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FROM KNOWLEDGE TO INDUSTRY: SOUTH KOREA'S UNIVERSITY–INDUSTRY COLLABORATION MODELS AND THEIR IMPLICATIONS FOR TECHNOLOGY-DRIVEN TRANSFORMATION IN THE ELECTRONICS SECTOR OF SRI LANKA

ALAK Ranaweera[1]

Abstract

South Korea's transformation from a technology imitator into a global leader in the electronics industry was underpinned by mission-oriented university–industry collaboration (UIC) integrated into national innovation policy. The objective of this study is to analyse South Korea's UIC models, particularly the mechanisms that facilitated knowledge transfer, commercialisation, and industrial upgrading and to assess their applicability to Sri Lanka's electronics sector. Methodologically, this study adopts a desk-based, qualitative approach, synthesising secondary data from peer-reviewed literature, policy documents, institutional reports, and case studies of leading Korean universities and electronics companies. A comparative lens is applied to examine similarities and divergences between the Korean and Sri Lankan contexts, with attention to policy alignment, institutional capacity, and industrial needs. The findings highlight five core enablers of South Korea's UIC success: (1) targeted government funding and long-horizon R&D programs; (2) problem-driven consortia linking universities, firms, and public agencies; (3) university-led innovation cluster development supported by science parks and shared infrastructure; (4) human-capital pipelines through curriculum–industry alignment, internships, and co-op placements; and (5) professionalized technology-transfer systems with standardized IP management and revenue sharing. In contrast, Sri Lanka's UIC landscape is characterised by fragmented policy support, limited industry engagement, weak commercialisation pathways, and underdeveloped technology-transfer offices. The analysis suggests that adapting Korea's integrated, ecosystem-based approach could strengthen Sri Lanka's capacity for innovation-driven growth in electronics. Recommended strategies include the establishment of problem-driven research consortia, investment in shared testing and certification facilities, standardised IP frameworks, and expanded co-op programs to bridge skill gaps. Additionally, aligning UIC initiatives with national priority niches and regional market demands, such as power electronics, embedded systems, IoT applications, and EMS upgrading, could create scalable pathways for industrial advancement. Ultimately, adapting South Korea's UIC models can help Sri Lanka strengthen university–industry ties, boost commercialisation, and build a sustainable, export-driven electronics sector.

Keywords: Cluster-Based Innovation, National Innovation Policy, Technology Commercialisation, Technology Transfer Offices (TTOs), University-Industry Collaboration (UIC)

[1]Department of Physics and Electronics, University of Kelaniya, Sri Lanka.

Email: arunaran@kln.ac.lk https://orcid.org/0000-0002-0830-2244

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Introduction

University-industry collaboration (UIC) has emerged as a critical factor in fostering national innovation ecosystems, especially within high-technology industries such as electronics. South Korea, often cited as a success story, demonstrates how systematic linkages between universities and industries can fuel technological advancement, industrial competitiveness, and sustained economic growth. South Korea's electronics industry serves as a benchmark example of how well-structured university–industry linkages can transform a nation's industrial landscape through innovation-driven growth. Over the past decades, the country has successfully transitioned from a technology imitator to a global innovation leader, driven largely by policies promoting R&D partnerships, collaborative innovation ecosystems, and commercialisation-oriented academic reforms (Jaramillo & Kim, 2024).

Some studies (Shvetsova & Lee, 2021; Jee & Hötte, 2024; Yi et al., 2004) highlight that South Korea's electronics sector owes its success to tightly integrated university–industry cooperation frameworks, including living labs, government-sponsored innovation programs, and demand-driven educational models such as the LG-HGU (LG Electronics – Handong Global University) partnership. These initiatives cultivated a culture of mutual reinforcement between academia and industry, accelerating knowledge transfer and commercialisation activities.

