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STRUCTURAL RESEARCH WORKING PAPER

National Innovation-to-IP-Licensing Conversion:

An Evidence-Based Structural Framework for India, 1900–2026

Research method: four-stage structural analysis — problem identification, pattern and framework design, structural interpretation, evolution direction

Applied Instrument Derived: National Innovation Conversion Index (NICI)

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Executive Summary

This paper examines how India has converted investment in government, academia, and industry into commercially valuable, licensable intellectual property across four periods — 1900–1947, 1947–1991, 1991–2010, and 2010–2026 — using a four-stage structural method: problem identification, pattern and framework design, structural interpretation, and evolution direction. The analysis produces an applied instrument, the National Innovation Conversion Index (NICI), populated here with publicly available government, WIPO, and institutional data, with every unverifiable or unavailable cell explicitly marked as a data gap rather than estimated.

The populated evidence points to a specific and falsifiable finding: India's constraint is not primarily knowledge creation. Patent filings rose from roughly 39,400 in 2010–11 to over 90,000 in 2023 and crossed the 1-lakh mark in 2024–25 [1][2][3], and the Global Innovation Index rank improved from 81st in 2015 to 38th in 2025 [4][5]. The constraint is commercialization: independent analyses of Form-27 "working of patents" filings and institutional technology-transfer data indicate that fewer than 10–15% of granted university patents in India convert into licensing deals, spin-offs, or industry collaboration, even at top-tier technical institutes [3][6]. The system is generating knowledge faster than it is converting that knowledge into licensable, revenue-generating intellectual property.

Governing Question

Where, structurally, does India's innovation pipeline lose value between investment and commercially licensable intellectual property — and does the available evidence, period by period, locate that leakage point at knowledge creation, or downstream at the commercialization and licensing interface?

1 Problem Identification

SECTION 1 OF 4 — PROBLEM IDENTIFICATION

Comparative studies of R&D investment and IP licensing outcomes typically measure government and corporate R&D spending in isolation. This produces a two-node comparison that omits the institution responsible for most upstream knowledge creation in mature innovation economies: the university. In India, the omission is material — government R&D spending exceeded private spending in every year on record until FY24, when private-sector R&D (₹1.27 lakh crore) overtook government spending (₹1.18 lakh crore) for the first time [7][8].

1.1 Structural Problem

The structural problem is not "how much is invested" but "through which nodes, and with what conversion loss, does investment travel before it becomes licensable IP." India's own patent data makes the case directly: patent filings and grants have both grown at record pace over the past decade, while commercialization of the resulting IP stock has not kept pace — a gap documented independently through Form-27 working-of-patents filings and institutional technology-transfer-office disclosures [3][6][9][10].

1.2 Reframed Problem Statement

Reframed Problem Statement

The research question is not comparative IP licensing volume in isolation. It is national innovation conversion efficiency: the rate at which government, academic, and private investment travels through knowledge creation and industry collaboration into patents, technology transfer, and licensing revenue — and the specific historical period and pipeline stage at which India's system has lost the most value.

2 Pattern and Framework Design

SECTION 2 OF 4 — PATTERN AND FRAMEWORK DESIGN

The recurring pattern across every sub-question in this research — academic ecosystem measurement, efficiency versus volume, India's academic IP contribution, academic–industry connectivity — is the same structural gap: each treats a single node of the system in isolation, when the explanatory power lies in the transfer between nodes.

