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Article

The Triple Helix in Practice: Empirical Insights from Institutions of National Importance in India

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Abstract: Triple Helix (TH) model, or the idea of interconnectedness of the functions of the university, industry, and government, is the prevailing theoretical concept in the development of powerful knowledge-based innovation ecosystems. As much as this model is well confirmed in developed economies, its empirical confirmation and its real implementation is least explored in the premier non-western institutional environments. It is a research that fills a serious gap in innovation literature because it rigorously assesses the practical efficacy and perceived subtleties of the TH configuration in particular in Institutions of National Importance (INIs) in India, institutions that are critical to the achievement of the technological and economic goals of the country. With the help of the powerful mixed-method design, including extensive surveys and semi-structured interviews in the effectively organized form, the information was collected systematically in a stratified cohort of 165 INIs. The core analysis examines three systemic dimensions, which are the depth of inter-institutional cognitive awareness, the level of real stakeholder participatory engagement, as well as the impact of both systemic impediments and systemic policy catalysts on effective TH integration. The paper presents viable empirical data on the issues of operations and strategic opportunities of developing a unified TH setting in India. The results are useful in designing specific evidence-based policy models that maximize the impact of INI on the national innovation capability and long-term economic development.

Keywords: Triple Helix Model; Stakeholder Awareness; Knowledge Economy; Innovation Policy; Government–Academia–Industry Collaboration; Institutions of National Importance (INIs); Research and Development; India

1. Introduction

1.1 Background of the Study

The modern world is swinging with decisive shifts towards dynamic and knowledge-based systems as against the resource-based and linear industrial systems in the world economy [1], [3]. The continued innovation, excellent research, and dense networks of cooperation have become the primary forces of competitiveness and sustainable development in this context [6]. A successful integration of their scientific venture, technological potential, tertiary education as well as entrepreneurship puts a country in a better position to transform science into a socio-economic value [7]. More to the point, innovation has not been developed through the efforts of single scholars or through the research and development of individual company; it is developed through complex and iterative interaction of universities, industries and government agencies [1], [8]. Triple Helix is an example of innovation that introduces a rigid order of the study of such interactions, the manner in which knowledge production and commercialization results in the prosperity of the country [1].

The necessity to formalize collaborative innovation is desperate in the case of India. The move towards competitive knowledge economy in the country comes in with massive opportunities and structural challenges [19]. Institutions of National Importance (INIs) (including IITs, IIMs, IISERs, and AIIMS) constitute the intellectual and human-capital support of this transition [20]. Besides teaching and basic research, these institutions are now being invoked to be proactive technology-building, entrepreneurial incubation and research that is policy-relevant [18]. However, some gaps between quality academic work and the transfer of this academic work to scalable industrial

work or evidence-based policy still persist [19]. In order to address these gaps, there is the need that there should be an empirically based knowledge on how the Triple Helix is received, internalized and implemented in India [10]. The given research work is relevant because it evaluates the level of awareness and perceptions of the stakeholders in various INIs in terms of the primary governmental programs; SPARC, PMRF, RUSA and NIDHI to determine which strengths and structural constraints within the given system [20].

1.2 The Triple Helix Model of Innovation

The concept of innovation as a non-linear, co-evolutionary process that takes place as a result of the mutual interdependence of universities, industry, and government is conceptualized in the Triple Helix model [1], [6]. It does not follow a linear model of lab-to-market-to-regulation, but focuses on overlapping functions: universities become more entrepreneurial, through strategic alliances in R&D; industry is participating in knowledge creation, through strategic alliances in market launches; and the government is becoming more of an enabling financier, convener, and coordinator of the system [7].

The model comes operationally in the form of hybrid organizations—joint research centers, science and technology parks, technology transfer offices, the university-based incubators, regional innovation clusters, and public/private alliances—that intentionally blur sectoral boundaries to hasten the rate at which knowledge flows and commercialization take place [1], [6]. However, the model needs to be adapted in the fast-emerging economies like India, that are complex due to policy discontinuities, institutional capacity, bureaucratic inertia, and cultural barriers to collaborating [8], [19]. The three spheres can have relationships that are either compartmentalized or apprehensive and limit synergy [10]. An empirical, stringent evaluation of the awareness, perception, and engagement among stakeholders is consequently necessary to measure pragmatic effectiveness and leverage to further integrate [13].

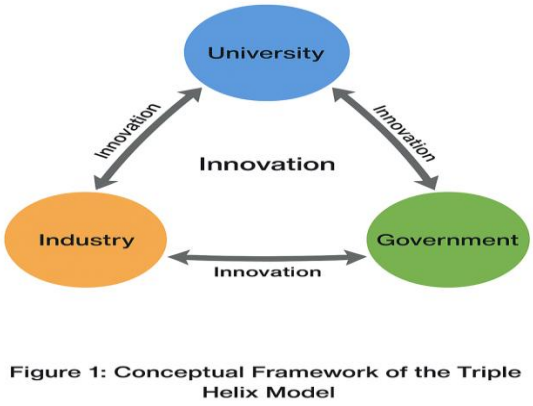

Figure 1: Conceptual Framework of the Triple Helix Model

Figure 1 Conceptual Framework of the Triple Helix Model

1.3 Innovation and the Knowledge Economy

Currently, innovation is the key driver of economic development, national competitiveness, and social development [3], [12]. Knowledge-economy paradigm postulates that the main forces of production are not material inputs, but human capital, intellectual resources and codified knowledge [14]. Continuous growth requires the effective generation, dispersion, and large-scale implementation of knowledge, and universities and national research centres provide both high-level skills and low-level scientific solutions to industry to commercialize [6].

Such initiatives as Make in India, Startup India, Digital India, as well as the National Education Policy (NEP) 2020 are some of the steps that India has been undertaking towards such a paradigm, all with the aim of integrating the quality of education, digital infrastructure, and entrepreneurship [20]. Nonetheless, a lack of alignment still exists: the frictions of communication, the ad hoc interfaces, and the lack of mechanisms that would support the long-term collaboration can cause the under-exploitation of research results [19]. To develop a knowledge economy at scale, India has to conduct itself as an integrated adaptive ecosystem, not as a group of siloed players [10]. The structural scaffold of that shift is furnished in the Triple Helix [1]. Through the analysis of the stakeholder understanding,

participation, and perceptions in INIs, this research assesses institutional and cultural preparedness to fully operationalize an innovation system based on the knowledge [20].

