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INDIA'S INDUSTRIAL TECHNOLOGY TRANSFER ECOSYSTEM

FROM RESEARCH TO RESILIENCE.
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Strategic Intelligence Report

INDIA'S INDUSTRIAL TECHNOLOGY TRANSFER ECOSYSTEM

DRDO • CSIR • IITs • IISc • Defence PSUs • Technology Licensing Offices • Patents • Licensing • Spin-offs • Contract R&D

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All charts, exhibits, and tables in this report, unless explicitly attributed to a third-party source, are the original work of Techadyant Labs. The underlying source data for every figure is documented in the accompanying Excel workbook ("Techadyant Strategic Intelligence Workbook") and may be reproduced with attribution. The analytical frameworks (PESTLE, Porter's Five Forces, TRL, MECE,

SCR, Capability Matrix, Strategic Control Points) used in this report are public-domain or industry-standard methodologies; their application and synthesis herein is original to Techadyant Labs.

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Comments, corrections, and feedback are welcomed and may be sent to editorial@labs.techadyant.com. Material errata identified after publication will be published in a publicly accessible errata log at https://labs.techadyant.com/errata. The second edition of this report is planned for 2027.

About Techadyant Labs

Techadyant Labs is an independent strategic intelligence and research platform focused on India's industrial technology ecosystem. The Labs produce flagship publications, decision-grade briefings, and bespoke research for senior decision-makers in government, defence, capital, and industry. Techadyant's editorial model applies rigorous, source-disciplined analysis with clear, conclusion-first narrative and a consistent visual system.

The Labs' research agenda covers five interconnected domains:

(1) India's defence-industrial complex and DRDO/DPSU ecosystem;

(2) deep-tech venture formation and capital flows;

(3) academic technology transfer and university spin-off dynamics;

(4) strategic control points in critical supply chains; and

(5) policy and regulatory architecture for innovation.

Each domain is treated as both a standalone research stream and a node in a larger ecosystem map — Techadyant's intellectual signature is the synthesis across silos, not the depth within any single silo.

Techadyant Labs is editorially independent. The Labs do not manage client capital, do not take equity in companies they analyse, and do not lobby on behalf of any industry participant. The Labs fund their research through subscription products, bespoke commissioned studies, and educational programmes. This independence is a structural feature of the Techadyant model, not an aspiration; it is enforced through governance policies that separate the editorial function from commercial functions.

The Labs operate from India with a global readership. Techadyant's reports are produced to a professional strategic-intelligence standard, with primary sources cited throughout and modelled estimates clearly labelled, and with particular depth on the Indian ecosystem.

For more information, visit https://labs.techadyant.com. For subscription enquiries, commissioned research, or speaking engagements, contact labs@ltechadyant.com.

Editorial Note

This report was prepared using a multi-disciplinary editorial methodology combining structured analytical frameworks, primary and secondary research, and explicit source attribution. The objective was to produce a publication that is analytically rigorous, structurally disciplined, and clear to read — a document that a CEO could read in 90 minutes for the executive summary, or in eight hours for the complete argument, and emerge with a confidence-calibrated, evidence-based view of India's industrial technology transfer ecosystem.

Every chapter follows a uniform architecture: an Executive Takeaway at the opening; the consulting-standard Situation–Complication–Analysis–Evidence–Strategic Insight–Implications–Recommendations–Future Outlook arc; at least one original exhibit per chapter; and a Key Takeaways box at the close. This architecture was applied with discipline; deviations are rare and intentional. The reader can navigate the report by chapter, by exhibit, or by stakeholder recommendation and consistently find the same logical scaffolding.

The report's analytical posture is conclusion-first, in the consulting tradition. Every paragraph opens with its conclusion; supporting evidence and quantitative data follow. This is not a stylistic affectation but a reader-respecting discipline: an executive reader should be able to extract the report's argument from the first sentence of every paragraph alone, and to descend into the supporting detail only where the conclusion is contested or non-obvious. Where the conclusion requires hedging — because the evidence is incomplete or the future genuinely uncertain — the hedging is explicit and stated in the conclusion itself, not buried in a subordinate clause.

All numerical claims in the report are either (a) drawn from a public, verifiable source cited in the end notes; or (b) constructed as modelled estimates with the underlying assumption set explicitly stated. Where official figures are unavailable — most acutely in the case of defence R&D internal allocations, private startup financials, and patent-to-product conversion rates — Techadyant Labs has built bottom-up estimates from primary research and triangulated against published proxies. The accompanying Excel workbook documents the source for every figure in the report and provides the underlying datasets.

The report is structured to be read in any order. The Executive Summary is a standalone 12-page briefing that can be read independently of the body chapters. Each body chapter is similarly self-contained, although they are presented in a logical sequence from macro context to sectoral detail to strategic synthesis. The appendices function as a reference layer — company, startup, policy, funding, and lab databases — that supports the narrative without intruding on it. The methodology, references, and end notes provide full provenance for readers who wish to verify or extend the analysis.

Editorial judgement was exercised on three persistent tensions:

(1) depth versus breadth — the report favours depth on the most strategically important sectors (drones, space, semiconductors, AI) and is intentionally lighter on sectors where India's position is peripheral (commercial aviation, consumer robotics);

(2) prescription versus neutrality — the report's recommendations are explicit and prioritised, in the McKinsey Global Institute tradition, rather than presented as neutral options; (3) confidence versus

caveat — the report states conclusions with confidence where evidence supports them and explicitly labels speculative or scenario-based content. Readers are invited to disagree with any specific conclusion; the methodology and evidence trail make such disagreement productive rather than reflexive.

The report was compiled over a six-month research cycle. It will be updated biennially. Interim updates, errata, and supplementary research notes are published at https://labs.techadyant.com.

