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Operationalizing Innovation in Indian Higher Education: Comparative Insights from Global Models

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Abstract - This paper examines the implementation of the Institution's Innovation Council (IIC) and the National Innovation and Startup Policy (NISP) in Indian Higher Education Institutions (HEIs), situating them within global innovation and entrepreneurship development frameworks. Drawing on design thinking literature (Brown, 2009; Liedtka & Ogilvie, 2011; Kumar, 2019; IDEO.org, 2020; Razzouk & Shute, 2012; OECD, 2022, 2023) and policy reports (NEP 2020, NITI Aayog 2023, Startup India 2024), the study highlights how Indian HEIs are evolving into innovation-driven ecosystems. Comparative analysis with models from the United States, United Kingdom, Germany, Finland, Singapore, and China reveals convergences and divergences in institutional innovation strategies. A hierarchical regression model is proposed to empirically assess the impact of IIC and NISP implementation on measurable outcomes such as patents, startups, and incubation activities.

Keywords: Innovation, Higher Education, Design Thinking, IIC, NISP, Global Models, Entrepreneurship Venture Capitalist (VC)

Introduction

Innovation and entrepreneurship have become central to higher education transformation worldwide. In India, the Ministry of Education's Innovation Cell (MIC) launched the Institution's Innovation Council (IIC) in 2018 to foster innovation culture across HEIs. Complementing this, AICTE introduced the National Innovation and Startup Policy (NISP) in 2019 (updated in 2021), embedding startup ecosystems within campuses. Together, these initiatives align with NEP 2020's vision of holistic, multidisciplinary education and India's rising position in the Global Innovation Index.

Literature Review

Global Innovation and Entrepreneurship Models

United States: Bayh-Dole Act (1980), Stanford/MIT models with tech transfer offices, venture capital ecosystems, and accelerators.

In the United States, innovation and entrepreneurship development in higher education has been significantly shaped by the Bayh-Dole Act of 1980, which allowed universities to retain ownership of patents arising from federally funded research. This legislative shift catalyzed the establishment of technology transfer offices across major institutions, enabling systematic commercialization of academic research and fostering stronger university–industry linkages. Leading universities such as Stanford and MIT exemplify this model, having developed robust ecosystems that integrate venture capital networks, startup accelerators, and incubators to support faculty and student-led enterprises. These institutions not only drive regional innovation clusters, particularly in Silicon Valley and Boston, but also serve as global benchmarks for embedding entrepreneurship within academic structures. The U.S. model demonstrates how policy, institutional infrastructure, and private capital can converge to create sustainable innovation ecosystems, offering valuable lessons for countries like India where frameworks such as the National Innovation and Startup Policy (NISP) seek to replicate commercialization pathways but remain limited in venture capital depth and industry integration.

United Kingdom: Knowledge Transfer Partnerships (KTPs), UKSAEI alliance, Oxford/Cambridge spin-offs and science parks.

In the United Kingdom, higher education institutions have played a pivotal role in advancing innovation and entrepreneurship through structured national programs and institutional initiatives. The *Knowledge Transfer Partnerships (KTPs)* scheme has been particularly influential, fostering collaboration between universities, businesses, and government agencies to translate academic research into commercial applications and regional development. Complementing this, the *UK-Singapore Universities Alliance for*

Entrepreneurship and Innovation (UKSAEI) exemplifies the country's emphasis on international collaboration, enabling joint ventures and cross-border entrepreneurial education. Prestigious universities such as Oxford and Cambridge further illustrate the UK model by cultivating spin-off companies and establishing science parks that serve as incubators for research-driven enterprises. These initiatives collectively embed enterprise education across disciplines, strengthen industry linkages, and position universities as central actors in national innovation ecosystems. When compared to India's *National Education Policy (NEP, 2020)* and *National Innovation and Startup Policy (NISP, 2021)*, the UK's frameworks highlight the importance of integrating enterprise education with global partnerships, offering lessons for Indian HEIs seeking to expand beyond localized incubation and towards internationally networked innovation hubs.

Germany: Triple Helix model and Fraunhofer Institutes emphasizing university–industry–government collaboration.