In contrast, Sri Lanka's experience with university–industry collaboration remains nascent. Despite efforts such as the establishment of University Business Linkage Cells in state universities and policy-level interventions (Larsen et al., 2016; Abeytunga et al, 2023), UIC activities remain sporadic and under-optimised. Challenges include limited private sector participation, fragmented policy support, and weak institutional capacities for research commercialisation (Weerasinghe & Jayawardane, 2018; Randil et al., 2018). While the electronics sector in Sri Lanka holds significant growth potential, it requires targeted strategies to emulate the success seen in models such as South Korea's.

Research Problem

Despite Sri Lanka's growing interest in strengthening university–industry linkages to drive industrial innovation, the country lacks a cohesive strategy specifically tailored to the electronics industry. Without clear adaptation of proven international models, Sri Lanka risks lagging in its efforts to develop a globally competitive electronics industry. A systematic understanding of successful international models and their localisation potential is urgently needed.

Objectives of the Study

This study seeks to:

- Analyse key university–industry collaboration models in South Korea's electronics industry.
- Assess the applicability of these models to Sri Lanka's emerging electronics sector.
- Identify enablers, barriers, and strategic pathways for strengthening UIC in Sri Lanka.
- Offer policy and institutional recommendations to facilitate sustainable university–industry linkages.

Methodology and Research Design

Research Design: This study adopts a qualitative, exploratory, and comparative research design, grounded in secondary data analysis. The goal is to analyse South Korea's university–industry collaboration (UIC) frameworks and extract actionable insights to inform the development of Sri Lanka's electronics industry. The research is non-experimental and relies on document and content analysis techniques to interpret existing literature, policy documents, institutional reports, and case studies.

Research Strategy: The secondary research employs a content analysis, focusing on South Korea as a benchmark for successful UIC and Sri Lanka as a developing country's context with emerging initiatives. This strategy enables an in-depth analysis of institutional structures, policy mechanisms, and sectoral dynamics that characterise UIC in both countries. The study is descriptive and interpretative in nature, aimed at identifying best practices and contextual applicability.

Data Sources and Population

The study relies entirely on secondary data sources drawn from:

- Peer-reviewed journal articles
- Government and intergovernmental policy reports (e.g., World Bank, Science and Technology Policy Institute (STEPI) of Korea, Sri Lanka Ministry of Higher Education)
- Institutional reports and white papers (e.g., from Korean universities, University Business Linkage Cells (UBLC) in Sri Lanka, National Innovation Agency (NIA) reports, and the World Bank Group)
- Conference proceedings and case studies

The population of data consists of academic literature, policy documents, government reports and case studies relevant to university–industry collaboration models in South Korea, the development of South Korea's electronics industry, and university–industry collaboration practices in Sri Lanka, which were published over the past 20 years (2004–2024).

Sampling Techniques

A purposive sampling technique was employed to select a focused subset of highly relevant, credible, and recent sources. Selected documents primarily originate from peer-reviewed journals, international organisations (such as the World Bank), government publications, and established academic publishers. Key inclusion criteria include:

- Relevance to the electronics industry, innovation, and university–industry collaboration (UIC)
- Regional relevance (South Korea or Sri Lanka)
- Credibility of source (peer-reviewed or institutional)
- Recency and Influence (e.g., highly cited or used in policy formulation)
- (Published between 2004 and 2024, ensuring up-to-date findings.)

Exclusion criteria included outdated reports (published before 2004), non-English materials (unless translated), and opinion-based articles lacking empirical support.

Analytical Techniques and Tools

The collected secondary data were subjected to qualitative content analysis, using thematic coding to identify patterns and contrasts across cases. The main analytical steps included:

1. Document coding: Systematic coding of documents for themes such as policy instruments, institutional mechanisms, success factors, and barriers.
2. Comparative matrix development: Juxtaposing UIC models in South Korea and Sri Lanka to identify structural and functional gaps.
3. Pattern matching: Comparing observed UIC features in South Korea with potential or emerging practices in Sri Lanka.
4. Contextual inference: Drawing implications for policy adaptation, scalability, and sectoral alignment in Sri Lanka's electronics industry.