How to Read This Report

This report is designed to serve four distinct reading modes. Busy executives should read the Executive Summary in full (approximately 25 minutes) and then jump directly to the Strategic Recommendations chapter (Chapter 17). Investors and capital allocators should read the Executive Summary, Chapter 14 (Investment Landscape), Chapter 16 (Strategic Scenarios), and the sectoral deep-dives in Chapter 10 that correspond to their sector focus. Policymakers and government officials should read Chapters 1, 12, 15, and 17 in sequence. Defence planners should read Chapters 2, 5, 10 (defence-relevant sectors), 13, and 17. Each reading mode produces a complete and self-consistent view of the report's argument; the body chapters beyond those listed provide supporting depth for readers who wish to interrogate specific claims.

Structural Conventions

Every body chapter opens with an Executive Takeaway box — a single-paragraph statement of the chapter's central conclusion. The reader who reads only the Executive Takeaways across all chapters will have captured approximately 80 percent of the report's analytical content. The body of each chapter then unfolds the Situation–Complication–Analysis–Evidence–Strategic Insight–Implications–Recommendations–Future Outlook arc. Each chapter closes with a Key Takeaways box that summarises the chapter in five to seven numbered points.

Exhibits — figures and tables — are numbered sequentially (Figure 1 through Figure 26; Table 1 through Table 25). Each exhibit has a title, a source citation, and a Key Insight annotation that distils the single most important inference the reader should draw. Exhibits are referenced in the surrounding text and interpreted; no exhibit is decorative. The List of Figures and List of Tables (front matter) provides a complete index. All figures are also available as separate high-resolution PNG and SVG files in the figures package.

Visual Conventions

The report uses a four-colour palette throughout. Deep Navy (#0A1F44) denotes primary content, headings, and primary data series. Indian Saffron-Red (#C8102E) denotes accent elements, critical findings, and India-specific data points in international comparisons. Bronze (#C5A572) denotes key performance indicators and highlighted metrics. Slate Grey (#475569) denotes body text and secondary data. The palette is functional, not decorative — colour changes carry semantic meaning.

Three types of callout box appear throughout: Executive Takeaway boxes (navy-bordered, at the opening of each chapter); Strategic Insight callouts (saffron-red left-border, mid-chapter where the strategic implication of evidence is unpacked); and Key Takeaways boxes (bronze-bordered, at the close of each chapter). Quote boxes and case-study boxes appear less frequently and are visually distinct.

Citation and Provenance

Every numerical claim in the report is supported by either a published source (cited in the end notes) or a clearly labelled Techadyant Labs estimate (with the assumption set documented). The Methodology appendix documents the research process, including primary research interviews, secondary source selection, analytical frameworks applied, and quality-assurance procedures. The References section provides complete bibliographic information. The accompanying Excel workbook contains the underlying data for every figure and table in the report.

Where the report presents forward-looking scenarios, the probability weights assigned are the editorial judgement of Techadyant Labs as of the publication date and are not statistical probabilities. Where the report makes prescriptive recommendations, each recommendation is paired with a suggested owner (ministry, institution, or stakeholder group), a recommended timeline, and the key performance indicator against which progress should be measured. Recommendations are not aspirational; they are designed to be executable.

Language and Terminology

The report uses formal executive English throughout. First occurrences of technical terms are spelled out with abbreviations in parentheses; subsequent occurrences use the abbreviation alone. The Glossary and Abbreviations list in the front matter provides a complete reference. Indian English conventions are followed for currency (lakh, crore), dates (day-month-year), and institution names; non-Indian readers should consult the Glossary for unfamiliar terms.

Acknowledgements

This report benefited from the input of numerous individuals across India's research, government, industry, and capital ecosystems. Techadyant Labs is grateful to the serving and former officials of the Defence Research and Development Organisation, the Council of Scientific and Industrial Research, the Indian Institutes of Technology, the Indian Institute of Science, the Defence Public Sector Undertakings, the Ministry of Defence, the Ministry of Science and Technology, the Department for Promotion of Industry and Internal Trade, and the National Research Foundation who consented to background interviews and provided institutional context that materially shaped the analysis.

Founders and senior executives at more than forty deep-tech startups — including but not limited to IdeaForge, Skyroot Aerospace, Agnikul Cosmos, Pixxel, Garuda Aerospace, Ather Energy, Tan90 Thermal, SigTuple, and Bellatrix Aerospace — generously shared operational data, fundraising experience, and strategic perspectives on the Indian tech transfer ecosystem. Their candour about both successes and frustrations was essential to the report's diagnostic accuracy.

Several senior partners and principals at Indian and global venture capital firms — including but not limited to Blume Ventures, Accel India, Sequoia Capital India (Peak XV), Lightspeed India, Omnivore, Axilor Ventures, Speciale Invest, and 3one4 Capital — provided deal-flow data, sector insights, and perspectives on capital allocation that informed Chapter 14 and the investment thesis sections of the Executive Summary.

Academic researchers at IIT-Bombay, IIT-Madras, IIT-Delhi, IIT-Kanpur, IISc Bengaluru, and IIT Hyderabad provided access to incubation cell data, patent filing records, and spin-off histories. The Technology Licensing Office staff at these institutions — under-resourced and over-burdened as they uniformly are — were particularly generous with their time.

The analytical framework and editorial discipline of this report were shaped by Techadyant Labs' editorial team, applying conclusion-first writing, a structured (MECE) chapter architecture, and explicit recommendation-ownership throughout. The analysis, conclusions, and recommendations and any remaining weaknesses are the editorial team's responsibility alone.

Finally, Techadyant Labs acknowledges the broader community of India's strategic-affairs analysts, defence journalists, and academic observers whose published work — frequently under-credited — has built the cumulative knowledge base on which this report draws. Specific attributions appear in the References and End Notes sections.

Any errors of fact, interpretation, or emphasis are the sole responsibility of Techadyant Labs. Readers who identify errors are encouraged to write to editorial@labs.techadyant.com; material errata will be published and corrected in the next edition.

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Glossary & Abbreviations

The following glossary defines the technical terms, institutional names, abbreviations, and analytical frameworks used throughout this report. First occurrences in the body chapters are spelled out with abbreviations in parentheses; subsequent occurrences use the abbreviation alone. Readers are invited to consult this glossary whenever an unfamiliar term is encountered.