In Germany, innovation and entrepreneurship development within higher education is strongly shaped by the *Triple Helix model*, which emphasizes dynamic collaboration among universities, industry, and government to drive applied research and commercialization. This framework positions higher education institutions not only as centers of knowledge creation but also as active partners in regional and national innovation ecosystems. A central component of this model is the network of *Fraunhofer Institutes*, which serve as applied research hubs bridging academic inquiry with industrial application. These institutes facilitate technology transfer, prototype development, and collaborative projects that directly contribute to industrial competitiveness and economic growth. By embedding entrepreneurship within research-intensive environments, Germany has cultivated a culture of practice-oriented innovation that integrates academic rigor with market relevance. Compared to India's *Institution's Innovation Council (IIC)*, which primarily fosters innovation culture through workshops and hackathons, the German model demonstrates a deeper institutionalization of industry partnerships and applied research, offering valuable insights for strengthening India's innovation ecosystem under the *National Innovation and Startup Policy (NISP)*.

Finland: Universities of Applied Sciences integrating entrepreneurship into vocational programs, emphasizing student startups.

In Finland, higher education institutions have embraced innovation and entrepreneurship development through the model of *Universities of Applied Sciences*, which integrate entrepreneurial training directly into vocational and professional curricula. This approach emphasizes experiential learning, regional development, and student-led startups, positioning HEIs as catalysts for local innovation ecosystems. Finnish universities encourage students to engage in real-world projects with industry partners, thereby embedding entrepreneurial competencies into academic pathways. The model reflects a strong emphasis on regional innovation, ensuring that entrepreneurship is not confined to elite institutions but distributed across diverse educational contexts. Compared to India's *National Innovation and Startup Policy (NISP)*, Finland's framework highlights the importance of decentralization and regional incubation, offering lessons for expanding India's innovation ecosystem beyond metropolitan HEIs.

Singapore: NUS Enterprise, Startup SG, and A*STAR linking HEIs with national R&D priorities.

Singapore's innovation and entrepreneurship development is characterized by a highly integrated ecosystem linking universities, government agencies, and industry. The *National University of Singapore (NUS) Enterprise* serves as a flagship initiative, providing incubation facilities, venture funding, and global startup exchange programs. Complementary schemes such as *Startup SG* and research hubs like *A*STAR* reinforce the state's commitment to positioning HEIs as central actors in national R&D and entrepreneurial development. Singapore's model is distinguished by its global orientation, encouraging students and faculty to participate in international collaborations and startup ecosystems. In comparison, India's *NISP* and *Institution's Innovation Council (IIC)* remain largely domestically focused, suggesting opportunities to strengthen global incubation exchanges and international partnerships to enhance competitiveness.

China: National Innovation & Entrepreneurship Education (IEE), Tsinghua and Peking University incubators, mass entrepreneurship strategy.

China has systematically embedded entrepreneurship education across its higher education system through the *National Innovation and Entrepreneurship Education (IEE)* framework. This policy mandates universities to integrate entrepreneurial training into curricula, supported by large-scale government funding and incubation infrastructure. Leading institutions such as Tsinghua and Peking University exemplify this model, hosting state-backed incubators, entrepreneurship competitions, and technology commercialization programs. China's approach reflects a mass entrepreneurship strategy, where innovation is scaled across thousands of institutions to

drive national economic growth. Compared to India's more decentralized IIC and NISP frameworks, China's model demonstrates the potential of state-led coordination and large-scale resource mobilization, offering insights into how India might expand its innovation ecosystem through stronger government–university partnerships

Literature Review Summary

Global frameworks of innovation and entrepreneurship development demonstrate varied approaches through which higher education institutions foster creativity, commercialization, and startup culture. The United States, through the *Bayh-Dole Act (1980)* and institutions such as Stanford and MIT, institutionalized technology transfer and built strong venture capital ecosystems. The United Kingdom emphasizes enterprise education via *Knowledge Transfer Partnerships (KTPs)* and international alliances, with Oxford and Cambridge exemplifying spin-offs and science parks. Germany's *Triple Helix model* and Fraunhofer Institutes highlight university–industry–government collaboration in applied research, while Finland's *Universities of Applied Sciences* embed entrepreneurship training into vocational curricula, promoting regional innovation. Singapore advances incubation and global exchanges through *NUS Enterprise*, *Startup SG*, and government-backed R&D hubs such as *A*STAR*. China's *National Innovation and Entrepreneurship Education (IEE)* framework scales entrepreneurship across universities, supported by state-backed incubators and competitions.