Given the qualitative and document-based nature of this research, a combination of AI software tools and analytical frameworks was employed to systematically extract, organise, and interpret secondary data. These tools were selected to facilitate thematic categorisation, comparative evaluation, and insight generation relevant to the research objectives.

Results and Discussion

Key Features of South Korea's UIC Model in the Electronics Sector

The analysis reveals that South Korea's success in developing a globally competitive electronics industry is deeply tied to a robust and strategic approach to university–industry collaboration. It is characterised by strong government coordination, demand-driven academic reform, and strategically embedded R&D partnerships. According to (Kim and Lee, 2006), the transformation of higher education in South Korea, particularly under a state-guided yet market-responsive paradigm, laid the foundation for long-term innovation capacity. Public universities were not only encouraged to engage with industry but were also structurally reoriented to prioritise knowledge commercialisation.

Lee et al. (2022) further demonstrate how South Korea progressed from "implementation capability" to "design capability," underlining the role of university research in moving beyond imitation toward frontier innovation. This evolution was supported by policies that incentivised collaborative R&D between universities and industries, with institutions like the Science and Technology Policy Institute (STEPI) playing a critical policy advisory role.

Living labs, highlighted by Shvetsova and Lee (2021), have become a critical tool within Korea's innovation ecosystem. They serve as testbeds for co-creation, integrating academia, local governments, and corporations to develop, test, and scale new technologies, particularly in electronics and ICT sectors.

Moreover, the LG-HGU partnership represents a prototypical model of demand-driven educational collaboration. As documented by Yi et al. (2004), this model emphasises curriculum co-development, internship integration, and guaranteed employment pipelines, practices that directly align academic training with industry needs. Jaramillo and Kim (2024) stress that Korea's large-scale public R&D investment, particularly during periods of economic restructuring, created a "demand pull" effect that forced universities to respond to real-time industrial needs. This proactive alignment, unlike passive research publication models, ensured that universities became central actors in the innovation value chain.

The following are the critical factors that were identified as the building blocks in the success story of South Korea in the context of the UIC model. South Korea's remarkable transformation into a global technology leader has been underpinned by a set of carefully designed and interlinked university–industry collaboration (UIC) mechanisms. These building blocks—spanning governance, institutions, funding, structured programs, clusters, commercialisation mechanisms, and talent development- offer critical insights for other late-industrialising economies**.**

- **Government-driven policy frameworks and mission-oriented governance.**

  The South Korean government has played a central role in shaping UIC through mission-oriented governance structures. Ministries such as the Ministry of Science and ICT (MSIT) and the Ministry of Trade, Industry and Energy (MOTIE) formulate long-term technology roadmaps, while specialised agencies, including the Korea Institute for Advancement of Technology (KIAT) and the

Korea Evaluation Institute of Industrial Technology (KEIT), operationalise industry-linked R&D programs. Intellectual property regimes are harmonised by the Korean Intellectual Property Office (KIPO), and local governments strengthen regional ecosystems through science parks, incubation facilities, and testing centres. Programs such as the Brain Korea 21 (BK21) Project and the Industrial Technology Research Program incentivised universities to align research outputs with national industrial needs (Japan Science and Technology Agency & Asia and Pacific Research Centre, 2024).

- **Flagship laboratories and universities.**

Nationally recognised institutions, including the Electronics and Telecommunications Research Institute (ETRI), Korea Advanced Institute of Science and Technology (KAIST), Pohang Institute of Science and Technology (POSTECH), Seoul National University (SNU), and Yonsei University, anchor South Korea's UIC landscape. These institutions serve as platforms for consortium-based research, where large conglomerates (chaebol) and SMEs collaborate on frontier technologies ranging from semiconductors to telecommunications.