1.4 India's Vision and Policy Framework for a Knowledge Economy

The Indian innovation vision is in compliance with Triple Helix principles and is provided with the set of national policies [18], [20]. Atal Innovation Mission, Startup India and the National Innovation Policy support collaboration in research, entrepreneurship, and engagement between the government and the business sector [19]. The following four flagship programs are of great relevance to the linkages between academia, industry, and the government: SPARC promotes research collaboration worldwide; PMRF enhances the excellence of the doctoral research; RUSA promotes systemic higher-education reform; NIDHI promotes incubation and initial commercialization [20].

An amalgamation of these initiatives is a signifier of a strategic change to an outcome-oriented collaborative innovation [8]. The bodies such as the Department of Science and Technology, NITI Aayog and the Office of the Principal Scientific Adviser organize the implementation [18]. Nonetheless, it is often disaggregated: the programs may be in policy silos, there may be a lack of cross-ministerial coordination, the large firms, which led to diffusion and employment, may also be overrepresented and SMEs as the major stakeholders in diffusion and employment are often neglected [19]. Consciousness of stakeholders and depth of institutional internalization in INIs, thus, are eventual indicators of success of this policy scaffolding [20]. This being is meant to comprehend and practice these policies in real life within the major institutions that are the core of the India innovation system [10].

1.5 Research Problem and Rationale

Through a thick policy architecture and abundant programmatic tools, there exist enduring institutional and operational bottlenecks, which stifle synergistic cooperation in India [19], [8]. INIs produce research of high quality regularly, but there is a lack of research translation into marketable technologies or policy interventions [10]. Academic work is frequently thought of as being too theoretical or too out of step with market cycles by industry, and the government attempts to connect sectors may be hampered by bureaucracy and duplication of role [19].

The pivotal issue of concern here is how important stakeholders not only understand the concept of Triple Helix but also how they coordinate their functions appropriately to the functionalities of the concept [1], [6]. It is impossible to have transformative outcomes on the basis of inaccurate mass consciousness and careless involvement of policies [13]. This research is warranted on two levels: first, to generate a stringent, quantitative evaluation of awareness, perceptions, and involvement at the levels of academia, industry, and government and second, to determine and characterize structural and perceptual obstacles to constant cooperation [20]. The question is timely in connection with the current innovation reforms planned in India in the NEP 2020 and missions [18]. Awareness and perception can be used to inform policymakers and institutional leaders to develop strategies that are more targeted, less frictional, and a culture that focuses on collaborative and result-oriented innovation [19].

1.6 Objectives of the Study

The present research is guided by a singular, overarching objective, which is then broken down into specific, testable sub-objectives:

Overarching Objective: To assess stakeholders' awareness and perceptions of the functional implementation of the Triple Helix model in India, with a specific focus on Institutions of National Importance (INIs) and their engagement with major national innovation programs.

Specific Sub-Objectives:

1. To quantitatively measure and compare the level of awareness of key government innovation programs (specifically SPARC, PMRF, RUSA, and NIDHI) across the academic, industry, and government stakeholder groups.
2. To identify and analyze the latent dimensions (factors) that underpin stakeholders' perceptions of Triple Helix collaboration, including perceived effectiveness, institutional capacity, and systemic barriers.
3. To determine if statistically significant differences exist in the awareness and perception scores among the three primary stakeholder groups.
4. To qualitatively explore, through stakeholder interviews, the key facilitators and inhibitors of collaboration and to gain contextual insight into the operational challenges of Triple Helix integration in INIs.

This set of objectives is designed to empirically bridge the divide between national policy formulation and the practical comprehension of major innovation programs. The study aims to quantify awareness levels, analyze stakeholder variations, and explore perceptions related to collaboration effectiveness, institutional capacity, and policy alignment. Through this robust, mixed-methods analysis, the research aspires to offer empirically grounded evidence to both academic and policy discourses on innovation in India.

1.7 Research Questions

Primary Research Question

RQ1: How is the Triple Helix model (interaction among academia, industry, and government) implemented in Institutions of National Importance (INIs) in India?

Secondary Research Questions

Collaboration Dynamics

RQ2: What are the key forms and mechanisms of collaboration between academia, industry, and government within INIs?

RQ3: What factors facilitate or hinder effective Triple Helix interactions in these institutions?

Institutional Role and Structure

RQ4: How do institutional policies and governance structures influence academia–industry–government linkages?

RQ5: What role do incubation centers, technology transfer offices, and research parks play in strengthening Triple Helix interactions?

Innovation and Outcomes

RQ6: What are the measurable outcomes of Triple Helix collaborations in INIs (e.g., patents, startups, research commercialization)?

RQ7: How do these collaborations contribute to innovation and knowledge transfer in the Indian context?

Government and Policy Influence

RQ8: How do government policies and funding mechanisms support or constrain Triple Helix collaborations in INIs?

Comparative and Contextual Insights

RQ9: How do Triple Helix practices vary across different types of INIs (e.g., technical, management, medical institutions)?

RQ10: What best practices can be identified from successful cases of Triple Helix implementation in INIs?

Hypothesis-Oriented Questions

RQ11: Is there a significant relationship between the level of industry collaboration and innovation output in INIs?

RQ12: Does government funding positively influence the intensity of Triple Helix interactions?

2. Literature Review

2.1 Conceptual Foundations of the Triple Helix Model

The Triple Helix model, which was conceived by Etzkowitz and Leydesdorff, is a paradigm shift in the way of understanding the functioning of innovation systems [1]. In contrast to the older, linear model of innovation that presupposed one-way flow of knowledge between the universities and industry and further to the government regulation, the Triple Helix conceptualizes innovation as the resultant, recursive and reciprocal process occurring in the interactions of three overlapping institutional domains university, industry and government [1], [6]. All these helices not only play their traditional roles but also in some measure play the roles that the other helices do and this has created points of overlap and joint responsibility [1], [7].

In this context, universities become entrepreneurial and contribute to patenting, licensing, and development of spin-offs in addition to their teaching and research services [6], [13]. The engagement of industries is further extended to cover the foundational research and co-production of knowledge rather than just application and commercialization [13]. Governments cease being regulators, transforming into facilitators of strategic venturing by providing enabling environments in terms of policies, infrastructure, and specific funding [3], [7].

One of the fundamental ideas of this model is the creation of hybrid organizations including university technology transfer offices (TTOs), research parks, innovation consortia, and partnerships between the government and business [1], [6], [13]. These institutions act as structural bridges in terms of knowledge sharing, co-financing as well as mobilizing intellectual and financial resources [6]. Moreover, the law of reflexivity, according to which all of the helixes constantly adjust according to the alterations in the others, guarantees that the ecosystem of innovations is dynamic and resilient [1], [7].

To analyse the effectiveness of collaborative innovation based on the relationships and perceptions held by the stakeholders in the triple helix, the Triple Helix will be used as a critical analytical tool in this study [1]. The success of the model is highly dependent on the degree of mutual trust, shared vision and operational knowledge between the three spheres [6], [13]. It is on this conceptual foundation of the assessment of the internalization and application of these principles in India as a fast-emerging knowledge economy [18]–[20].

