research” is a synergy-oriented model based on deep interdependence. In this approach, participants jointly define problems and co-create knowledge through continuous interaction. Trust, shared norms, and

relational governance are essential. The expected outcome is performance “greater than the sum of the parts” ($1+1>2$), which is particularly suitable for high-uncertainty or exploratory R&D tasks requiring innovative breakthroughs.

Table 1. Comparative Features of Cooperative and Collaborative Research Models

Feature	Cooperative Research	Collaborative Research
Primary Goal	Efficiency, Cost/Risk Sharing	Synergy, Innovative Breakthroughs
Task Structure	Partitioned, Independent Sub-tasks	Interdependent, Jointly Executed
Interaction Level	Low, Sporadic	High, Continuous
Knowledge Process	Aggregation of Existing Knowledge	Co-creation of New Knowledge
Governing Mechanism	Formal Contracts, Clear Deliverables	Trust, Shared Norms, Relational
Expected Outcome	Sum of Parts ($1+1=2$)	Greater than Sum of Parts ($1+1>2$)

3. The Ambidextrous Institutional Platform

Neither of these two models is universally superior. Instead, the effectiveness of joint research depends on the nature of the technical challenge. According to the organizational ambidexterity literature, innovation systems must integrate both exploitation (cooperation) and exploration (collaboration) to achieve long-term sustainability. We apply this concept to the inter-organizational level, positing that ITRA serves as an “Ambidextrous Institutional Platform.” Unlike rigid consortia, ITRA’s flexible legal structure allows it to evolve from a cost-sharing body into a co-creation ecosystem, addressing a critical gap in static innovation policy models.

III. Korea’s Approach: Institutional Analysis of the ITRA System

1. Legal Basis and Institutional Characteristics

Korea’s ITRA was introduced as a strategic response to global technology protectionism and intensifying international competition in the mid-1980s. Recognizing that no single company, particularly SMEs, could independently develop or acquire advanced technologies, the government enacted the “Industrial Technology Research Cooperatives Support Act” in 1986. The Act

endowed ITRA with three decisive institutional characteristics. First, ITRA possesses “Legal Personality and Neutrality” as a non-profit corporation with independent status, allowing it to act as a neutral intermediary among diverse member companies. Second, it features “Inclusive Governance,” where membership is voluntary, voting rights are equal, and activities are directed toward the collective interests of participants rather than individual firms. Third, it carries a broad mandate encompassing not only joint R&D but also technology transfer, education and training, joint utilization of equipment, and the joint acquisition of advanced technologies.

Since its inception, more than 160 associations have been established, with approximately 80 actively operating as of 2025. This scale underscores the institutionalization of ITRAs as a core mechanism within Korea’s innovation system.

2. Governance and Intermediary Role

ITRA occupies a central position as an intermediary organization connecting industry, academia, research institutes, and the government. Unlike the US university-led model or the German Fraunhofer model of specialized research institutions, the Korean system is explicitly “Industry-led.” Companies initiate associations centered on shared technological challenges, with universities or public research institutes participating as partners. ITRA’s intermediary role manifests in three ways: “Strategic Coordination,” designing and managing large-scale projects beyond individual firm capabilities; “Interest Alignment,” balancing diverse incentives among large enterprises, SMEs, universities, and government agencies; and “Capacity Building,” serving as a hub for knowledge exchange, technology development, and industrial ecosystem formation.

3. Government Support Mechanisms

The sustainability of ITRA has been reinforced by multi-layered government support mechanisms. Financial incentives include direct project funding, preferential access to industrial development funds, and commercialization grants. Tax benefits include tax credits for member contributions and VAT exemptions for internal R&D. Furthermore, market access is secured through preferential public procurement for products developed via ITRA projects and tailored commercialization support programs. These policy instruments reduce the risks of collaborative R&D, encourage SME participation, and address structural barriers hindering successful cooperative ventures. Crucially, this signals the state’s strong commitment to maintaining a collaborative platform, which is an essential element for building trust among participants.

IV. Operating Principles of the ITRA System

1. Pooling Resources for Efficiency

At the most fundamental level, ITRA functions as an efficient platform for cooperative research. By pooling resources, member companies, particularly SMEs, gain access to cutting-edge equipment and technological infrastructure that would be unaffordable individually. Joint investment also reduces individual firms' financial exposure and spreads the risks associated with uncertain or costly projects. This structural design directly addresses one of the most persistent barriers in innovation systems: the inability of small actors to bear the costs and risks of advanced R&D. Through this, ITRA institutionalizes efficiency gains and creates broad incentives for participation across the industrial ecosystem.

