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Confederation of Indian Industry

Building India's innovation backbone: Industry-academia collaboration for research-led growth

December 2025

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Published by

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Foreword by Taskforce Chair

Dr. Naushad Forbes
Chairman – CII National Forum on Industry–Academia Partnership
Co-Chairperson, Forbes Marshall

India's long-term growth will depend on how well we connect scientific research with industrial innovation. Countries that have built strong innovation-led economies have done so by creating practical ways for universities, industry, research labs, start-ups, and government to work together.

CII's National Forum for Industry–Academia Partnership has been formed to improve collaboration between academia and industry, with government supporting these efforts.

This year's report, Building India's Innovation Backbone: Industry–Academia Collaboration for Research-Led Growth, looks at what can help India strengthen its research and innovation system. It reviews partnership models, institutional arrangements, and support structures that can build research capacity, speed up technology development, and improve how ideas are taken to market. Areas such as researcher autonomy, flexible funding, Centres of Excellence, and strong technology transfer mechanisms will be important for India to turn its scientific strengths into meaningful innovation.

I hope this report is helpful for policymakers, industry leaders, and academic institutions as we continue working together to build a stronger research ecosystem and an innovation-driven economy in the years ahead.

Message from the Forum's Vice Chair (Academia)

Prof. V Ramgopal Rao
Group Vice Chancellor, Birla Institute of Technology and Science, Pilani
Former Director, Indian Institute of Technology, Delhi

India has made steady progress in strengthening its research and innovation ecosystem, supported by an expanding industrial base, a young scientific workforce, and a growing emphasis on frontier technologies. Yet structural gaps persist—particularly in the alignment between academic research and industry needs. Despite significant research output, the translation of knowledge into deployable technologies and market-ready solutions remains uneven. This underscores the urgent need to strengthen institutional mechanisms that bring together researchers, innovators, and industry leaders in a more coordinated and outcome-oriented manner.

While India has a vibrant entrepreneurial landscape, only a fraction of its technology-driven enterprises are rooted in deep science or IP-led innovation. Many promising research-led start-ups emerging from academic institutions struggle to navigate the "valley of death"—the critical stages between proof of concept and commercial validation. Greater industry involvement in advancing technologies through intermediate readiness levels, along with predictable pathways for testing, validation, and scale-up, is essential to bridge this gap. MSMEs in particular can play an important role as testbeds and co-development partners for emerging technologies.

Enabling such collaboration requires a supportive policy environment that encourages co-investment, risk-sharing, and long-term partnerships. Clear frameworks for joint IP creation—covering ownership, licensing, revenue-sharing, and commercialization—remain essential to reduce friction and build trust. At the same time, institutional rigidities must evolve so that researchers, industry professionals, and innovators can work together more seamlessly. Mechanisms such as joint supervision of doctoral candidates, mobility programs, embedded researchers, and co-funded laboratories can significantly accelerate the pace of technology translation.

A large proportion of India's academic institutions continues to face challenges in engaging effectively with industry, often due to procedural bottlenecks, capacity constraints, or ambiguity around collaboration policies. In this context, the Anusandhan National Research Foundation (ANRF) is well positioned to play a catalytic role by strengthening national frameworks, harmonizing research processes, and supporting systemic reforms that enable smoother, more productive partnerships across the value chain.

The CII Industry–Academia Partnership Report 2025 is grounded in these imperatives. It examines the structural barriers that limit collaboration, draws lessons from global innovation leaders, and highlights models of engagement that demonstrate how aligned incentives and coordinated action can improve research quality, accelerate technology development, and enhance industry relevance. By identifying actionable pathways across priority sunrise sectors—including biofutures, medtech, advanced manufacturing, and next-generation mobility—the report seeks to provide a roadmap for building a more cohesive, mission-driven national research ecosystem.

India's innovation potential is significant. Realizing it will require sustained collaboration, institutional coherence, and shared commitment—so that scientific excellence translates into technological capability, economic growth, and societal impact.

Message from the Forum's Vice Chair (Industry)

Aniket Gandhi
Head – R&D Strategy & Operations and Site Leader, Mumbai R&D, Hindustan Unilever Limited (HUL)Vice Chair (Industry), CII National Forum on Industry-Academia Partnership

As India stands at a defining moment in its research and innovation journey, strengthening the partnership between industry and academia has become a national imperative. The convergence of scientific inquiry with market-oriented application is central to translating ideas into technologies that can drive competitiveness, inclusivity, and sustainable growth.

The CII National Forum on Industry–Academia Partnership continues to play a crucial role in advancing this mission. By fostering deeper linkages between researchers, innovators, and industry leaders, the Forum contributes to building a more coherent and coordinated R&D ecosystem—one that supports high-quality science, accelerates technology translation, and aligns research priorities with India's emerging industrial and societal needs.

India's strong scientific workforce, expanding industrial base, and growing focus on frontier technologies present significant opportunities. Yet, as highlighted in this report, realizing these opportunities requires addressing persistent structural challenges: fragmented governance, uneven institutional capacity, limited commercialization pathways, and relatively low R&D intensity. Bridging these gaps calls for deliberate institutional design, mission-oriented funding, and sustained collaboration between government, academia and industry.