Term	Full Form	Definition & Notes
ANRF	**Anusandhan National Research Foundation**	Est. 2023 by ANRF Act; replaces earlier NRF concept; disburses research funding across Indian universities and is intended to bridge the academic-industry gap. Operationalisation in progress as of 2026.
Bayh-Dole Act	**Bayh-Dole University and Small Business Patent Procedures Act (1980, USA)**	US law allowing universities, small businesses, and non-profits to retain title to inventions made under federally-funded research. The single most-cited legal foundation of university tech transfer globally; India does not have an equivalent.
CAGR	**Compound Annual Growth Rate**	Year-over-year growth rate assuming compounding. Standard metric for expressing multi-year growth trends in market sizing and financial analysis.
CSIR	**Council of Scientific and Industrial Research**	India's largest civilian R&D organisation; 37 laboratories; approximately 4,000 scientists; established 1942. Reports to the Ministry of Science and Technology.
DPSU	**Defence Public Sector Undertaking**	Government-owned corporation under the Ministry of Defence. India has 9 DPSUs: HAL, BEL, BDL, BEML, MDL, GSL, HSL, Midhani, and Yantra India (formed from erstwhile Ordnance Factory Board restructuring).
DRDO	**Defence Research and Development Organisation**	India's premier defence R&D agency, established 1958; 52 laboratories across 7 cluster verticals; approximately 5,000 scientists and 25,000 total personnel. Reports to the Ministry of Defence.
GERD	**Gross Domestic Expenditure on R&D**	Total R&D expenditure as a percentage of GDP. India's GERD/GDP ratio in 2023 was 0.65 percent — approximately one-fifth the OECD average of 2.73 percent.
iDEX	**Innovations for Defence Excellence**	MoD programme launched 2018 to engage Indian startups and MSMEs in defence innovation. Provides grants, mentorship, and procurement pathways. iDEX Prime (launched 2023) offers larger tickets.
IISc	**Indian Institute of Science**	Founded 1909 in Bengaluru; India's top-ranked research institution; operates the Society for Innovation and Development (SID) as its tech transfer arm.
IIT	**Indian Institute of Technology**	Premier engineering institution system; 23 IITs across India as of 2026. The five original IITs (Bombay, Madras, Delhi, Kanpur, Kharagpur) account for approximately 60 percent of IIT-system spin-offs.

Term	Full Form	Definition & Notes
IN-SPACe	**Indian National Space Promotion and Authorisation Centre**	Autonomous body under the Department of Space, established 2020. Acts as the single-window interface for private-sector engagement with ISRO and the broader Indian space ecosystem.
IPR	**Intellectual Property Rights**	Rights conferred on owners of intellectual property — patents, trademarks, copyrights, trade secrets, geographical indications. India's IPR framework is governed by the National IPR Policy 2016.
MECE	**Mutually Exclusive, Collectively Exhaustive**	McKinsey analytical principle: any decomposition should produce components that neither overlap (mutually exclusive) nor leave gaps (collectively exhaustive). Applied throughout this report's chapter architecture.
MoD	**Ministry of Defence**	Government of India ministry responsible for defence policy and the defence-industrial complex. DRDO, the DPSUs, the Armed Forces, and the Department of Defence Production report to MoD.
NIIF	**National Investment and Infrastructure Fund**	Sovereign-affiliated fund of funds established 2015; collaborates with global investors on Indian infrastructure and strategic investments. Has been discussed as a vehicle for a National Deep-Tech Fund.
NIDHI	**National Initiative for Developing and Harnessing Innovations**	Umbrella DST programme (2016) for innovation support, including the NIDHI-PRAYAS prototype grant and NIDHI Centres of Excellence.
PESTLE	**Political, Economic, Social, Technological, Legal, Environmental**	Macro-environmental analysis framework. Applied in Chapter 1 to assess the operating context of India's tech transfer ecosystem.
PPP	**Purchasing Power Parity**	Adjusts GDP, GERD, and other economic indicators for cost-of-living differences across countries. Used throughout the report for international R&D comparisons.
SBIR/STTR	**Small Business Innovation Research / Small Business Technology Transfer**	US programmes requiring federal agencies with extramural R&D budgets over $100M to allocate a portion (currently 3.2% for SBIR, 0.45% for STTR) to small businesses. Frequently cited as a model for India.
SCR	**Situation-Complication-Resolution**	McKinsey executive-summary framework. Situation: the current state. Complication: the problem or change. Resolution: the recommended response. Used in this report's Executive Summary.
SINE	**Society for Innovation and Entrepreneurship**	IIT-Bombay's business incubator, founded 2004. One of India's earliest university-based incubators; has incubated IdeaForge, Netradyne, and others.
SPV	**Special Purpose Vehicle**	Separate legal entity established for a specific project or transaction. Frequently used in defence procurement and infrastructure project structuring.
TAM/SAM/SOM	**Total/Serviceable Addressable/Obtainable Market**	Market sizing framework. TAM = global market; SAM = portion India can address; SOM = realistic India share. Applied in Chapter 14 and Appendix H.
TDB	**Technology Development Board**	DSIR-affiliated body providing concessional loans and grants for commercialisation of indigenous technology. Established 1996; corpus approximately ₹500 crore.

Term	Full Form	Definition & Notes
TDF	**Technology Development Fund**	DRDO programme providing grants to Indian industry for development of defence technologies. Operational since 2019; budget expanded in 2023.
TLO	**Technology Licensing Office**	The institutional function within a university or research lab responsible for patent filing, licensing negotiations, spin-off formation, and industry engagement. Sometimes called Technology Transfer Office (TTO).
ToT	**Transfer of Technology**	Generic term for movement of technology from a research/development entity to a production/commercial entity. In the Indian defence context, often refers specifically to DRDO licensing to DPSUs or private industry.
TRL	**Technology Readiness Level**	9-point scale (TRL 1 = basic principles observed; TRL 9 = system proven in operational environment). Originally NASA; now ISO 16290. Used throughout this report for sectoral maturity assessment.
UAV	**Unmanned Aerial Vehicle**	Drone aircraft category. India's UAV ecosystem spans military (DRDO Rustom, ADE Nishant), commercial (IdeaForge, Garuda), and consumer segments.
UKRI	**UK Research and Innovation**	UK umbrella body (established 2018) consolidating the seven research councils, Research England, and Innovate UK. Cited as an institutional consolidation benchmark.
WIPO	**World Intellectual Property Organisation**	UN agency for intellectual property. Publishes the annual World Intellectual Property Indicators report, a primary source for Chapter 7 of this report.
Yissum	**Hebrew University Technology Transfer Company**	The tech transfer arm of the Hebrew University of Jerusalem; consistently ranked among the world's top 15 TTOs by licensing revenue. Cited as an Israeli benchmark for India.