2.2 Global Applications: Western and Non-Western Contexts

The Triple Helix model has had an impact on the global innovation policy as it determines national and regional innovation systems in countries [1], [6], [8]. In the West, institutionalization of Triple Helix principles within formal policy mechanisms and legislation has taken place. As an example, the United States Bayh-Dole Act (1980) gave universities the right to own federally-funded research, which sparked a proliferation in the patenting, licensing, and academic entrepreneurship [1]. A good example of geographically focused clusters of innovations can be found in the Cambridge Science Park (UK) where the universities, industry and the government work in a synergetic manner [6]. In Finland and the Nordic countries, there are special agencies such as Vinnava and Tekes that have funded collaborative research and development, which have greatly increased the rate of innovation and competitiveness [3], [8].

The Triple Helix model has also been adapted by other countries that do not follow western practices. South Korea capitalized on state-based innovation centres, and high-tech exports and university spin-offs [8]. The A*STAR program of Singapore shows how government intervention can facilitate the establishment of highly integrated innovation ecosystems, whereas the Torch Program of China and High-Tech Industrial Development Zones of China demonstrate how policy and institutional actions can focus innovation at regional level [4], [6]. Likewise, the examples of innovation hubs in Brazil demonstrate how Triple Helix partnerships can contribute to the local economic growth even in the case of governance issues [8].

There is a general tendency to believe that high stakeholder awareness, trust, and defined incentive structure is a precondition to successful collaboration as evidenced by such cases [1], [6], [13]. Triple Helix ecosystems can flourish where there are a high degree of communication and the alignment of incentives. On the other hand, partnerships are shallow in the case of low awareness or low trust [13].

Table 1 Summary of Global Triple Helix Applications

Country / Region	Context / Sector	Key Findings	Source
United States	University–industry partnerships under the Bayh–Dole Act	Legal autonomy for universities led to a surge in patents, technology licensing, and commercialization of research outcomes.	Etzkowitz & Leydesdorff (2000)
United Kingdom	Knowledge Transfer Partnerships (KTPs)	Enhanced innovation in SMEs and strengthened university engagement with local industries through government-supported collaboration schemes.	Philpott et al. (2011)

Finland	Tekes Innovation Funding Agency	Collaborative R&D funding improved cross-sector partnerships and national competitiveness.	Valli & Hautamäki (2015)
South Korea	Government-led innovation clusters	Policy-driven innovation ecosystems increased startup creation, high-tech exports, and university spin-offs.	Kim & Park (2018)
China	University Science Parks and regional innovation zones	Strategic integration of academia–industry–government partnerships boosted regional productivity and technology transfer.	Zhou (2019)
Brazil	Public–private innovation centres and incubators	Enhanced regional development through local innovation hubs, though limited by policy fragmentation.	Albuquerque et al. (2015)
India	Institutions of National Importance (INIs), Startup India, Atal Innovation Mission	Strong policy framework but moderate industry participation; INIs play a growing role in R&D and entrepreneurial ecosystems.	NITI Aayog (2020); MoE (2021)

2.3 Relevance of the Triple Helix in India

The Triple Helix model is becoming a major focus of the national innovation strategy of India [18]–[20]. There are programs like SPARC, PMRF, RUSA, and NIDHI which have been planned so as to institutionalize the partnership between academia, industry and government [18], [20]. They seek to promote research excellence, entrepreneurship and policy-relevant knowledge generation, and place Institutions of National Importance (INIs) consisting of IITs, NITs, IISERs and AIIMS at the heart of the national system of innovation [19], [20].

Nonetheless, policy intents and on-ground implementation are largely separated [19]. A great number of partnerships are not systemic but formal and transactional. There is a variation in the level of awareness among the stakeholders, particularly at the faculty-industry interface [18]. The barriers to effective collaboration are structural and cultural, such as red tape, low institutional autonomy, etc. [19]. Besides, there is also an imbalance in the industry engagement with high-technological industries, such as IT and engineering, and low upstream research [19].

This asymmetry in the distribution of awareness and participation highlights the necessity of the empirical assessment of the perception and operationalization of the Triple Helix model in the context of the Indian innovation ecosystem [18], [19]. It is important to understand these perceptions so as to know leverage points that can be used to boost collaboration [10], [13].

2.4 Stakeholder Awareness and Perceptions in Prior Studies

The perception and awareness of the stakeholders cannot be considered a secondary factor of the success or failure of Triple Helix collaborations [1], [6]. Etzkowitz and Cai and Liu state that the perception of mutual roles and benefits is the direct determinant of collaborative results [1], [3]. High awareness levels can also be linked to increased trust, better use of funds and longtime partnerships [6], [13].

In India, studies have shown that there is a perceptual bias in that, whereas academia and government have begun to regard the importance of collaborating with industries, industry sees universities as slow, bureaucratic, and commercially rigid [19]. This dilutes institutional connection and co-creation. The knowledge of innovation programs is also not even geographically and institutionally [18], [20]. According to NITI Aayog, more than 60 percent of academic interviewees were familiar with such programs as SPARC and RUSA, and only 35 percent of players in the industry had the same awareness [26]. These loopholes do not facilitate collaborative proposal writing, use of funds and translation of research [18], [19].

Thus, it is important to diagnose the reason why the India innovation ecosystem is not performing with supportive policies by systematically quantifying the levels of awareness and perceptions [18]–[20].

2.5 Barriers and Enablers in Implementing the Triple Helix

The difficulties with Triple Helix collaborations are common throughout the globe: institutional inflexibility, transient funding, intellectual property (IP) issues, and institutional disconnects [13]–[15]. These are augmented in India by the hierarchical nature of the governance system, poor commercialization ability in universities and the lack of professional liaison units that focus on the engagement of the industry [19], [18].

Meanwhile, there are significant enablers. These are innovation clusters, technology parks, and incubation centers that are supported by such programs as the Atal Innovation Mission (AIM) and Startup India [18], [20]. Such initiatives are supportive of entrepreneurship and offer structural spaces wherein various helices may effectively work together [6], [8]. Collaboration is further promoted by visionary institutional leadership and flexible forms of governance [19].

Stakeholder awareness is usually a determinant of the equilibrium between barriers and enablers [10], [13]. The institutions that have a clear picture of available mechanisms and constraints are in a better position to capitalize on enablers and suppress limitations to realize meaningful innovation outcomes [18]–[20].