2. Fostering Trust for Collaboration

Beyond cost sharing, ITRA's unique value lies in fostering collaborative research. Regular exchanges such as workshops, joint seminars, and technical conferences generate iterative interactions, gradually building mutual trust and psychological safety among participants. Within this neutral organizational environment, competitive tensions are mitigated, and knowledge is shared more freely. This social process transforms ITRA into an incubator for collaboration, enabling the generation of collective intelligence through continuous interaction. This dynamic is particularly advantageous for exploratory R&D tasks requiring problem-solving that transcends uncertainty and organizational boundaries.

3. Dynamic Transition Mechanism

Perhaps ITRA's most sophisticated function is its ability to enable a natural transition from cooperation to collaboration. Initially, companies often join associations to obtain tangible cooperative benefits such as cost reduction or access to shared facilities (Exploitation). However, as iterative interactions build trust capital, relationships evolve. Participants begin to transcend rigid task divisions, jointly exploring opportunities, and co-creating solutions unforeseen in the original project design (Exploration). This transition demonstrates how institutional design can lower transaction costs for collaboration and facilitate "ambidextrous" innovation capabilities. From a policy perspective, ITRA functions as a catalyst that cultivates collaboration from cooperation, yielding innovation outcomes greater than the "sum of the parts."

V. Empirical Effects and Comparative Analysis

1. Sector-Specific Case Studies

The effectiveness of the ITRA model is best demonstrated through empirical achievements across various industrial sectors. We selected representative cases to illustrate different modes of value creation.

First, the “Iron and Steel Fusion Technology Research Association” serves as a best practice for vertical integration between large enterprises and SMEs. This association supported the joint development of application technologies for high-performance steel materials between large corporations like POSCO and SMEs. This collaboration resulted in significant new sales and strengthened integration across the value chain, demonstrating ITRA’s capacity to coordinate interests among diverse market players.

Second, the “Agricultural PO Film Research Association” addressed the strategic need for technological sovereignty. By bringing together three film manufacturers and the Rural Development Administration (RDA), this association succeeded in reducing dependence on Japanese imports by developing domestic high-performance agricultural films. This case highlights ITRA’s role in promoting import substitution and strengthening national technological capabilities.

Third, the “Korea Drug Research Association (KDRA)” exemplifies ITRA’s role as an innovation broker in the pharmaceutical and bio-health sectors. By supporting the entire life cycle of new drug development, KDRA has fostered an open innovation ecosystem encompassing pharmaceutical companies, universities, hospitals, and investors. Through initiatives like the “InterBiz Forum” and technology transfer programs, this association has successfully functioned as a platform for ecosystem building.

Fourth, the “Machinery Convergence Technology Research Association” facilitated SME-led innovation in advanced research equipment. This association supported the development and successful commercialization of Field Emission Scanning Electron Microscopes (FE-SEM), contributing to import substitution and dramatically improving the technological prowess of participating SMEs.

Table 2. Representative Success Cases of Korean ITRAs

ITRA Name	Industry	Key Participants	Core R&D Goal	Major Outcome	Policy Implications
Iron & Steel Fusion	Steel Materials	POSCO, SMEs, POSTECH	High-performance steel applications	New products, SME sales growth	Large-small firm integration
Agricultural PO Film	Functional Film	3 film makers, RDA	Domestic independence from imports	High-performance PO film	Strategic technology sovereignty
KDRA	Pharma/Bio	Pharma firms, Universities, Hospitals	New drug development ecosystem	InterBiz Forum, Tech transfer	Innovation brokerage, ecosystem building
Machinery Convergence	Equipment/Parts	SMEs, KAMI	Domestic FE-SEM development	Successful commercialization	SME capability enhancement, import substitution
Nuclear I&C	Nuclear Decommissioning	KHNP, SMEs, Universities	Core decommissioning tech	Tech localization, Seminars	Preemptive response to emerging industries

2. International Comparison

To clarify the Korean model’s distinctiveness, we compare it with major global models using four criteria: Governance Structure, IP Regime, Demand Orientation, and Intermediary Role.

The United States model is largely defined by the Bayh-Dole Act and Technology Licensing Offices (TLOs). This system represents a strong technology-push approach led by universities, focusing on IP commercialization and startup creation. While effective for leveraging academic research, it may lack the direct industry demand orientation found in consortium models.

The German innovation system relies heavily on Fraunhofer Institutes and the AiF (German Federation of Industrial Research Associations). The Fraunhofer model functions as a dedicated intermediary for applied contract research and is strongly integrated with industry needs. However, as specialized institutions, they may offer less flexibility for direct governance participation by SMEs compared to the participatory nature of Korea’s ITRA.