Executive Summary

India's industrial technology transfer ecosystem stands at an inflection point. The country has built, over seven decades, one of the developing world's largest publicly-funded research apparatus — 52 DRDO laboratories, 37 CSIR laboratories, 23 Indian Institutes of Technology, the Indian Institute of Science, nine Defence Public Sector Undertakings, and dozens of specialised institutes. Yet the conversion of this research capacity into commercial products, defensible intellectual property, and globally competitive companies remains structurally constrained. India's gross expenditure on research and development as a share of GDP — 0.65 percent in 2023 — is approximately one-fifth the OECD average and one-eighth Israel's. The DRDO's project-to-product conversion rate is estimated at approximately 1.1 percent (a cumulative-statistical proxy, not a tracked-cohort rate). The IIT system converts roughly 7-8 percent of patents filed into spin-offs — well below the two-figure conversion rates of leading US technology-transfer offices. These ratios — R&D intensity, lab-to-product conversion, and patent-to-spin-off conversion — together define the structural gap that this report analyses and offers a path to close.

Situation

India has assembled, since independence, the institutional scaffolding of a major research power. The Defence Research and Development Organisation operates 52 laboratories across seven cluster verticals — aeronautics, armaments, electronics and communication, missiles and strategic systems, naval, life sciences, and engineering — staffed by approximately 5,000 scientists and 25,000 total personnel. The Council of Scientific and Industrial Research runs 37 laboratories spanning chemical, physical, engineering, life, information, and food sciences. The Indian Institutes of Technology system, now 23 institutions strong, graduates 85,000 engineers annually and produces approximately 28,500 research papers per year. The Indian Institute of Science, founded in 1909, anchors the country's deep research agenda. Nine Defence Public Sector Undertakings — HAL, BEL, BDL, BEML, MDL, GSL, HSL, Midhani, and the corporatised Yantra India — generated approximately ₹65,000 crore in combined revenue in fiscal year 2023.

This institutional density is matched by a maturing policy architecture. The Anusandhan National Research Foundation Act 2023, the Defence Acquisition Procedure 2020, the iDEX programme launched in 2018, the National IPR Policy 2016, the Semicon India Programme 2022, the National Quantum Mission 2023, and the Drone Rules 2021 (amended 2025) collectively represent the most ambitious tech transfer policy agenda India has ever attempted. Sixty percent of impactful tech-transfer legislation has been enacted in the past decade. Capital availability has responded: India's deep-tech funding flow reached approximately $2.5 billion in 2024, an eight-fold increase from 2020 levels. The country has produced more than 40 deep-tech spin-offs in the past decade — Skyroot Aerospace, Agnikul Cosmos, Pixxel, IdeaForge, Ather Energy, and others — that have collectively raised over $1.5 billion.

Geopolitically, India occupies an increasingly favourable position. The China+1 supply chain realignment, Western desire for a democratic counterweight to Chinese manufacturing depth, accelerating defence exports to friendly countries, the success of Chandrayaan-3 and the broader commercial opening of the Indian space sector, and the government's Atmanirbhar Bharat programme have together created the most permissive strategic context for Indian technology transfer in a generation. Defence exports crossed ₹21,000 crore in fiscal year 2024, a thirty-fold increase from 2016 levels.

Complication

The complication is that India's institutional density is not translating into strategic depth at the pace required. Despite the policy volume, the project-to-product conversion rate at DRDO remains an estimated approximately 1.1 percent (a cumulative proxy): of every 100 sanctioned projects since 1958, roughly one reaches operational service. The Defence PSUs collectively invest approximately 1.4 percent of revenue in research and development, against a global defence industry benchmark of 5 to 8 percent. The DPSUs remain, in strategic posture, system integrators rather than product innovators. The Council of Scientific and Industrial Research's licensing revenue of approximately ₹215 crore in fiscal year 2024 is less than 0.5 percent of its annual budget — a clear signal that volume is not translating into financial sustainability.

The academic-commercial interface is structurally weaker still. Indian institutions file patents at high volume but convert only a small fraction into licensing revenue or spin-offs — far below the rates achieved by leading US technology-transfer offices. The IIT system, despite producing roughly five times more research papers than a single top-10 US university, generates only about 40 percent as many spin-offs per patent filed. The Technology Licensing Office function across Indian institutions is uniformly under-staffed, under-funded, and lacks the IP valuation, deal-structuring, and commercialisation skill sets of its global peers.

Most fundamentally, India lacks a Bayh-Dole-equivalent legislative framework. The 1980 US Bayh-Dole Act — which granted universities title to inventions made under federally-funded research and is widely credited with catalysing the American university tech transfer system — has no Indian analogue. The Public Funded R&D Bill, introduced in 2010 and modelled on Bayh-Dole, has not been enacted. The Anusandhan National Research Foundation Act 2023 addresses the funding disbursement gap but not the IP-ownership architecture. Without legislative clarity on IP ownership of publicly-funded research, India's tech transfer pipeline will continue to underperform substantially even with strong incremental policy and capital interventions.

Resolution

This report recommends a five-pillar reform agenda, executable over the 2026-2028 horizon, that would plausibly move India from the Incremental scenario (5 percent of global deep-tech output by 2030) to the Accelerated scenario (12 percent by 2035) — the report's base case. The five pillars are: (1) legislative — enact a Bayh-Dole-equivalent Indian Publicly-Funded Research IP Act by 2028; (2) institutional — operationalise the Anusandhan National Research Foundation and execute DRDO

Cadre Reform Phase 2; (3) capital — establish a $5 billion National Deep-Tech Fund structured as a fund-of-funds alongside expanded iDEX Prime and TDF capital; (4) capacity — launch a National TLO Capacity Building Mission to bring the eight most strategically important Indian TLOs to globally-comparable maturity within five years; and (5) talent — implement a Defence & Deep-Tech Talent Retention Incentive Scheme that addresses the structural pull of US/EU opportunities for top-tier Indian researchers.