2.6 Role of Government Policies and Innovation Programs

Government policy plays a central role in Triple Helix ecosystems [3], [8]. In India, policies like IMPRINT, NIDHI, PLI schemes, and NEP 2020 aim to bridge academia–industry gaps and promote translational research [18]–[20]. These interventions are intended to catalyze stakeholder collaboration by setting national priorities, providing funding, and simplifying institutional pathways [19], [20].

However, the literature reveals uneven policy awareness [18], [19]. While premier institutions such as IITs and IISERs have dedicated administrative structures, smaller INIs lack the capacity to navigate complex funding landscapes [19]. This leads to "policy fatigue", where institutions know of policies but fail to use them effectively [20],. Improving policy accessibility and administrative support is thus essential for maximizing impact [18]–[20].

2.7 Industry–Academia Collaborations and Entrepreneurship

Industry–academia collaboration is the most visible and practical embodiment of the Triple Helix [6], [13]. International examples like the Stanford–Silicon Valley model and the Cambridge Innovation Cluster showcase how sustained cooperation can generate technological and economic transformation [6].

In India, these partnerships are still emerging. Basant and Chandra observe that industries often perceive universities as lacking market orientation, while academics cite limited funding and trust issues [19]. Nevertheless, initiatives like the Uchchatar Avishkar Yojana (UAY), Technology Incubation Centers, and Innovation Hubs under NIDHI are helping bridge the gap between research and entrepreneurship [18], [20]. However, challenges such as low trust, bureaucratic delays, and limited SME involvement remain significant [19].

Encouraging industries to participate in curriculum co-design, research sponsorship, and mentorship for start-ups can foster stronger innovation ecosystems [13], [19]. For this to occur, greater awareness and trust between academia and industry are essential [10], [13].

2.8 Public–Private Partnerships (PPPs) in Innovation

Public–Private Partnerships (PPPs) are a key mechanism for operationalizing the Triple Helix [8]. They enable shared risk-taking, resource pooling, and faster technology commercialization [8], [13]. Globally, PPPs have been critical to programs like Innovate UK and Australia's Cooperative Research Centres (CRC) [8].

In India, PPPs are central to Smart Cities, Digital India, and Make in India initiatives [18], [19]. However, research by Awate and Kale shows that most PPPs remain infrastructure-focused, with limited orientation toward innovation [27]. Unclear revenue-sharing models and IP frameworks often discourage private investment [14], [19]. To strengthen Triple Helix collaboration, sector-specific PPP guidelines for R&D and greater awareness of PPP mechanisms are needed [8], [19], [20].

2.9 Research Gap

The existing literature clearly establishes the importance of the Triple Helix as a driver of innovation but reveals a notable empirical gap regarding stakeholder awareness and perceptions, particularly in the Indian context [1], [6], [18], [19]. Much research has focused on policy structures, institutional capacity, or innovation output, with less attention to perceptual and cognitive factors that shape collaborative behavior [13], [19].

Works by Etzkowitz and Cai and Liu underscore that perceptions precede participation—stakeholders engage meaningfully only when they understand their roles and see clear benefits [1], [3], [6]. In India, awareness levels remain fragmented across stakeholder groups, and the relationship between awareness and tangible outcomes (such as patenting, start-up creation, or program participation) remains underexplored [18]–[20].

This study addresses that gap by empirically assessing awareness and perceptions of the Triple Helix model within Institutions of National Importance [18]–[20]. By linking conceptual frameworks to real-world stakeholder behavior, the research will provide actionable insights for strengthening communication, building trust, and aligning incentives among the three helices [13], [19]. Ultimately, this will inform policy and institutional strategies to enhance India's innovation capacity [19], [20].

3. Research Methodology

A multiple case study approach is employed to gain an in-depth understanding of the Triple Helix dynamics across selected INIs. This allows for comparative analysis and identification of common patterns as well as institution-specific variations.

3.1 Research Design and Approach

This study employs a mixed-methods design that integrates quantitative and qualitative strands to generate a comprehensive, contextually grounded understanding of stakeholder awareness and perceptions of the Triple Helix model in India [3], [10]. The logic of triangulation underpins the design: statistically robust survey evidence is cross-validated and enriched by interpretive insights from semi-structured interviews, thereby enhancing construct validity, explanatory depth, and practical relevance to India's innovation system [10], [13].

Methodologically, the study is descriptive, explanatory, and exploratory. It is descriptive in quantifying awareness levels and their distribution across stakeholder groups; explanatory in modelling associations between policy exposure and perceived collaboration effectiveness; and exploratory in surfacing emergent perspectives on operational bottlenecks and enabling conditions within Institutions of National Importance (INIs) [13], [18].

The epistemic stance is post-positivist: while the survey permits objective measurement and inferential testing, the interview strand acknowledges the socially constructed nature of collaboration, allowing us to interrogate how and why stakeholders interpret the same policies and interfaces differently [10]. This combination of breadth and depth ensures that findings speak both to generalizable patterns and to institution- and sector-specific dynamics [13], [18].

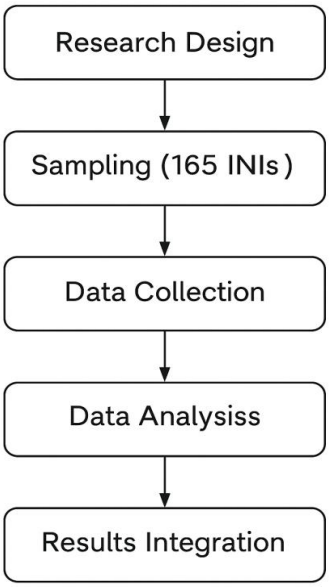

Figure 3
Research Framework

Figure 2 Research Framework / Flow Diagram

3.2 Statement of the Research Problem

India has introduced multiple innovation programs—SPARC, PMRF, RUSA, NIDHI—to catalyze collaboration among university, industry, and government actors [18]–[20]. Yet, empirical clarity about the actual awareness, functional understanding, and perceived relevance of these programs among key stakeholders remains limited [19], [20]. Many institutional and industrial actors are uncertain about program mechanisms, eligibility pathways, IP/benefit-sharing, and evaluation criteria—issues that directly shape willingness to participate [18], [19]. Consequently, engagement is inconsistent, and opportunities are underutilized [19].

The problem addressed here is twofold: (i) to determine whether stakeholders—especially within INIs—possess adequate awareness of Triple Helix policies and programs; and (ii) to test whether such awareness translates into positive perceptions of collaboration and intent to act [18], [20]. Prior research in comparable developing settings suggests that top-down policy diffusion without targeted sensitization can dilute outcomes [3], [8]. By systematically measuring awareness and perception, identifying barriers to participation, and comparing group-wise differences, this study fills an evidence gap with the potential to inform program communication, interface design, and resource allocation [18]–[20].