This report underscores how global innovation economies have succeeded by building unified research governance, strong applied research institutions, and structured engagement mechanisms. It presents insights and analyses that can help India adopt similar best practices—especially in high-potential sunrise sectors such as biofutures, medtech, advanced manufacturing and next-generation mobility.

Looking ahead, the Forum remains committed to enabling an ecosystem where India's scientific excellence and industrial capability can work in tandem. By bringing together diverse stakeholders around shared national priorities, we can systematically strengthen India's research foundations, accelerate innovation-led growth, and position the country as a global leader in technology and knowledge creation.

Message from CII Director General

Chandrajit Banerjee
Director General
Confederation of Indian Industry (CII)

As India advances toward its long-term development goals, strengthening the country's research, development, and innovation capabilities has become a strategic imperative. Achieving this requires a coordinated and mission-oriented effort, where academia, industry, research institutions, and start-ups work in a more integrated manner, supported by coherent policies, predictable funding pathways, and modern institutional mechanisms. This collective architecture—envisioned by CII as the National Research Quad—forms the backbone of a high-performing national innovation system.

Such collaboration is essential to India's economic and technological transformation. Academic institutions provide the foundations of scientific inquiry and talent creation, while industry contributes application-driven perspective, scale, and the ability to bring technologies to market. When complemented by the agility of start-ups and the specialized capabilities of mission-driven research centres, this convergence creates a powerful engine for advancing frontier technologies and strengthening India's global competitiveness.

The CII Industry–Academia Partnership Report 2025 reflects this integrated vision. It examines the current state of India's research ecosystem, highlights structural gaps that limit R&D productivity, and draws lessons from global innovation leaders. The report further identifies emerging collaboration models and priority sunrise sectors—such as biofutures, medtech, advanced manufacturing, and next-generation mobility—where targeted partnerships can deliver transformative impact. By mapping ecosystem needs to actionable research and innovation pathways, the report underscores how coordinated efforts across stakeholders can accelerate technology development, strengthen institutional capacity, and generate sustained economic and societal value.

EY-Parthenon foreword

Research and innovation form the backbone of a nation's economic ambition, and India today stands at a pivotal moment in its scientific and technological journey. Over the past decade, the country has witnessed strong momentum—research output has expanded rapidly, the deep-tech ecosystem has matured, and India now ranks among the world's top producers of scientific publications. Patent filings are rising, STEM talent is strengthening, and industry participation in applied research is steadily increasing.

Yet despite this progress, India's research performance continues to face structural constraints. While publication volumes are high, quality indicators such as citation impact and research translation remain below global benchmarks. Fragmented governance, limited private-sector participation, and modest R&D spending have slowed the transition from scientific discovery to commercially deployable solutions. As a result, India's research system has not yet translated its scale and talent into global leadership.

The Government of India has taken important steps to address these gaps—launching the National Research Foundation, strengthening mission-driven programs, and expanding support for innovation, start-ups, and frontier technologies. These initiatives signal a growing recognition of research as a national priority. Their success, however, will depend on how effectively they are implemented, how well funding is aligned to strategic domains, and how meaningfully industry and academia collaborate to accelerate outcomes. International experience shows that high-performing innovation economies succeed when research priorities, talent, and funding are coordinated under clear missions and supported by strong institutions. India now has an opportunity to draw on these global models to build an ecosystem that fosters deeper partnerships, reduces fragmentation, and expands the role of universities as engines of innovation.

India's long-term aspiration must be to move from incremental advancements to world-leading discovery, commercialization, and societal impact. Doing so will require strengthening institutional capability, enabling interdisciplinary research, professionalizing technology transfer pathways, and creating incentives that reward quality, collaboration, and translation at scale. Equally important is reimagining how industry, academia, and government work together—anchored in shared priorities, co-funded programs, and mission-oriented research platforms.

This report seeks to outline a clear path forward. It brings together global lessons, sector-specific opportunities, and a focused set of recommendations for India's research and innovation stakeholders. Our hope is that it provides a meaningful foundation for coordinated action that unlocks India's full potential as a global research powerhouse and enables the country to shape the frontier technologies of the future.

Amitabh Jhingan
Partner, EY-Parthenon
EY Global Education Sector Leader
Ernst & Young LLP
New Delhi, India

Dr Avantika Tomar
Partner, EY-Parthenon
Ernst & Young LLP
Bengaluru, India

Messages from track chair and co-chairs

India is at an inflection point where strategic reforms in R&D governance can unlock unprecedented innovation-led growth. The insights in this report reaffirm the need for mission-driven funding, unified research coordination, and deeper industry participation—critical steps that will enable the country to convert its scientific strengths into global leadership.