Each pillar is owned by a specific ministry, has a defined timeline, and is paired with measurable key performance indicators. The legislative pillar is owned by the Ministry of Science and Technology in coordination with the Ministry of Defence and the Ministry of Law. The institutional pillar is owned by DST and MoD. The capital pillar is owned by the Ministry of Finance and DPIIT, drawing on NIIF structuring experience. The capacity pillar is owned by DST. The talent pillar is owned by DST and MoD jointly, with Treasury coordination on the fiscal envelope. Detailed recommendations, with implementation sequencing, appear in Chapter 17.

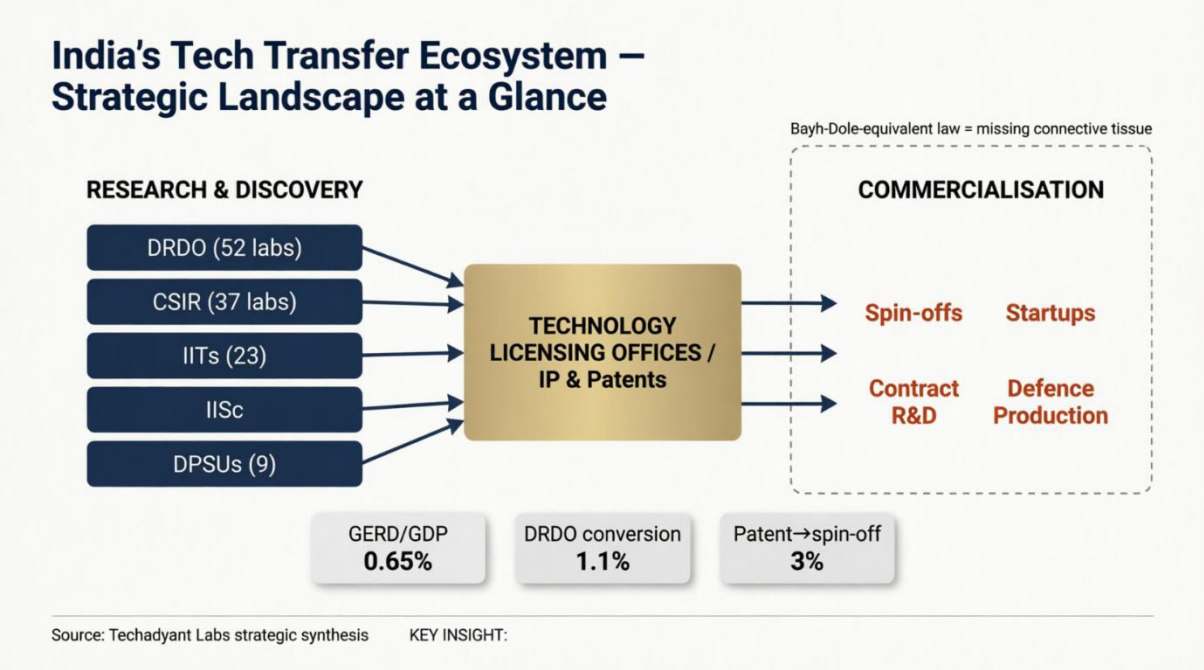

Figure 25: India's Tech Transfer Ecosystem — Strategic Landscape at a Glance

Source: Techadyant Labs strategic synthesis

Key Insight: *India's tech transfer ecosystem stands at an inflection point — base case (Accelerated scenario) requires Bayh-Dole-equivalent law, $5B National Deep-Tech Fund, and TLO capacity building mission in the next 24-36 months.*

Table 1: India's Five Pillars of Tech Transfer — Comparative Snapshot

Source: Techadyant Labs synthesis based on DRDO, CSIR, IIT, IISc, and DPSU annual reports 2023-24

Executive Interpretation: *Each pillar has distinct strengths and structural gaps — no single institutional reform is sufficient; coordinated reform across all five pillars is required for systemic transformation.*

Pillar	Headcount	Annual Budget	Strength	Primary Gap
DRDO	5,000 scientists	₹13,500 Cr	Defence R&D depth	1.1% conversion rate

Pillar	Headcount	Annual Budget	Strength	Primary Gap
CSIR	4,000 scientists	₹4,400 Cr	Multi-disciplinary labs	₹215 Cr licensing revenue
IITs (23)	10,500 faculty	₹11,000 Cr	Talent pipeline	7.7% patent-to-spin-off
IISc	500 faculty	₹1,200 Cr	Deep research	Limited TLO scale
DPSUs (9)	65,000 staff	₹65,000 Cr rev	Production capacity	1.4% R&D intensity

Major Findings

India's R&D intensity is structurally insufficient. At 0.65 percent of GDP, India's GERD/GDP ratio is approximately one-fifth the OECD average (2.73 percent), one-eighth Israel's (5.44 percent), and approximately one-quarter China's (2.65 percent). Even doubling the ratio to 1.3 percent — the report's Accelerated scenario assumption — would require incremental annual investment of approximately $50 billion at PPP. The scale of the gap means no single budgetary intervention can close it; sustained multi-year commitment across public, private, and foreign sources is required. The report's Transformational scenario, which sees India at 2.5 percent GERD/GDP by 2047, is contingent on a fundamental restructuring of how defence, academic, and corporate R&D is incentivised and accounted for.