3.3 Study Population and Sampling

The study population comprises Institutions of National Importance (INIs), including IITs, NITs, IIMs, IISERs, AIIMS, and other specialized bodies established by Parliamentary Acts [19], [20]. To ensure analytical balance, we implemented stratified random sampling by institutional type (reflecting founding Acts and mission focus) and, within institutions, by stakeholder role [13], [18]. Four strata capture the breadth of India's research-to-impact pipeline: (1) Technical Institutions (IITs/NITs) for engineering/applied sciences; (2) Management Institutions (IIMs) for business innovation and industry interface; (3) Science and Research Institutes (IISERs/IISc) for fundamental and interdisciplinary science; and (4) Medical and Health Sciences (AIIMS and peers) for biomedical research and translational practice [18–20].

Respondents were drawn from academia (faculty, researchers, research administration), industry (R&D/innovation managers), and government (policy/program officers). The final dataset comprises 165 valid institutional responses and 307 individual respondents, enabling cross-tabulation by institutional type and role [19]. This design increases external validity within the INI system and supports comparative analyses of awareness/perception patterns across India's diversified innovation landscape [18–20].

Table 2 Sampling Distribution by INI Type and Stakeholder Group

Category / INI Type	Number of Institutions	Academia (n)	Industry (n)	Government (n)	Total (n)
Indian Institutes of Technology (IITs)	23	46	20	12	78
National Institutes of Technology (NITs)	31	42	16	10	68
Indian Institutes of Management (IIMs)	20	28	15	9	52
Indian Institutes of Science Education & Research (IISERs)	7	18	7	5	30
All India Institutes of Medical Sciences (AIIMS)	9	22	8	6	36

Other Central Institutions (e.g., IIITs, NIDs, NIFTs)	15	25	10	8	43
Total (165 INIs)	**165**	**181**	**76**	**50**	**307**

3.4 Data Collection

Structured Questionnaire. The questionnaire tool will measure awareness (program familiarity, procedural knowledge, history of engagement), and perceptions (collaboration effectiveness, institutional capacity, systemic barriers and general Triple Helix integration) [10], [13]. It has 40 items, which are compared to four conceptual blocks (1) Government–Academia collaboration, (2) Academia–Industry collaboration, (3) Industry–Government interaction, and (4) Overall Triple Helix effectiveness. The answers are given on a five-point Likert scale (1 = strongly disagree to 5 = strongly agree). The instrument quality was determined using expert review (senior academics/policy analysts), cognitive pretest and pilot on an independent sample with a Cronbach's alpha = 0.87 representing a high level of internal consistency [13], [14].

Semi-Structured Interviews. We interviewed 12 people (equally represented by stakeholder groups) including policy officials (e.g., MoE/DST), INI directors/deans, and R&D leaders working in the industry [18], [19]. The enablers, barriers, interface experiences, IP/contracting norms and navigation of programs were investigated in interviews. All the sessions (30–45 minutes) were recorded with permission and transcribed verbatim. Usage of instruments helps the survey to determine patterned regularities whereas interviews offer causal accounts and contextual sensibility [10], [13].

3.5 Data Analysis Techniques

Descriptive Statistics. We generated distributional summaries, standard deviations, and means of all items of awareness and perceptions, respondent, and institutional profiles [13]. This move sets the baseline landscape and determines the salient variations according to role and institutional type [18].

Exploratory Factor Analysis (EFA). In order to detect latent constructs, we performed a Principal Component Analysis that was run using varimax rotation on the blocks of perception and awareness [14], [15]. Sampling adequacy was checked through KMO = 0.81, and Bartlett's Test showed that it was factorable ($p < 0.001$). The items placed on factors that are decipherable as Policy Awareness, Collaboration Effectiveness, Institutional Capacity, and Perceived Barriers indicate construct validity and allow the construction of factor-score to be used in future testing [14], [15].

ANOVA and Post-hoc Tests. We used one-way ANOVA testing the difference in means between academia, industry, and government in terms of awareness and each factor [13], [15]. In cases where significant omnibus F-tests were found, Type I error was controlled through a non-parametric procedure, Tukey HSD, and the pairwise differences were identified. These tests discuss the systematic relevance of stakeholder positions in the formulation of knowledge and perceptions [14], [15].

Multiple Regression. In order to study the predictors of perceived Triple Helix effectiveness, we estimated models by adding factor scores (awareness, capacity, barriers), program exposure, stakeholder role, and institutional type as predictors [13]. Adequacy of the model was checked using diagnostics (residual plots, multicollinearity checks, etc.). Coefficients are measures of changes in perceptions in relation to marginal effects of awareness and exposure holding institutional context constant [13], [15].

Thematic Content Analysis. Transcripts of the interviews were coded through inductive and iterative coding (NVivo) to create a codebook of interfaces, procedural clarity, transaction costs, trust and incentives, IP norms, and leadership/governance [10], [18]. The codes were assigned to themes and compared to the quantitative factors to generate meta-inferences. Such integration explains why some groups have lower/higher scores and provides leverage that can be acted upon (e.g., liaison offices, template agreements, SME-friendly calls) [18]–[20].

Reliability Testing

This study uses Cronbach's alpha to examine inter-object consistency among selected items. Cronbach's coefficient alpha reports the inter-item consistency reliability for multi-point items. According to Cronbach's alpha, the higher the coefficient, better the measurement. In the reliability analysis of this study the overall, Cronbach's alpha

coefficient for all variables was 0.81, which is in a good acceptable range for the final analysis. Also all selected items in the study were around 0.81 which has good inter-object relationship and is useful for analysis.

3.7 Operationalization of Objectives

The single objective of the study—to assess stakeholders' awareness and perceptions with the Triple Helix model in India—was operationalized into measurable variables and analytical steps to ensure clarity and precision [18]–[20].

- Independent Variables: Stakeholder group (academia, government, industry), institutional type (IIT, NIT, IIM, IISER, AIIMS), and program exposure (SPARC, PMRF, RUSA, NIDHI) [18], [19].
- Dependent Variable: Overall perception of the Triple Helix model, derived from Likert-scale responses measuring collaboration effectiveness and policy awareness [13], [18].
- Quantitative Measures: Mean awareness scores, factor loadings, and regression coefficients were computed to examine relationships between policy exposure and perception levels [13]–[15].
- Qualitative Measures: Thematic insights from interviews were analyzed to explain quantitative trends, providing a deeper understanding of how awareness influences collaboration behavior [10], [18].

This explicit operational framework ensured that every methodological step and analytical output directly contributed to fulfilling the stated research objectives, thereby establishing a strong, traceable foundation for the subsequent presentation and discussion of the empirical results [18]–[20].