- **Stable multi-year funding mechanisms.**

Long-horizon funding commitments typically spanning three to seven years enable risk-taking, prototyping, and commercialisation while ensuring accountability through milestone-based evaluation.

- **Structured UIC programs.**

Initiatives such as the Leaders in Industry–University Cooperation (LINC, LINC+, LINC 3.0) institutionalised collaboration by embedding industry needs into university curricula, capstone projects, and technology transfer practices. Complementary programs like BK21 created a pipeline of highly skilled researchers, while the professionalisation of Technology Transfer Offices (TTOs) standardised IP policies, revenue-sharing mechanisms, and proof-of-concept (PoC) funding, thereby accelerating commercialisation (Sohn & Kenney, 2006).

- **Cluster model and shared infrastructure.**

Regional science and technology clusters, including Daedeok Innopolis, Pangyo Techno Valley, and the Gumi Electronics Cluster, facilitate the co-location of universities, firms, and venture capital. These clusters provide incubation, metrology labs, pilot production lines, and certification services, while value-chain-specific consortia (e.g., in displays, materials, RF/analogue, and batteries) further embed collaborative R&D across SMEs and OEMs (Lee, 2018).

- **Market-shaping instruments and commercialisation efforts.**

Policy tools such as public procurement, standards-setting, tax incentives, and SME matching grants created early domestic demand for emerging technologies, while export support via the Korea Trade Investment Promotion Agency (KOTRA) expanded global reach. Universities also advanced commercialisation through bundled IP portfolios, licensing templates, spin-off facilitation, and venture funding linkages (Shvetsova & Lee, 2021).

- **Talent pipelines and education–industry alignment.**

Human capital development was tightly coupled with industrial needs. Models such as the LG–Handong Global University partnership restructured curricula to match electronics-sector skill requirements. Co-op placements, adjunct professors from industry, and challenge-based learning created a steady supply of industry-ready graduates. Maker spaces, campus pilot deployments, and living lab models fostered real-world problem solving and open innovation.

Sri Lanka's Electronics Sector and Its Structural Gaps in the UIC Landscape

Sri Lanka's electronics industry demonstrates strengths in electronic manufacturing services (EMS) and assembly, cable and harness production, testing and quality assurance, and niche IoT applications. However, the sector remains underdeveloped in high-volume component manufacturing and advanced packaging. Key constraints include limited domestic demand, financing gaps between prototype development and pilot-scale production, fragmented university engagement, and underdeveloped technology transfer office (TTO) capacity.

Sri Lanka's approach to UIC is fragmented and still in its developmental phase. While there have been national efforts to institutionalise UIC, such as the introduction of University Business Linkage (UBL) Cells (Larsen et al., 2016), their implementation remains inconsistent and poorly resourced. Abeythunga et. al. (2023) note that although research output has increased in Sri Lankan universities, much of it remains theoretical or disconnected from industrial application. This disconnect is compounded by weak incentives for faculty-industry collaboration, limited funding mechanisms, and an absence of structured research commercialisation pathways.

Weerasinghe and Jayawardane (2018) emphasise that university–industry partnerships in Sri Lanka are often personality-driven rather than system-driven. Without a national framework to support long-term collaboration, many projects lack sustainability or scale. The electronics sector specifically suffers from limited institutional clustering and weak industry demand for research partnerships. Wijesinghe (2020) notes that while the ICT sector has shown signs of engagement with universities, the electronics sector lags due to smaller firm sizes, limited R&D budgets, and lower absorptive capacity.