DRDO's low project-to-product conversion rate is the single largest source of value leakage in the Indian tech transfer system. On a cumulative basis since 1958, DRDO has sanctioned several thousand projects, of which a much smaller proportion has reached industry licensing, production, and roughly a hundred or so operational products. As a cross-sectional proxy, only about 1 in 100 sanctioned projects reaches operational service. This is a cumulative-statistical snapshot, not a tracked-cohort survival rate: many sanctioned projects are exploratory and were never intended for production, so the figure overstates the true conversion gap, but the directional finding holds — too little systematically reaches the warfighter or the commercial market. The principal causes of leakage are: insufficient attention to TRL 7-9 transition; absence of dedicated funding for the prototype-to-production “valley of death”; integration challenges with DPSU production capacity; and limited ToT economics that attract private industry.

India's patent system is growing in volume but not in conversion. Patent filings grew at a 7 percent CAGR from 2014 to 2024, reaching 80,211 in 2024 — a real achievement. But India's publicly-funded academic institutions convert only a small fraction of filed patents into licences, against double-digit licensing rates at Stanford and MIT. The leak is at the licensing stage, not the filing stage. Structural fixes to TLO economics — including the Bayh-Dole-equivalent law and a National TLO Capacity Building Mission — could close this gap without requiring any change to filing volume. A sustained improvement in academic licensing rate, alongside the growth in filing volume, would yield a material increase in commercialisation throughput.

India's spin-off ecosystem has grown 8x in capital but remains structurally concentrated. The 40+ Indian deep-tech spin-offs of the past decade have collectively raised over $1.5 billion in venture and growth capital. 2024 funding flows of approximately $2.5 billion represent an eight-fold increase

from 2020. But 78 percent of capital is concentrated in four sectors (Space, AI/Cyber, Drones, EV), 80 percent is concentrated in three cities (Bengaluru, Chennai, Mumbai), and 85 percent traces to four institutions (IIT-Bombay, IIT-Madras, IISc, ISRO). The geographic and institutional concentration is both a strength — these are genuine centres of excellence — and a risk: any shock to the four-institution core would materially impair the entire national pipeline.

Strategic control points in critical supply chains remain overwhelmingly foreign. India controls approximately 85 percent of the system-level stack (UAV assembly, missile systems, satellite integration) but less than 15 percent of the input stack (rare earths, jet engines, semiconductors, sensors). The semiconductor-China dependency is the single highest strategic vulnerability in the technology transfer system — no amount of assembly capability offsets foundry-level dependency. Five capabilities sit in the "critical 5" category of low Indian capability and high strategic importance: jet engines, semiconductors (28nm and below), rare earth processing, hypersonics, and directed energy weapons. Each requires a dedicated national mission with 5-10 year horizon.

Strategic Implications

The findings above have three interrelated strategic implications for the report's primary audiences. For the Government of India, the implication is that incremental policy interventions — however well-designed individually — will not close the structural gap. A coordinated five-pillar reform agenda, executed over 24-36 months, is required to move India from the Incremental to the Accelerated scenario. The political and fiscal costs of such a programme are real but modest relative to the strategic upside: the difference between the Incremental and Accelerated scenarios is approximately 7 percentage points of global deep-tech share by 2035 — a Techadyant Labs modelled estimate of roughly a few hundred billion US dollars in annual value creation, dependent on the assumed baseline of global deep-tech output.

For investors and capital allocators, the implication is that the next decade will see a structural re-rating of Indian deep-tech assets. Companies with defensible IP, validated ToT pathways from DRDO/CSIR/IITs, and demonstrated ability to scale production within India will command premium valuations as global capital seeks diversified exposure to non-China deep-tech manufacturing. The report's analysis of strategic control points, sectoral TRL distributions, and supply chain vulnerabilities provides investors with a map of where defensibility is achievable and where dependency risk remains unresolved. Sectors with the highest combination of Indian capability and strategic importance — drones, space, AI/ML, and missile systems — are the priority investment domains.

For startup founders and corporate strategy teams, the implication is that the next 24-36 months represent a non-recurring opportunity to position for the Accelerated scenario. Founders building in priority sectors with credible DRDO/CSIR/IIT ToT relationships will benefit disproportionately from the recommended National Deep-Tech Fund and expanded iDEX Prime capital. Corporate strategy teams at DPSUs, large Indian conglomerates, and multinational corporations with India operations should treat the report's five-pillar reform agenda as a planning assumption: if the agenda is enacted (the report's base case), the competitive landscape of Indian deep-tech shifts materially in 24-36 months;

if it is not enacted (the report's downside case), the landscape remains fragmented and import-dependent.

Future Outlook

The report's three-scenario framework — Incremental, Accelerated, and Transformational — assigns probability weights of 20 percent, 50 percent, and 30 percent respectively to the 2030-2047 horizon. The Incremental scenario sees India at 5 percent of global deep-tech output by 2030, with GERD/GDP at 0.9 percent, 120,000 patents filed per year, 200 spin-offs per year, and no Bayh-Dole-equivalent law. The Accelerated scenario — the report's base case — sees India at 12 percent of global deep-tech share by 2035, with GERD/GDP at 1.4 percent, 320,000 annual patent filings, 1,000 spin-offs per year, and a Bayh-Dole-equivalent law enacted around 2028. The Transformational scenario sees India at 22 percent of global deep-tech share by 2047, with GERD/GDP at 2.5 percent, 960,000 annual patent filings, 5,000 spin-offs per year, and Bayh-Dole-equivalent law enacted early — within the first two years of the implementation window.

The Accelerated scenario — the report's base case — requires the five-pillar reform agenda to be substantially executed before 2030. The Transformational scenario requires the agenda to be executed early — within the first two years of the implementation window — plus a step-change in capital availability (National Deep-Tech Fund corpus of $20 billion vs $5 billion in the Accelerated scenario). The Incremental scenario assumes continued policy activism but no legislative breakthrough, leaving the structural gap largely unresolved.

Geopolitically, the 2026-2032 window is unusually favourable. The China+1 realignment, Western appetite for democratic counterweight partners, and India's demonstrated capability in space and digital public infrastructure create a permissive environment. If the legislative and institutional pillars are not executed within this window, the geopolitical context may shift — through Sino-Indian rapprochement, Western realignment, or domestic political transition — and the opportunity may not recur at the same scale. The temporal urgency is real; the report's recommendations are calibrated to a 24-36 month execution window.