4. Results

4.1 Descriptive Statistics of Awareness Levels (SPARC, PMRF, RUSA, NIDHI)

The descriptive analysis of stakeholder awareness offers clear insights into the diffusion of key Triple Helix innovation schemes—SPARC, PMRF, RUSA, and NIDHI—across India's Institutions of National Importance (INIs) [18]–[20]. Awareness levels were captured using a five-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). The analysis revealed an overall moderate-to-high awareness, but with meaningful variation between programs and stakeholder groups [18], [19].

Among the four schemes, SPARC achieved the highest mean awareness score (M = 4.12, SD = 0.63). Respondents widely recognized SPARC as a key mechanism for international academic collaborations, citing its role in research capacity building and fostering strategic partnerships [18], [20]. PMRF followed closely (M = 3.95, SD = 0.72), reflecting broad familiarity with its doctoral fellowship structure and contribution to research excellence within INIs [19], [20]. These results suggest that government–academia-focused programs, especially those administered by the Ministry of Education, are well embedded in institutional practices [18]–[20].

Conversely, NIDHI (M = 3.48, SD = 0.81) and RUSA (M = 3.22, SD = 0.78) displayed moderate awareness [18], [19]. RUSA's orientation toward state universities likely explains its lower recognition within INIs, though respondents acknowledged its indirect systemic benefits [20]. Awareness of NIDHI varied considerably by institutional type, with engineering and management institutes showing greater familiarity—likely due to its entrepreneurship and incubation focus—than science or medical institutions [18], [19].

When aggregated by stakeholder role, academia showed the highest mean awareness (4.10), followed by government officials (3.85) and industry (3.42). This gap highlights a communication asymmetry: while universities and government agencies receive program information through formal channels, industry stakeholders—especially SMEs—are less systematically included, limiting their active participation [19].

Table 3 Descriptive Statistics of Awareness Levels Across Major Government Innovation Programs

Program / Scheme	Mean Awareness Score	Standard Deviation (SD)	Minimum	Maximum	Awareness Rank
SPARC (Scheme for Promotion of Academic and	4.12	0.63	2.7	5.0	**1**

Research Collaboration)					
PMRF (Prime Minister's Research Fellowship)	3.95	0.72	2.3	5.0	**2**
NIDHI (National Initiative for Developing and Harnessing Innovations)	3.48	0.81	1.9	5.0	**3**
RUSA (Rashtriya Uchchatar Shiksha Abhiyan)	3.22	0.78	1.8	4.9	**4**

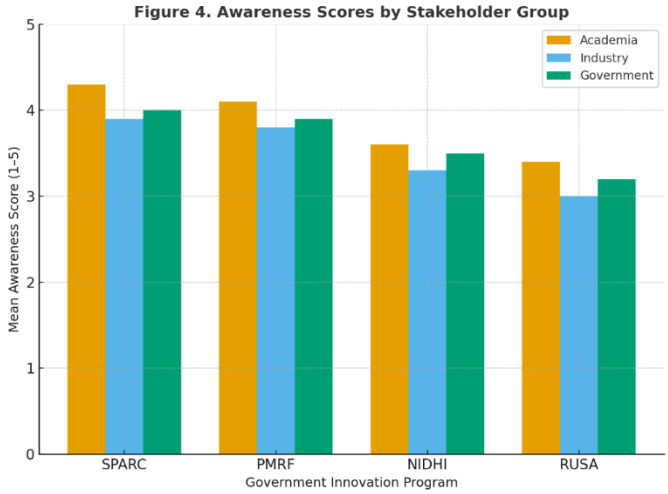

Figure 3 Awareness Scores by Stakeholder Group

4.2 Factor Analysis Results – Awareness & Perception Dimensions

To examine the structure underlying awareness and perceptions of the Triple Helix model, Exploratory Factor Analysis (EFA) was applied using principal components with varimax rotation [14], [15]. The results confirmed the suitability of the dataset (KMO = 0.81, Bartlett's $p < 0.001$). A four-factor structure explained 70.1% of total variance, each dimension representing a core element shaping stakeholder engagement [13–15].

Factor 1: Policy Awareness and Institutional Alignment (23.1%)

This factor represents knowledge of key programs (SPARC, PMRF, RUSA, NIDHI) and perceived alignment of institutional goals with national innovation strategies [18–20]. High scorers displayed a strategic understanding of policies, often associated with higher engagement in funding proposals and collaboration networks [19].

Factor 2: Perceived Collaboration Effectiveness (18.8%)

This dimension covers perceptions of role clarity, transparency, and communication in tri-partite collaborations [13]. While most respondents viewed collaborations as beneficial, many highlighted bureaucratic hurdles and ambiguous responsibilities as significant obstacles [19].

Factor 3: Institutional Capacity for Innovation (15.6%)

This factor reflects research infrastructure, skilled human resources, and leadership support [19]. Strong scores were concentrated in IITs and IISERs, whereas smaller INIs or medical institutions reported gaps in funding and commercialization infrastructure [18], [20].

Factor 4: Systemic Barriers and Enablers (12.6%)

This dimension includes bureaucratic rigidity, lack of industry incentives, IP issues, and communication barriers, along with enabling structures like incubators and liaison offices [18], [19]. Respondents noted that policies exist but monitoring and feedback mechanisms remain weak [19].

Table 4 Factor Analysis Results – Rotated Component Matrix (Varimax Rotation)

Variable / Item	**Factor 1: Policy Awareness**	**Factor 2: Collaboration Effectiveness**	**Factor 3: Institutional Capacity**	**Factor 4: Systemic Barriers**
Awareness of national innovation programs (SPARC, PMRF, RUSA, NIDHI)	**0.84**	0.19	0.22	0.05
Understanding of government policy objectives	**0.79**	0.24	0.21	0.12
Engagement in university–industry joint projects	0.15	**0.81**	0.18	0.09
Frequency of academic–industry–government meetings	0.26	**0.77**	0.22	0.14
Institutional funding support for innovation activities	0.23	0.25	**0.74**	0.10
Availability of trained R&D staff and labs	0.28	0.19	**0.71**	0.12
Bureaucratic delays in collaboration approval	0.11	0.15	0.18	**0.83**
Lack of incentives for industry participation	0.14	0.22	0.16	**0.79**
Communication barriers among stakeholders	0.19	0.27	0.25	**0.75**
Eigenvalue	3.46	2.82	2.34	1.89
% Variance Explained	23.1%	18.8%	15.6%	12.6%
Total Variance Explained				**70.1%**

These factors highlight a layered ecosystem where awareness is necessary but not sufficient for effective collaboration. Institutional capacity and systemic conditions critically shape how well policies are translated into practice [13], [18]–[20].