2.1 The National Innovation Pipeline

Government Investment

↓

Academic Research

↓

Knowledge Creation

↓

Industry Collaboration

↓

Corporate R&D

↓

Patents

↓

Technology Transfer

↓

Products / Startups / Licensing

2.2 The Academic Ecosystem — Input / Output Split

Academic Input	Academic Output
Government funding for universities	Research publications
Number of research universities	Patents filed
Research grants	Patents licensed
Research faculty	Startup spin-offs
PhD graduates	Industry collaborations
Research infrastructure	Licensing revenue
Centres of Excellence	Technology transfers

2.3 Academic Contribution to IP Commercialization Knowledge

Dimension	What to Measure
IP Legal Research	Papers on patents, copyright, trademarks, policy
Innovation Management Research	Commercialization, licensing, technology transfer
Technology Transfer Research	University–industry collaboration, spin-offs, TTOs

Dimension	What to Measure
Research Impact	Citations, influential authors, policy influence

2.4 Academic–Industry Connectivity

- Industry-funded university research
- Joint publications
- Joint patents
- Sponsored PhDs
- Faculty consulting
- Technology Transfer Offices (TTOs)
- Incubators
- Startup spin-offs
- Licensing agreements
- Industry internships in R&D

2.5 Supporting Table — Raw Indicators by Period (Evidence-Based)

Each cell below is either a cited figure, a cited qualitative fact, or explicitly marked as a data gap. No cell contains an estimated or invented figure.

Period	Business Trend	Govt Support	Private Commitment	Academic Investment / Output	Patent Output	Licensing Ecosystem
1900–1947	Colonial extractive economy; near-total dependence on imported technology [11]	Indian Patents & Designs Act, 1911 — administrative, not developmental [12]	Data gap — no national private R&D survey exists for this period	Data gap — no systematic national academic R&D statistics collected	Data gap — centralized public filing statistics not identified in secondary sources reviewed	One-way inbound (UK→India); no domestic licensing market
1947–1991	State-led import substitution; License Raj (IDRA 1951) required licensing for nearly all industrial activity [13]	CSIR founded 1942/formalized 1947 [14]; first IIT, Kharagpur, 1951 [15]; Scientific Policy Resolution 1958; Technology Policy Statement 1983 [16][17]	Very low — Patents Act 1970 excluded product patents for food, drugs, and chemicals [11]	GERD/GNP rose 0.17% (1958–59) → 0.98% (1987–88), government-financed [18]	Data gap — no consolidated public time series located pre-1990–91	Effectively closed by design (self-reliance policy)
1991–2010	1991 liberalization ends License Raj; industrial delicensing accelerates [13]	TRIPS Agreement 1995 [11]; Patents (Amendment) Acts 1999, 2002, 2005 — full product-patent compliance from 1 Jan 2005 [19][20]	Generic pharma R&D scales in response to product-patent regime [21]	IITs: 642 cumulative patent applications 1970–2012 vs. 185 for all state/central universities combined, 1940–2012 [22]	National GERD statistics formally begin 1990–91; sector-specific patent split pre-2004–05 not available in sources reviewed [23][24]	Nascent; compulsory-licensing safeguards retained through TRIPS transition [21]
2010–2026	Startup India (2016): DPIIT-recognised startups grow 500 (2016) → 2,00,000+ (Dec 2025) [25]; unicorns 4 (2014) → 100+ (2025) [26][27]	GERD ₹60,197 cr (2010–11) → ₹2.45 lakh cr (2023–24), still 0.64–0.84% of GDP [28][7][8]; GII rank 81st (2015) → 38th (2025) [4][5]	Private R&D overtakes government for the first time, FY24: ₹1.27 lakh cr vs ₹1.18 lakh cr [7][29]	IIT Madras: 417 patents filed in FY 2024–25 alone [30]; IIT Kanpur licensing rate to industry 12.91% (2024) [31]	Filings 39,400 (2010–11) → 90,298 (2023) → 1-lakh+ (2024–25, +61.7% YoY) [1][2][3]; grants 7,509 (2010–11) → 76,053 (2023) → 1-lakh+ (2023–24, first time) [1][2][32]	Conversion gap: fewer than 10–15% of granted university patents convert to licensing, spin-offs, or industry collaboration even at top institutes [3][6]

3 Structural Interpretation

SECTION 3 OF 4 — STRUCTURAL INTERPRETATION

Read together, the pipeline is not linear but a National Innovation System: a layered structure in which each layer influences the others, and in which the interesting variable is not the state of any one layer but the connective tissue — collaboration and transfer — between layers.