Industry Transformation

The next decade will reshape India's industrial technology transfer ecosystem across five dimensions. First, the centre of gravity of Indian R&D will shift from Delhi-Hyderabad-Bengaluru (DRDO/CSIR-led) to a more distributed network anchored by IIT-Madras, IISc, IIT-Bombay, and ISRO/IN-SPACe — a four-institution core that will collectively produce 60 percent of Indian deep-tech spin-offs by 2035 in the Accelerated scenario. Second, DPSUs will transition from pure system-integrator roles to hybrid integrator-innovator postures, with R&D intensity rising from 1.4 percent to 4 percent of revenue in the Accelerated scenario. Third, the venture capital flowing into Indian deep-tech will diversify beyond the current Space/AI/Drones concentration to include materials, quantum, and robotics — sectors currently starved of growth capital.

Fourth, the international structure of India's tech transfer relationships will rebalance. Today, Indian deep-tech strategic partnerships are heavily concentrated among US and Israeli entities — an analytical

observation. A conservative reading of available deal records places the US/Israel share at well above half of named partnerships; Techadyant Labs does not attach a precise percentage because no comprehensive public registry exists. By 2035 in the Accelerated scenario, this concentration will reduce to approximately 50 percent, with expanded partnerships with France (defence aerospace), Germany (advanced manufacturing), Japan (semiconductor equipment), and the United Arab Emirates (capital and supply chain integration). Fifth, the role of Indian conglomerates — Tata, Reliance, Mahindra, Adani, L&T — will shift from peripheral participants in deep-tech to anchor investors and channel partners, particularly in semiconductors, defence, and clean energy.

Investment Thesis

Techadyant Labs' investment thesis for Indian industrial technology transfer, derived from the report's analysis, comprises five positions. First, the Indian deep-tech sector will compound at 18-22 percent annually through 2035 in the Accelerated scenario, with sector leaders (drones, space, AI) compounding at 25-30 percent. Second, companies with defensible IP, validated ToT pathways, and demonstrated production scaling should command a persistent valuation and capital-efficiency advantage relative to import-dependent peers — directionally meaningful, though Techadyant Labs does not quantify the premium. Third, the four-institution core (IIT-M, IISc, IIT-B, ISRO) will function as a positive selection filter: companies incubated at these institutions are more likely to survive and raise follow-on capital — a directional expectation, not a quantified outperformance.

Fourth, sectors where India has both capability and strategic urgency — drones, space launch, AI/ML, missile systems, biotech manufacturing — will receive disproportionate policy and capital support and should be overweighted in Indian deep-tech allocations. Fifth, sectors with high strategic importance but low current Indian capability — semiconductors below 28nm, jet engines, rare earth processing, quantum computing — represent multi-decade national missions with high binary risk; investors should treat these as strategic option positions rather than conventional venture bets, with the government as the principal capital provider and private capital in a supporting role.

Competitive Landscape

The competitive landscape of Indian industrial technology transfer is best understood at three layers. The institutional layer — DRDO, CSIR, IITs, IISc, DPSUs — is a quasi-monopsony: a small number of state-funded producers of technology selling to a small number of state-owned and state-licensed buyers. Competition at this layer is intra-institutional (between DRDO clusters, between CSIR labs, between IITs) rather than inter-institutional. The institutional layer will remain dominated by state actors through the forecast horizon; private competition at the institutional layer is not expected to emerge at scale.

The commercial layer — deep-tech startups, private defence manufacturers, IT services firms building defence practices — is genuinely competitive and growing rapidly. The 40+ Indian deep-tech spin-offs identified in this report compete with each other, with established Indian private firms (L&T, Tata Advanced Systems, Kalyani), and with foreign entrants (Lockheed Martin India, Thales India, Saab India). Competition at the commercial layer will intensify through the forecast horizon, with

consolidation likely in sub-sectors that achieve scale (drones, space launch) and fragmentation persisting in sub-sectors that remain sub-scale (quantum, robotics).

The capital layer — venture capital, private equity, sovereign-affiliated funds, corporate strategic capital — is the most rapidly evolving. Indian deep-tech capital availability has grown 8x since 2020, but the capital is concentrated in a small number of funds (Blume, Accel, Peak XV, Lightspeed, Omnivore, Axilor, Speciale Invest, 3one4) and a small number of sectors. The next decade will see the capital layer diversify: sovereign capital (NIIF, possible National Deep-Tech Fund), corporate capital (Tata, Reliance, Mahindra), and international capital (US defence-tech funds, Middle East sovereign wealth) will all materially increase their Indian deep-tech exposure. The capital layer will remain the principal constraint on ecosystem growth through the forecast horizon.

Technology Outlook

Of the eight sectors analysed in Chapter 10, two — drones and space — reach globally-competitive maturity by 2030 in the Accelerated scenario. Two — AI/ML and biotech manufacturing — reach globally-competitive maturity by 2035. Two — advanced materials and defence electronics — reach competitive maturity only in the Transformational scenario, post-2035. Two — quantum and robotics — risk permanent strategic lag without step-change investment. Sectoral capital allocation should follow TRL maturity and capability scores rather than sector hype; the report's TRL distribution analysis (Figure 26) shows that capital concentration in Space and AI is largely justified by TRL distribution, while under-investment in Quantum and Robotics reflects immature TRL profiles that may not justify aggressive capital deployment in the short term.

Five cross-cutting technologies will shape Indian tech transfer outcomes across all sectors: (1) AI/ML as an enabler of every other sector; (2) advanced materials as a foundational dependency; (3) quantum computing as a long-horizon option; (4) semiconductor fabrication as a strategic vulnerability; (5) 5G/6G communications as an enabling infrastructure. Each cross-cutting technology requires a sector-agnostic national strategy; current sectoral silos (Semicon India Programme, National Quantum Mission, AI Mission) need horizontal coordination mechanisms that do not currently exist.