4.3 Stakeholder Group Comparisons (Academia, Industry, Government)

To analyse differences across stakeholder groups, a one-way ANOVA was conducted on the factor scores and overall perception index. The results (Table 5) revealed significant differences ($p < 0.05$) across most dimensions.

- Academia showed the highest levels of policy awareness and perceived effectiveness (Overall $M \approx 4.08$). Academics cited SPARC and PMRF as instrumental in funding research and expanding international collaborations [18]–[20]. However, they also flagged institutional bureaucracy and inconsistent funding cycles as key barriers to sustained partnerships [19].
- Government respondents demonstrated moderate awareness ($M \approx 3.85$) and recognized program effectiveness but emphasized coordination challenges across ministries and agencies. They acknowledged the lack of robust evaluation frameworks, which weakens long-term monitoring of collaboration outcomes [18], [19].
- Industry had the lowest awareness and perception levels ($M \approx 3.46$), particularly among SMEs, who face challenges like unclear IP frameworks, slow approvals, and informal collaboration mechanisms [19]. While large corporations engage through structured partnerships, SMEs often rely on personal networks rather than institutional channels.

Table 5 ANOVA Results Comparing Mean Perceptions Across Stakeholder Groups

Dependent Variable	Between-Group df	Within-Group df	F-Statistic	p-Value	Significant Differences (Tukey HSD)
Policy Awareness	2	304	**6.48**	**0.002**	Academia > Industry*
Collaboration Effectiveness	2	304	**5.92**	**0.003**	Academia > Government*
Institutional Capacity	2	304	**4.11**	**0.017**	Academia > Industry ($p < .05$)
Systemic Barriers	2	304	**3.68**	**0.026**	Industry > Academia ($p < .05$)
Overall Perception Index	2	304	**7.43**	**0.001**	Academia > Industry and Government**

These findings underline that industry remains the least integrated helix, with weaker awareness and perceptions compared to academia and government [19], [23]. Bridging this gap is critical to realizing the full collaborative potential of India's innovation ecosystem [18-20].

4.4 Qualitative Insights from Interviews

Overall, the qualitative findings reinforce the quantitative results by showing that awareness is concentrated but uneven, perceptions are positive but cautious, and collaboration potential is high but underutilized [10], [18]. Stakeholders share a collective belief in the importance of the Triple Helix model but emphasize that translating policy into practice requires institutional reforms, enhanced communication, and stronger trust-building mechanisms among all three sectors [1], [6].

A thematic analysis of the twelve semi-structured interviews presented a rich context to these quantitative trends; there were four themes present, namely policy alignment, institutional culture, awareness communication, and barriers to collaboration [10], [18].

- Policy Alignment: Governmental officials were optimistic about the India policy architecture on the topic of innovation—in particular NEP 2020, AIM, and Startup India—but identified coordination issues between

ministries and universities. This is in line with the moderate scores of collaboration effectiveness realized in the quantitative findings [18–20].

- Institutional Culture: Academic leaders found that despite the fact that patents or start-ups are more appropriate than publications as reward systems, they have adopted an incentive system that is misaligned. It was a popular cause to reform the faculty appraisal systems to appreciate innovation and results of partnerships [19].
- Information Awareness: It was also discovered by both academic and industrial stakeholders that poor information dissemination was a bottleneck. They have circulars and announcements, but these may be inaccessible or unclear to the industry players, especially the SMEs, and this is what influences their lower awareness levels [19].
- Obstacles to Cooperation: According to the stakeholders, bureaucratic delays, IP ambiguity, and the absence of standard templates were listed as the obstacles. There is also an issue of capacity of smaller institutions such as few liaison offices and administrative support. But the respondents also admitted positive changes that included the growth of incubation centres and innovation cells [18–20].

On the whole, the interviews support the ambivalent image provided by the quantitative data: the awareness of policies is focused, perceptions are sceptically positive, and institutional preparedness is not even [18], [19]. The Triple Helix model is considered by many as valuable, but to achieve the full effect, it should be communicated more clearly, incentives aligned, collaboration processes simplified, and especially industry—and SMEs in particular—need to be more active participants in the ecosystem [13], [19].

5. Discussion

5.1 Interpretation of Awareness Levels in Indian INIs

The examination shows that the understanding of government-based innovation initiatives at Institutions of National Importance (INIs) in India is organized and not standardized [18], [19]. The awareness of programs like SPARC and PMRF remains high due to their close focus on current systems of incentives, specifically the one that currently prioritizes the output of research, internship programs, and collaboration with the international community [18]–[20]. This high diffusion among the faculty is enhanced by the fact that they are administered by the Ministry of Education and communicated specifically through academic channels [19], [20]. This highlights the use of policy objectives in ensuring high awareness by means of alignment of policy objectives with institutional incentives [18], [20].

On the other hand, there is a lack of awareness regarding RUSA and NIDHI [18], [19]. RUSA has a stronger presence in state universities than in INIs, which is why it is not as visible, whereas NIDHI is focused on engineering and management research, but has minimal penetration into basic sciences and medicine [19]. It is such a disciplinary asymmetry that can be used to reflect an uneven-yet-unequal landscape of innovation [18]. Academia > Government > Industry Awareness gradient shows the asymmetry in communication between the helices [19]. Academia is given systematic information and industry is left at the fringe whereby transfer of knowledge and diffusion of technology is not possible [23]. The Triple Helix theory proposed by Etzkowitz and Leydesdorff suggests that all three helices have to be engaged in a balanced way to create systemic innovation [1], [6]. The system in India is still academic in nature and not industrialized, which creates an imbalance in structure and thus restricts collaborative results [18], [19].

5.2 Stakeholder Perceptions: Benefits and Barriers

Stakeholder perceptions reveal a duality: widespread optimism about Triple Helix potential but frustration over persistent operational barriers [1], [6], [13]. Academics and government respondents emphasize the model's strategic value for increasing research relevance, attracting non-governmental funding, and accelerating technology transfer [13], [19]. Yet these positive perceptions are undermined by bureaucratic hurdles, unclear IP frameworks, and inadequate financial incentives [18], [19]. Industry respondents, in particular, highlight high transaction costs, procedural delays, and limited clarity on IP ownership as deterrents to deeper collaboration [19]. Additionally, an entrenched publication-driven academic culture disincentivizes faculty from engaging in commercialization [13], [19]. This divergence between strategic optimism and operational difficulty indicates that structural and cultural reforms—not just administrative adjustments—are required to enable seamless collaboration [18]–[20].