Japan has historically utilized “Technology Research Associations” (TRA). However, following the 2009 reform, Japan transitioned toward “Collaborative Innovation Partnerships (CIPs),” which allow for conversion into joint stock companies to promote commercialization. While Japan moves towards

corporate structures, Korea retains the strength of non-profit, collective governance supported by the state.

A comparative perspective reveals the uniqueness of the ITRA model in three dimensions. First, it features industry-led governance that starts from market demand. Second, it utilizes a collaborative governance structure where companies directly participate rather than outsourcing to a separate agency. Third, it possesses dual functionality, supporting both catch-up efficiency and first-mover innovation. This hybrid nature makes ITRA a powerful institutional tool balancing short-term efficiency and long-term dynamism.

VI. Policy Suggestions for Enhancing Cooperation and Future Directions

1. Structural Limitations

Despite its achievements, the ITRA system faces structural limitations. First, the Industrial Technology Research Cooperatives Support Act strictly defines ITRAs as non-profit entities. Consequently, key elements of modern innovation policy, such as direct profit-generating commercialization, spin-offs, and aggressive IP monetization, are constrained compared to Japan's CIP model. Second, data indicate a bifurcation where active associations thrive, but a significant number remain "dormant" or inactive after government project funding expires, revealing a dependency on state support rather than self-sustaining business models.

2. Evolving into Ecosystem Builders

To overcome these limits, ITRA must evolve from a simple R&D consortium into an "Ecosystem Builder." Recent cases, such as the "White Bio Circular Economy Technology Research Association," demonstrate this potential. By mobilizing actors across the value chain, including raw material suppliers such as SKC and CJ as well as manufacturing and distribution companies such as Starbucks and CU, ITRA can lead the development of future strategic industries. Policy frameworks should be updated to explicitly support such ecosystem-building functions that go beyond the role of merely executing R&D.

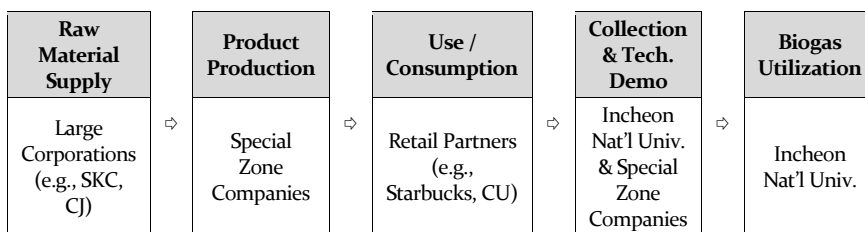


Figure 1. The Value Chain of the White Bio Circular Economy Research Association

3. Institutional Reform and Policy Recommendations

Drawing on the comparative analysis, particularly Japan’s 2009 CIP reforms, we propose several directions for improvement. First, the Act should be revised to allow successful ITRAs to convert into for-profit entities or establish commercial subsidiaries, thereby accelerating technology transfer and enabling the creation of a sustainable revenue model. Second, governance procedures related to dissolution and restructuring should be made more flexible in order to reduce the number of dormant associations and to support the dynamic recombination of members according to market needs. Third, the legal scope of ITRA activities should be expanded to explicitly include ecosystem activation functions such as regulatory sandboxes and talent development. Finally, standardized IP agreements and strengthened roles for Technology Licensing Offices (TLOs) are necessary to minimize conflicts and facilitate efficient technology transfer.

VII. Conclusion: ITRA as a Global Benchmark for Collaborative Innovation Policy

This study has reconceptualized Korea’s Industrial Technology Research Association not merely as an R&D funding recipient but as an “ambidextrous institutional platform” capable of balancing cooperative efficiency and collaborative synergy. By lowering transaction costs, pooling resources, and cultivating trust-based relationships, the ITRA system supports companies, especially SMEs, in overcoming structural barriers like the Valley of Death and co-creating new technological value.

The empirical cases reviewed demonstrate that ITRA contributes not only to supporting industrial competitiveness but also to broader policy goals including SME advancement, strategic technological independence, and ecosystem formation. Comparative analysis highlights the distinct “industry-led, non-profit,

collective” nature of the Korean model. For policymakers worldwide, the Korean ITRA model offers a compelling benchmark. It demonstrates how institutional arrangements can systematically cultivate trust, align diverse actors, and create an ecosystem that sustains both exploitation and exploration. In this sense, ITRA represents a policy innovation that extends beyond a Korean success story to offer global implications for nations seeking to strengthen their innovation systems in the 21st century.

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