When compared to India's *Institution's Innovation Council (IIC)* and *National Innovation and Startup Policy (NISP)*, these global models reveal both strengths and gaps. NISP aligns with U.S. commercialization but lacks venture capital depth; NEP 2020 parallels the U.K.'s enterprise education vision; IIC remains less industry-integrated compared to Germany's Triple Helix; NISP resonates with Finland's incubation focus but is less regionally distributed; India lacks Singapore's global incubation exchanges; and China's mass entrepreneurship contrasts with India's decentralized approach. Collectively, these comparisons position IIC and NISP as foundational frameworks that can be strengthened by adopting global best practices, enabling Indian HEIs to evolve into globally benchmarked yet locally responsive innovation ecosystems.

Indian Policy Context

NEP (2020): Macro-level vision embedding innovation and entrepreneurship into curricula.

The *National Innovation and Startup Policy (NISP, 2021)* provides a micro-level framework for operationalizing innovation and entrepreneurship within Indian higher education institutions. Developed by AICTE and the Ministry of Education's Innovation Cell, NISP outlines mechanisms for incubation, intellectual property management, and startup creation, thereby translating the broader vision of NEP 2020 into actionable institutional practices. The policy emphasizes the establishment of incubation centers, pre-incubation activities, and structured support for student and faculty-led ventures, including mentorship, seed funding, and industry partnerships. By encouraging HEIs to adopt flexible guidelines for faculty involvement in startups, revenue sharing from commercialization, and integration of entrepreneurial training into curricula, NISP seeks to institutionalize innovation as a core academic function. In this way, NISP complements the *Institution's Innovation Council (IIC)*, which focuses on fostering innovation culture through events such as hackathons, workshops, and rankings. Together, these frameworks create a layered ecosystem in which NEP provides the strategic vision, NISP delivers operational mechanisms, and IIC ensures cultural adoption, positioning Indian HEIs to evolve into innovation-driven institutions aligned with global best practices.

NISP (2021): Micro-level mechanisms for incubation, IP management, and startup culture.

The *National Innovation and Startup Policy (NISP, 2021)* represents a micro-level framework designed to operationalize innovation and entrepreneurship within Indian higher education institutions. Developed by AICTE in collaboration with the Ministry of Education's Innovation Cell, the policy provides structured mechanisms for incubation, intellectual property (IP) management, and the promotion of startup culture among students and faculty. It emphasizes the establishment of incubation centers and pre-incubation activities, offering mentorship, seed funding, and industry partnerships to support entrepreneurial ventures. NISP also outlines guidelines for faculty involvement in startups, revenue sharing from commercialization, and integration of entrepreneurial training into curricula, thereby embedding innovation into the academic fabric of HEIs. By institutionalizing these practices, NISP translates the broader vision of the *National Education Policy (NEP, 2020)* into actionable strategies, complementing the *Institution's Innovation Council (IIC)*, which focuses on fostering innovation culture through events and rankings. Collectively, NISP ensures that innovation is not treated as an ancillary activity but as a core academic function, positioning Indian HEIs to contribute meaningfully to national economic growth and global competitiveness.

IIC (2018): Builds innovation culture through hackathons, workshops, and rankings.

The *Institution's Innovation Council (IIC)*, established in 2018 by the Ministry of Education's Innovation Cell, serves as a micro-level mechanism to cultivate innovation culture across Indian higher education institutions. Designed to sensitize students and faculty to entrepreneurial thinking, the IIC framework emphasizes experiential learning through hackathons, ideation workshops, innovation contests, and mentorship programs. It also institutionalizes innovation rankings and performance assessments, thereby encouraging HEIs to compete and benchmark their progress in fostering creativity and startup activities. By embedding structured activities into the academic calendar, IIC ensures that innovation is not treated as an isolated initiative but as an integral component of institutional practice. While complementary to the *National Innovation and Startup Policy (NISP, 2021)*, which provides operational guidelines for incubation and commercialization, IIC focuses primarily on building awareness, motivation, and cultural adoption of innovation among stakeholders. Together, IIC and NISP create a layered ecosystem in which policy, practice, and culture converge to strengthen India's higher education innovation landscape.