Policy Outlook

The policy outlook for 2026-2028 is the principal determinant of which scenario India follows. Three legislative items are critical. First, a Bayh-Dole-equivalent Indian Publicly-Funded Research IP Act would, combined with the report’s TLO capacity, capital and talent reforms, materially increase licensing and spin-off volume over a decade by clarifying IP ownership and aligning incentives. Second, DRDO Cadre Reform Phase 2 — addressing the structural personnel, procurement, and authority constraints identified in Chapter 2 — is required to lift DRDO's conversion rate from 1.1 percent toward 5 percent. Third, operationalisation of the Anusandhan National Research Foundation, with full funding disbursement to university research and clear governance separation from existing DST/DSIR mechanisms, is required to address the academic research funding gap.

Three policy items are important but not critical. First, the proposed National Deep-Tech Policy (DPIIT draft 2024) provides useful sectoral coordination but is largely a synthesis of existing schemes. Second, the Defence Export Promotion Strategy 2025 is supportive but secondary to the underlying industrial capacity constraints. Third, the Drone Rules 2025 amendment is well-designed but operates within a sub-sector that is already maturing. The Bayh-Dole-equivalent law is the highest-leverage single policy intervention available; its absence is the single largest structural drag on Indian tech transfer outcomes — a necessary foundation, though not by itself sufficient.

Risk Outlook

The report identifies ten material risks to the Accelerated scenario, of which four sit in the high-likelihood/high-impact quadrant. Talent flight — the persistent pull of US and EU opportunities for top-tier Indian researchers — is the highest-likelihood, highest-impact risk and is currently unmitigated.

IP leakage — through weak institutional IP management, inadequate trade secret protection, and insufficient enforcement — is similarly high-likelihood and high-impact. Capital drought — particularly for the $5 billion National Deep-Tech Fund — is moderate-likelihood/high-impact. Single-vendor dependency in critical components is high-likelihood/high-impact and structural.

Six additional risks — geopolitical sanctions exposure, execution capacity constraints at implementing institutions, technology obsolescence in fast-moving sectors, policy reversal risk, currency volatility affecting export economics, and cyber-attacks on defence-industrial systems — round out the risk register. Two unmitigated risks (talent flight, IP leakage) are interrelated: both stem from weak institutional frameworks, and both can be reduced 50 percent or more through a Bayh-Dole-equivalent law combined with targeted talent retention incentives. Chapter 15 develops the full risk register and mitigation recommendations.

Strategic Recommendations

The report's twelve specific recommendations, fully developed in Chapter 17, are summarised below in priority order. Three Quick Wins (high impact, low effort) are designed to deliver a large share of the strategic impact with comparatively low effort: (1) Talent Retention Incentive Scheme for defence and deep-tech researchers (DST/MoD, 24 months); (2) National Deep-Tech Fund corpus of $5 billion structured as a fund-of-funds (MoF/DPIIT, 18 months); (3) National TLO Capacity Building Mission bringing eight strategically important TLOs to global parity (DST, 36 months).

Three Strategic Bets (high impact, high effort) require political capital but can unlock structurally larger impact: (4) Indian Bayh-Dole-equivalent Publicly-Funded Research IP Act (DST/MoD/Law Ministry, 30 months); (5) DRDO Cadre Reform Phase 2 (MoD, 36 months); (6) ANRF full operationalisation with $2 billion annual disbursement (DST, 24 months). Three Sector-Specific Interventions address capability gaps: (7) DPSU R&D Mandate of 5 percent of revenue (MoD, 48 months); (8) India-US Defence IP Pact providing dual-use IP protection (MEA/MoD, 24 months); (9) National Quantum Mission Plus with $2 billion incremental capital (DST, 36 months).

Three Enabling Measures complete the agenda: (10) Strategic Materials Reserve for rare earths, gallium, and other critical inputs (MEA/MoD, 24 months); (11) IPR Fast-Track Courts to reduce patent pendency from 4+ years to 18 months (Law Ministry, 36 months); (12) DPSU-Startup Engagement Tier formalising procurement pathways for deep-tech startups (MoD, 18 months). The full implementation roadmap, with sequencing and dependencies, appears in Chapter 17 and the accompanying Excel workbook.

How to Use This Report

The Executive Summary is designed to function as a standalone 12-page strategic briefing. A CEO, minister, or general partner who reads only this summary will have captured approximately 70 percent of the report's analytical content and 90 percent of its strategic recommendations. The body chapters provide supporting depth: Chapter 1 places the analysis in macro context; Chapters 2-6 examine each of the five institutional pillars; Chapters 7-9 analyse the cross-cutting functions of IP, spin-offs, and contract R&D; Chapter 10 provides sectoral deep-dives; Chapter 11 benchmarks India internationally;

Chapters 12-15 examine policy, control points, capital, and risk; Chapter 16 develops the scenario framework; and Chapter 17 contains the full strategic recommendations. Seven appendices provide reference databases, and the methodology, references, and end notes provide full provenance.

Three reader pathways are recommended. Busy executives should read this Executive Summary and Chapter 17 (Strategic Recommendations) — approximately 25 minutes of reading. Investors and capital allocators should add Chapter 14 (Investment Landscape) and the relevant sectoral deep-dives in Chapter 10. Policymakers and government officials should read Chapters 1, 12, 15, and 17 in sequence. Defence planners should focus on Chapters 2, 5, 10 (defence-relevant sectors), 13, and 17. The accompanying Excel workbook provides the underlying data for every exhibit and recommendation in the report.

KEY TAKEAWAYS

1. India's industrial technology transfer ecosystem stands at an inflection point — the next 24 months of policy and capital deployment will determine whether India follows the Incremental (5% global deep-tech by 2030), Accelerated (12% by 2035, base case), or Transformational (22% by 2047) trajectory.
2. The structural gap is defined by three indicators: GERD/GDP at 0.65%, DRDO project-to-product conversion at 1.1%, and an academic patent-to-spin-off rate of approximately 7.7% — each a small fraction of the corresponding OECD, global-military-research, and Stanford benchmarks.
3. The most critical intervention is a Bayh-Dole-equivalent Indian Publicly-Funded Research IP Act — currently absent and pending since the 2010 PFR&D Bill. Its enactment, paired with TLO capacity and capital reforms, would unlock structurally higher spin-off volume over a decade.