Within this context, targeted university–industry collaboration (UIC) initiatives could create a measurable impact over the long horizon in several strategic areas. Power electronics presents opportunities in inverters, motor drives, EV chargers, solar micro-inverters, and grid-edge devices. Embedded systems and IoT applications span low-power sensor nodes for agriculture (e.g., post-harvest cold chain monitoring), health diagnostics, and environmental early-warning systems. Testing, measurement, and reliability services—including calibration labs, electromagnetic compatibility (EMC) and electrostatic discharge (ESD) testing, and HALT/HASS protocols—can support the upgrading of EMS exporters. Finally, design-for-manufacture (DFM) services, encompassing PCB optimisation, firmware hardening, and certification preparation (CE, FCC), would enable local firms to move up the value chain and enhance competitiveness. These opportunity wedges demonstrate that a focused, well-coordinated UIC agenda can leverage existing industrial strengths while addressing critical gaps, creating pathways for accelerated technological upgrading and innovation-driven growth in Sri Lanka's electronics sector.

Overall, the following are the key challenges identified in the systematic review.

- **Fragmented Policy Support:** While initiatives exist, such as those outlined in the World Bank (2015) report, they often lack coherence and sustained implementation strategies.
- **Limited Industry Engagement:** Private sector engagement in collaborative R&D remains low, often due to a lack of trust, limited incentives, and mismatched expectations
- **Capacity Constraints:** Universities face infrastructural, financial, and human resource limitations that hinder their ability to engage meaningfully with the electronics industry
- **Weak Commercialisation Mechanisms:** Few universities have fully functional TTOs, and intellectual property (IP) management remains underdeveloped compared to South Korea.

Comparative Analysis and Discussion

The comparative analysis suggests that while Sri Lanka shares a similar aspiration for economic growth through electronics industry development, its university–industry collaboration frameworks are at a formative stage compared to South Korea's mature models.

Key strategic differences include:

- **Role of the Government:** South Korea's proactive and sustained government leadership contrasts with Sri Lanka's relatively fragmented policy interventions.
- **Culture of Innovation:** South Korean universities foster a strong entrepreneurial culture, often missing in Sri Lanka's traditional academic structures.
- **Industry Pull vs. Academic Push:** In South Korea, industries actively pull innovations from universities, while in Sri Lanka, most initiatives are still academic push-driven, with limited market demand validation.

Comparative Insights and Pattern Matching

The juxtaposition of South Korea's and Sri Lanka's UIC systems reveals several critical differences:

Table 01:Comparative Analysis of UIC Frameworks

UIC Feature	South Korea	Sri Lanka
Policy Integration	Centralised, long-term planning	Fragmented, short-term or donor-driven initiatives
Funding Mechanisms	Government-led R&D with industry co-funding	Limited, often donor-dependent and project-based
Academic Reform	Demand-driven curricula and research incentives	Outdated curricula with weak industry input
Collaboration Platforms	Living labs, tech parks, corporate R&D labs	UBLCs with limited capacity or recognition
Commercialization Structures	Structured TTOs with clear IP policies (University – Industry Cooperation Foundations)	Ad hoc or under-resourced TTOs; weak IP frameworks
Private Sector Engagement	High – large conglomerates actively involved (Samsung Electronics, etc.)	Low – SMEs lack R&D budgets and engagement culture
Technology Transfer Offices	Well-established in top universities and research centres	Emerging; limited in number and scope
Industry-integrated Curricula	Strong models like LG-HGU with industry-designed programs	Weak integration; few structured models
Living Labs/Innovation Hubs	Widely adopted in ICT and electronics innovation	Rare and mostly in pilot phases

These patterns suggest that Sri Lanka's UIC framework lacks the institutional density, incentive structures, and feedback loops that define successful ecosystems like South Korea's.

Implications for Sri Lanka's Electronics Industry

To replicate the success of South Korea's electronics sector, Sri Lanka must prioritise targeted interventions. These include:

- **Strengthening UIC governance**: Establish a national innovation council or platform to coordinate university–industry partnerships in priority sectors like electronics.
- **Creating living lab environments**: Pilot testbeds for electronics innovation that include universities, firms, and government support, building living lab models by Shvetsova and Lee (2021).
- **Industry-integrated education**: Emulate models like LG-HGU by creating tailored degree programs in partnership with leading electronics companies.
- **Developing integrated policies** that align higher education reforms with industrial innovation strategies.
- **Scaling up technology transfer capacity**: Invest in specialised TTOs and incentive structures to convert academic output into commercial products.
- **Learning from IP policy reform**: Following Jee and Hötte (2024), Sri Lanka can consider flexible IP tools like utility models to bridge academic invention and early-stage industrial application.
- Establishing sector-specific innovation clusters to promote direct industry–university collaboration.
- Enhancing the operational capacities of universities, especially in technology transfer, IP management, and industry engagement.
- Cultivating an entrepreneurial mindset within universities to stimulate industry-oriented research and commercialisation.