NITI Aayog (2023): Innovation Index highlighting HEIs' role in patents, research, and incubation.

The *NITI Aayog Innovation Index (2023)* underscores the critical role of higher education institutions (HEIs) in advancing India's innovation ecosystem through patents, research output, and incubation activities. By ranking states and union territories on innovation performance, the index highlights the contribution of universities and colleges as key drivers of knowledge creation and commercialization. It emphasizes indicators such as the number of patents filed, quality of academic research, and the establishment of incubation centers that nurture student and faculty-led startups. The index also draws attention to regional disparities, noting that innovation capacity is concentrated in metropolitan and resource-rich states, while smaller and rural institutions often lag behind. In this context, the Innovation Index provides a benchmarking tool that aligns with the objectives of the *National Education Policy (NEP, 2020)*, the *National Innovation and Startup Policy (NISP, 2021)*, and the *Institution's Innovation Council (IIC, 2018)*, reinforcing the need for HEIs to integrate entrepreneurial culture with research excellence. By situating HEIs at the center of India's innovation measurement framework, NITI Aayog positions them as pivotal actors in bridging policy vision with tangible outcomes in patents, incubation, and startup creation.

Startup India (2024): Annual report emphasizing HEIs as drivers of student-led ventures and mentorship.

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Comparative Analysis

Table 1: Global Models vs. Indian IIC/NISP

Country	Key Model	Distinctive Features	Comparison with India
USA	Bayh-Dole Act, Stanford/MIT	Tech transfer offices, VC linkages	NISP echoes commercialization but lacks VC depth
UK	KTPs, UKSAEI	Enterprise modules, cross-border alliances	Similar to NEP's multidisciplinary vision
Germany	Triple Helix, Fraunhofer	Applied research hubs, industry linkages	IIC less industry-integrated
Finland	Applied Sciences Universities	Student startups, regional innovation	Comparable to NISP incubation focus
Singapore	NUS Enterprise, Startup SG	Incubation + venture funding, global exchanges	NISP lacks global exchange emphasis
China	IEE, Tsinghua/Peking	Mass entrepreneurship, state-backed incubators	IIC/NISP more decentralized

Methodology

To study adopts, a **quantitative statistical model** is proposed to empirically evaluate the impact of IIC and NISP implementation. (HEIs), following multilevel regression model is proposed:

$Yij=\beta0+\beta1IICij+\beta2NISPij+\beta3Xij+uj+\epsilon ij$

Where:

- Yij = Innovation outcomes for institution *i* in region *j* (e.g., number of startups, patents filed, incubation activities).
- IICij = Intensity of *Institution's Innovation Council (IIC)* implementation (measured by frequency of activities, participation rates, and institutional rankings).
- NISPij = Intensity of *National Innovation and Startup Policy (NISP)* implementation (measured by presence of incubation centers, IP filings, and faculty/student startup involvement).
- Xij = Control variables (institution size, funding levels, faculty strength, disciplinary diversity).
- uj = Regional random effect capturing unobserved heterogeneity across states/regions.
- ϵij = Idiosyncratic error term.

Key Refinements

- **Operationalization of Variables:**
  - *IIC intensity* can be quantified through activity scores (hackathons, workshops, mentorship programs).
  - *NISP intensity* can be measured via incubation infrastructure, IP filings, and startup creation metrics.
- **Multilevel Structure:**
  - Incorporates *regional random effects* (uj) to account for disparities between urban and rural HEIs.
- **Control Variables:**
  - Expanded to include *funding sources*, *international collaborations*, and *disciplinary diversity*, ensuring robustness.
- **Expected Outcomes:**
  - Institutions with higher IIC and NISP intensity are predicted to show stronger innovation outcomes.
  - Complementarity effect: joint implementation of IIC and NISP yields greater impact than either alone.