5.3 Comparative Insights: India vs. Global Contexts

A comparison with global contexts positions India's Triple Helix model in an "emergent" stage [8], [18]. Similar to other late-industrializing nations like South Korea and China, India employs a top-down, policy-driven strategy [8]. This ensures strong governmental involvement but results in limited industry engagement and uneven institutional maturity [19]. In contrast, advanced innovation systems like those in the United States, Finland, or Singapore are characterized by bottom-up, market-oriented dynamics where government, academia, and industry co-evolve through shared governance [3], [6], [8]. In India, collaborations remain transactional rather than systemic, and the significant differences in the perception index ($p = 0.001$) confirm a lack of shared operational reality [18]. Bridging this gap requires transitioning from policy mandates to organically sustained co-innovation [6], [13], [18].

5.4 Role of Government, Industry, and Academia in Triple Helix Adoption

Each helix plays a distinct role in Triple Helix adoption [1], [6]. Government, as the principal architect, shows high policy awareness but faces coordination gaps across ministries [18], [19]. To act as a true facilitator, it must harmonize protocols, simplify IP frameworks, and lower transaction costs [18], [20]. Academia, as the most engaged helix, is well aligned with policy but constrained by incentive systems focused on publications rather than commercialization [13], [19]. Institutional reforms should emphasize IP creation, start-up incubation, and spin-offs [18]–[20]. Industry, currently the least engaged helix, needs clearer incentives, transparent IP arrangements, and low-friction engagement pathways [19]. Actively involving SMEs can be a strategic lever for scaling collaborative innovation [20].

5.5 Policy and Institutional Implications

Strengthening India's Triple Helix ecosystem requires reforms at both policy and institutional levels [18]–[20]. At the policy level, an Integrated National Innovation Coordination Framework could unify ministries, funding bodies, and research agencies under one strategy, reducing administrative fragmentation and creating a central Triple Helix observatory [18]. This would streamline grants, enhance IP transparency, and increase industry confidence [19], [20]. At the institutional level, Innovation Liaison Offices (ILOs) or Technology Transfer Units (TTUs) should be established to translate policy into practice, manage partnerships, and build trust with industry [13], [19]. Embedding innovation metrics in faculty appraisal systems can further align academic incentives with collaborative goals [19], [20]. Finally, developing regional innovation clusters that connect INIs with local industries and state governments can decentralize innovation and democratize participation [18], [20], [26]. Such systemic and cultural shifts would allow India to evolve from a policy-driven model to a mature, co-innovative Triple Helix ecosystem [1], [6].

6. Implications for Practice and Policy

6.1 For Policymakers

A key implication for policymakers is the urgent need to institutionalize inter-ministerial coordination through a high-level National Innovation Steering Committee (NISC) [18]–[20]. This body should include top representation from the Ministry of Education, DST, DIPP, and NITI Aayog, with authority to align policies, resolve jurisdictional conflicts, and reduce fragmentation [19]. Equally critical is the establishment of a Single-Window Clearance system for Triple Helix projects, integrating submission, approval, and funding processes, coupled with strict statutory timelines to reduce bureaucratic delays [18], [19].

To address the industry awareness gap, targeted outreach campaigns tailored to SMEs should communicate program benefits and simplify access, accompanied by tax incentives and R&D subsidies for formal collaborations with INIs [20]. Policymakers must also standardize IP frameworks for joint ownership, licensing, and revenue-sharing to mitigate investment risks [19]. Finally, a shift from input-based to outcome-based evaluation metrics is essential to ensure that policy success is measured through tangible outputs such as patents, commercialization outcomes, and industry-linked innovation [13], [18]–[20].

6.2 For Institutions of National Importance

For INIs, a strategic shift from fragmented engagement to professional innovation management is necessary [18], [19]. Establishing Innovation Liaison Offices (ILOs) as dedicated interfaces between academia, industry, and government can streamline IP management, contracts, and market outreach [13], [19]. Reforming faculty appraisal systems to value innovation equally with publications will counteract the entrenched publication bias and encourage IP creation, start-ups, and technology transfer [19], [20].

Curricular reforms should integrate entrepreneurship, IP management, and commercialization modules, aligning doctoral research with industry needs [13], [18]. Additionally, leveraging the visibility of successful programs like SPARC and PMRF through strategic industry-facing forums can enhance trust and foster long-term research consortia, positioning INIs as active innovation hubs [18]–[20].

6.3 For Industry Partners

For industry, the findings highlight the need to move beyond transactional partnerships toward co-creation of research agendas [13]. This involves funding academic R&D centres, defining industry-relevant challenges, and investing in institutionalized platforms such as incubation centres and technology parks for stability and scalability [18], [20].

Strategic use of CSR funding can provide sustained support for university-based research with commercialization potential [19]. Finally, mentorship and skill development programs led by industry experts can embed market insights into academic innovation, enhancing the commercial readiness of technologies and bridging the gap between laboratory research and real-world application [13], [19].

8. Conclusion

8.1 Summary of Key Findings

This mixed-methods study provides a rigorous empirical assessment of stakeholder awareness and perceptions of the Triple Helix model of innovation within India's Institutions of National Importance (INIs), focusing on SPARC, PMRF, RUSA, and NIDHI. The results indicate that India has a strong government-led innovation architecture but remains in an emergent and asymmetric operational phase. Quantitatively, three key findings stand out. First, awareness levels are uneven across the helices, with academia demonstrating the highest awareness (M=4.10), particularly for SPARC and PMRF, while industry exhibits the lowest (M=3.46). Second, factor analysis revealed four distinct perception dimensions—Policy Awareness, Collaboration Effectiveness, Institutional Capacity, and Systemic Barriers—with bureaucratic delays and IP ambiguity being major inhibitors. Third, ANOVA confirmed significant inter-helix differences (F=7.43, p=0.001), with academia holding the most positive perceptions and industry remaining cautious and critical.

Qualitative insights reinforced these results, identifying publication-focused academic culture and inter-ministerial coordination gaps as primary operational barriers, while highlighting strong government commitment and the establishment of institutional innovation cells as enablers. Theoretically, this research extends Triple Helix scholarship by providing a quantifiable, four-dimensional framework for measuring perceptual alignment and system maturity in an emerging economy context. Practically, it delivers targeted insights for policy and institutional reform—emphasizing standardized IP frameworks, simplified administrative mechanisms such as Single-Window Clearance, and innovation-oriented faculty appraisal systems.

Ultimately, India's innovation ecosystem must evolve from policy intent to operational integration. Achieving this requires coordinated administrative reform, strategic communication with industry, and cultural shifts within INIs. By fostering mutual trust and balanced engagement across academia, government, and industry, India can unlock the full potential of its intellectual capital and transition toward a mature, synergistic Triple Helix innovation system.

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23. Appendix
24. Table: List of Institutes of National Importance (INIs) by the Government of India (As per the act of Parliament)