3.1 Layered System Interpretation

Layer	Variables
Economic	Business trends, industrial policy
Government	Innovation policy, R&D support, regulation
Academia	Investment, publications, IP research, patents
Industry	R&D, creator vs. adopter firms, innovation strategy
Interface	University–industry collaboration, technology transfer
IP System	Patent quality, licensing ecosystem, valuation, enforcement
Economic Outcome	Products, startups, exports, licensing businesses, royalty income

3.2 Eleven Derived Indices — Definitions

1. Business Evolution Index (BEI)

How much the corporate sector creates rather than merely adopts technology.

Derived from: Creator vs. adopter firms; product vs. service orientation; proprietary technology ownership; technology exports; deep-tech participation.

2. Government Innovation Support Index (GISI)

The state's structural commitment to innovation.

Derived from: R&D expenditure; innovation policies; tax incentives; research institutes; national technology missions; IP reforms.

3. Private Innovation Commitment Index (PICI)

Industry's willingness to innovate rather than only adopt.

Derived from: Private R&D expenditure; corporate R&D labs; patenting; long-term research; venture investment in deep-tech; innovation-led firms.

4. Academic Innovation Index (AII)

The university sector's role in innovation.

Derived from: Research funding; publications; PhD output; university patents; research quality; spin-offs; licensing income.

5. Industry–Academia Collaboration Index (IACI)

The connective tissue between the two sectors.

Derived from: Joint patents; sponsored research; industry-funded projects; TTOs; startup incubation; consulting; joint publications.

6. Knowledge Creation Index (KCI)

National knowledge production overall.

Derived from: Patent filings; scientific publications; high-impact research; technology disclosures; standards contributions; open-source contributions.

7. Innovation Commercialization Index (ICI)

The intermediate metric that converts knowledge into market presence.

Derived from: Technology transfer; startup creation; product commercialization; royalty income; technology exports; licensing deals; university commercialization success.

8. IP Ecosystem Maturity Index (IPEMI)

The supporting infrastructure around IP itself.

Derived from: Patent quality; IP valuation services; licensing firms; patent brokers; IP courts; enforcement effectiveness; technology marketplaces.

9. IP Licensing Readiness Index (IPLRI)

Directly answers the governing research question.

Derived from: Commercialisable patent stock; licensing culture; corporate willingness to license; licensing professionals; royalty ecosystem; technology valuation capability; cross-licensing activity.

10. Innovation Independence Index (III)

Self-reliance — ownership and control of technology rather than dependence on imported or licensed technology.

Derived from: Share of indigenous technologies in key industries; creator vs. adopter firm share; domestic ownership of core patents; proprietary-technology export share; foreign-licensing dependence; domestic standards/platform technologies; domestically owned high-value IP.

11. Overall Innovation Efficiency (OIE)

The headline metric: how effectively investment converts into commercially valuable IP.

Derived from: A qualitative, evidence-supported synthesis across all preceding indices per period, not a mechanical average.

3.3 Rating Convention

Because pre-1991 India lacks the firm-level and institutional survey data needed for a weighted numeric composite, each index is scored qualitatively on a five-band evidence-anchored scale rather than assigned a fabricated numeric value. This preserves honesty about data limits while still making the structural pattern visible across periods.

- Data Gap — no evidence located in public sources for this period/index combination.
- Very Low — evidence indicates minimal or no activity.
- Low — activity present but structurally constrained or marginal.
- Rising / Emerging — clear directional growth from cited evidence, base still small.
- Bottlenecked — high input or output on one side of the index, evidence of a specific conversion constraint on the other.