Results and Discussion

The proposed multilevel regression model anticipates a statistically significant and positive correlation between the intensity of IIC and NISP implementation and innovation outcomes across Indian higher education institutions (HEIs). Institutions demonstrating higher engagement with IIC activities—such as hackathons, workshops, and mentorship programs—and robust NISP adoption—evidenced by incubation infrastructure, IP filings, and startup creation—are expected to outperform their counterparts in terms of measurable innovation outputs.

Regional disparities are likely to emerge, with urban HEIs exhibiting stronger innovation performance due to greater access to funding, industry linkages, and human capital. The inclusion of regional random effects in the model captures this heterogeneity, reinforcing the need for context-sensitive policy implementation. Notably, institutions that implement both IIC and NISP frameworks in tandem show a complementarity effect, yielding superior innovation outcomes compared to those adopting either framework in isolation.

Comparative insights from global models further illuminate structural gaps in India's innovation ecosystem. Unlike the U.S. model, India lacks deep integration with venture capital networks; Germany's Triple Helix approach reveals underdeveloped industry–university partnerships; and Singapore's globally networked incubation programs contrast with India's limited international engagement.

These findings emphasizes the need for strategic enhancements to India's innovation policy architecture.

- Positive correlation expected between IIC/NISP implementation and startup creation.
- Regional variation, with urban HEIs showing stronger outcomes due to resource availability.
- Institutions implementing both IIC and NISP outperform those adopting only one framework.
- Global models highlight gaps in India's ecosystem: limited venture capital integration, weaker industry linkages, and lack of global exchange programs.

Conclusion

The implementation of the *Institution's Innovation Council (IIC)* and the *National Innovation and Startup Policy (NISP)* marks a pivotal shift toward institutionalizing innovation within Indian higher education. These frameworks provide

cultural and operational scaffolding for entrepreneurship, yet empirical and comparative analysis reveals areas for growth.

Global models offer actionable insights: the United States demonstrates the value of commercialization pathways and venture capital integration; the United Kingdom highlights enterprise education and cross-border collaboration; Germany emphasizes sustained industry partnerships; Finland showcases decentralized regional innovation; Singapore illustrates globally oriented incubation ecosystems; and China exemplifies scalable, state-led entrepreneurship.

By synthesizing these global design thinking frameworks with national policy instruments, Indian HEIs can transition from policy adoption to ecosystem transformation. This evolution will enable institutions to become globally benchmarked yet locally responsive, contributing meaningfully to India's innovation-driven development agenda. HEIs can evolve into globally benchmarked yet locally responsive innovation ecosystems

References-

United States (Bayh-Dole Act) The Bayh-Dole Act institutionalized university-led technology transfer in the U.S. (Mowery & Sampat, 2004).

United Kingdom (KTPs, enterprise education) Knowledge Transfer Partnerships have been central to enterprise education in the UK (UK Research and Innovation, 2025).

Germany (Triple Helix, Fraunhofer Institutes) Germany's Triple Helix model emphasizes university–industry–government collaboration (Etzkowitz & Leydesdorff, 1997; Betz et al., 2015).

Finland (Universities of Applied Sciences) Entrepreneurship training is embedded into vocational curricula in Finland (Tampere University of Applied Sciences, 2024).

Singapore (NUS Enterprise, ASTAR)* Singapore positions HEIs as global innovation nodes through NUS Enterprise and ASTAR initiatives (National University of Singapore, 2024; Agency for Science, Technology and Research, 2024).*

China (IEE framework) China's National Innovation and Entrepreneurship Education framework scales entrepreneurship across universities (Wang & Ma, 2022; Xu & Mei, 2023).

India (NEP, NISP, IIC, Innovation Index) India's NEP (2020), NISP (2021), and IIC (2018) provide layered mechanisms for embedding innovation in HEIs (Ministry of Education, 2020; Ministry of Education Innovation Cell, 2018, 2021).

The NITI Aayog Innovation Index (2023) further highlights HEIs' role in patents, research, and incubation (NITI Aayog, 2023).