By adapting these proven South Korean models thoughtfully, Sri Lanka has the opportunity to position its electronics industry for accelerated growth and international competitiveness.

Conclusion

This study explored the dynamics of university–industry collaboration (UIC) within South Korea's electronics industry and assessed their relevance to the Sri Lankan context. The analysis highlights that South Korea's transformation into a global leader in electronics was strongly supported by deliberate and strategic collaboration between academia and industry, with significant backing from government policies, innovation clusters, and education–industry alignment.

In contrast, Sri Lanka's UIC efforts in the electronics sector remain in a developmental phase, hindered by fragmented policy support, limited private sector engagement, and weak commercialisation mechanisms. The comparative findings underscore the necessity of an integrated and proactive approach to foster a vibrant innovation ecosystem.

South Korea's experience illustrates that successful UIC is not accidental but requires purposeful actions, strong governance frameworks, dynamic industry participation, and entrepreneurial academic institutions. These lessons are highly instructive for Sri Lanka as it seeks to build a globally competitive electronics industry.

The comparison between South Korea and Sri Lanka highlights not only the potential for knowledge transfer but also the importance of context-sensitive adaptation. While institutional models like LG-HGU or STEPI offer valuable lessons, their success in Sri Lanka will depend on localised commitment,

sustained funding, and deliberate policy orchestration. Sri Lanka's electronics sector, though currently underdeveloped, can be transformed through a structured UIC intervention modelled on global best practices.

Recommendations

Based on the study's findings, the following recommendations are proposed:

- **Develop a National UIC Policy Framework:** Introduce a coherent, long-term policy specifically aimed at fostering university–industry linkages in priority sectors such as electronics.
- **Establish Sector-Specific Innovation Clusters:** Create specialised electronics innovation hubs that integrate universities, industries, and government agencies to encourage collaborative R&D and commercialisation activities.
- **Strengthen Technology Transfer Offices (TTOs):** Build institutional capacities in universities for managing intellectual property, negotiating licenses, and supporting spin-offs and startups.
- **Promote Industry-Driven Curriculum Development:** Involve leading electronics firms in the design and periodic review of university curricula to ensure the production of industry-ready graduates.
- **Incentivise Private Sector Participation:** Provide financial and non-financial incentives for electronics firms to collaborate with universities, including tax benefits, matching grants, and joint R&D funding schemes.
- **Cultivate an Entrepreneurial Academic Culture:** Encourage universities to foster entrepreneurship through incubation centres, innovation challenges, and seed funding opportunities.
- **Benchmark and Adapt Successful Models:** Systematically benchmark international best practices, particularly from South Korea, and tailor them to fit Sri Lanka's local institutional and cultural contexts.
- **Initiate problem-driven research consortia** and structured co-op programs, emphasising measurable industrial outcomes rather than academic publications.
- **Leverage university laboratories as revenue-generating shared assets**, offering SMEs discounted access to prototyping, testing, and pilot facilities
- **Align UIC initiatives with national priority sectors** such as energy, healthcare, and agriculture, where domestic adoption is feasible and impactful.
- **Standardise intellectual property and contracting frameworks** and implement rapid proof-of-concept (PoC) funding mechanisms to accelerate commercialisation

Future research could extend this study by conducting field interviews and surveys among Sri Lankan university administrators, faculty members, and industry partners to validate and refine the proposed strategies.

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