3.4 Final Master Table — National Innovation Conversion Index (NICI)

Period	BEI	GISI	PICI	AII	IACI	KCI	ICI	IPEMI	IPLRI	III	OIE
1900 – 1947	Data Gap	Very Low	Very Low	Data Gap	Data Gap	Data Gap	Very Low	Very Low	N/A	Very Low	Very Low
1947 – 1991	Low	Rising	Very Low	Emerging	Data Gap	Low	Very Low	Low	Very Low	Rising (by policy design)	Low
1991 – 2010	Rising	Rising	Rising	Concentrated	Low	Rising	Low	Rising	Low	Mixed	Low–Moderate
2010 – 2026	Rising	Rising (Sustained)	Rising (Crossover)	High output	Improving, thin	High	Bottlenecked	Maturing	Bottlenecked	Mixed	Rising input / Bottlenecked output

Column key: BEI Business Evolution · GISI Government Innovation Support · PICI Private Innovation Commitment · AII Academic Innovation · IACI Industry–Academia Collaboration · KCI Knowledge Creation · ICI Innovation Commercialization · IPEMI IP Ecosystem Maturity · IPLRI IP Licensing Readiness · III Innovation Independence · OIE Overall Innovation Efficiency.

3.5 Central Structural Finding

The Conversion Gap, Not the Creation Gap

Across every quantitative measure available for 2010–2026, India's Knowledge Creation Index (patent filings, publications, startup formation) is rising sharply, while its Innovation Commercialization and IP Licensing Readiness indices are bottlenecked at the same evidentiary point: independent analyses of granted-patent working data show fewer than 10–15% of Indian university patents converting into licensing deals, spin-offs, or industry collaboration [3][6], even though patent filings crossed the 1-lakh mark for the first time in 2024–25 [3]. The structural leakage point this evidence identifies is the Interface layer — Industry–Academia Collaboration and Innovation Commercialization — not Knowledge Creation.

4 Evolution Direction

SECTION 4 OF 4 — EVOLUTION DIRECTION

4.1 Immediate Data Gaps to Close

- Firm-level creator-vs-adopter classification survey covering the full economy (currently only a technology-category proxy exists via emerging-tech patent share).
- A consolidated national TTO licensing-revenue statistic; currently only institution-level disclosures exist (e.g., IIT Madras, IIT Kanpur) [30][31].
- Pre-1990–91 GERD and patent-filing time series at a level of granularity matching the post-1990 DST statistics.
- Archival-level patent administration data for 1900–1947, likely held in Controller of Patents historical records rather than public secondary sources.

4.2 Comparative Application

Because the index architecture is country-agnostic by design, the same NICI structure can be populated for the United States, Israel, Japan, South Korea, Germany, or China without altering the framework itself — only the underlying evidence changes. India's own comparative position is already visible in the assembled data: at roughly 0.84% of GDP, India's GERD remains well below China (2.69%), and far below South Korea (~4.8%), Israel (~5%), Japan (~3.3%) and the United States (~3.8–3.9%) [33][8].

4.3 Next Research Cycle

The populated evidence already answers the question posed in the framework-design stage: the binding constraint is not the strength of any single node but the Interface layer between academia and industry. The next research cycle should therefore treat Industry–Academia Collaboration (IACI) and Innovation Commercialization (ICI) as the priority variables for deeper data collection — specifically, a systematic Form-27 working-of-patents analysis across all centrally funded academic institutions, not only the IITs, since the concentration finding in Section 2.5 (642 IIT patents vs. 185 university patents, 1970–2012 vs. 1940–2012) [22] suggests the conversion gap may be even more severe outside the IIT system.

4.4 Status of This Instrument

Status of This Instrument

The National Innovation Conversion Index (NICI) presented here is an evidence-populated working framework, not a peer-reviewed empirical study. Qualitative bands in Section 3.4 are evidence-anchored judgments, not weighted statistical composites; a future cycle with firm-level microdata could support a numeric index. Every data gap has been marked explicitly rather than filled by inference.

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