Ms. TK Kanchana
Head, Government & Corporate Affairs, HUL

For India to emerge as a global research powerhouse, industry must play a far more active role in shaping the innovation agenda. This report underscores the importance of long-term collaboration models, co-funded research platforms, and market-aligned R&D that can bridge the gap between lab discoveries and industrial deployment.

Dr. Venugopal Shankar
VP, Head Technology Innovation, IP, Knowledge Management and Mahindra Technical Academy

The 'valley of death' in India's innovation pipeline can only be crossed through deliberate design—shared infrastructure, applied research institutions, and robust technology transfer systems. This report provides a strong foundation for rethinking how India can accelerate discovery-to-deployment pathways across critical sectors.

Mr. Datta Kuvalekar
COO, Forbes Marshell

As Track Chair, I see these case studies as a testament to the positive outcomes that emerge when diverse perspectives come together. They reaffirm the importance of continued engagement.

Mr Srinivas Peddi
Senior Director and Site Leader, Becton Dickinson Technology Campus India

This report clearly captures the urgency for academia to move beyond traditional boundaries and become central drivers of national innovation. The call for structured industry partnerships, stronger research translation pathways, and sector-focused collaboration aligns deeply with the aspirations of India's universities.

Dr. Vineetha Raghavan
Head, Research Development Office (RDO) and Coordinator Extramural Project Cell (EMPC), BRIC-inStem

This report rightly emphasizes that talent is India's greatest strategic advantage. Universities must nurture this strength through experiential learning, industry immersion, and research-driven curricula. By doing so, academia can cultivate the innovators who will shape India's next generation of technologies."

Prof. C. S. Shankar Ram
Department of Engineering Design, IIT Madras

The findings reinforce the need for universities to strengthen research governance, invest in advanced infrastructure, and build agile partnerships. As India aspires to global research leadership, academic institutions must evolve into hubs of multidisciplinary discovery and market-aligned innovation.

Prof. Kaushalkumar A. Desai
Department of Mechanical Engineering, Indian Institute of Technology Jodhpur

This report powerfully highlights the role universities must play in shaping India's research future. By aligning scholarly inquiry with industry needs and national priorities, academia can drive high-impact research that translates knowledge into meaningful societal and economic outcomes.

Dr. G. Arun Maiya
Dean | Manipal College of Health Professions, Professor | MCHP, MAHE
Chief: Centre for Podiatry & Diabetic Foot Care & Research | MAHE, Manipal

The comparative insights in this report show that India has all the ingredients to join the ranks of global innovation leaders. By adopting best practices such as coordinated governance, applied research centers, and mission-led coalitions, India can build a world-class environment where science, industry, and policy work seamlessly together."

Ms. Swati Ganeti
Managing Director, Masters Union

Contents

Executive summary

Executive summary

India stands at a pivotal moment in its research and innovation journey. With one of the world's largest STEM talent pools, a rapidly expanding industrial base and strong government commitment to frontier technologies, the country has the foundational ingredients to become a global research hub. Yet India's research productivity and industry participation remain constrained by low R&D intensity, inconsistent institutional capacity and limited pathways for technology translation. Strengthening collaboration between industry and academia is therefore central to unlocking India's next wave of research-led growth.

India's current research landscape

- India today ranks among the world's top research producers in terms of volume, with output increasing more than fourfold since 2010. The growth of incubators, the emergence of dedicated research centers and the increasing participation of corporations in applied R&D reflect the early maturation of the innovation ecosystem. However, several systemic barriers continue to limit research quality and industry-relevant outcomes.
- India's R&D expenditure remains about 0.65% of GDP—far below the global average—driven predominantly by government spending rather than industry, as seen in leading innovation economies. Research infrastructure and institutional capacity remain variable, with top-tier institutions attracting a significant share of funding and industry partnerships. Collaboration models are often ad hoc and project-specific rather than structured around long-term national priorities. Technology transfer offices, market-facing incentives and commercialization pathways are still nascent, slowing translation from laboratory research to deployable solutions.
- These structural gaps highlight the need for a more coherent national approach to collaboration—supported by aligned incentives, mission-oriented funding and institutional mechanisms that enable industry and academia to co-create knowledge, talent and technology.

Innovative practices from leading economies

- Global innovation leaders such as the United States, United Kingdom, Germany, Singapore and South Korea provide valuable models for designing collaboration systems that consistently convert research into industry impact. Their success is driven by several common features:
- **Unified national research governance** that aligns priorities across ministries, funding agencies and mission programs (for example, UK Research and Innovation)
- **Strong applied research and translation** institutions, such as Fraunhofer Institutes and Catapult Centers, which act as bridges between basic research and industry application
  - **Mission-driven innovation programs** such as NSF I-Corps and EU Horizon, which reduce fragmentation and mobilize large multi-sector coalitions around frontier challenges
  - **High industry participation** supported by incentives, tax credits, challenge funds, co-funded laboratories and predictable regulatory pathways
  - **Structured engagement mechanisms** including testbeds, shared R&D facilities and researcher mobility between academia and industry

These systems demonstrate that sustained industry–academia collaboration stems not from isolated partnerships, but from deliberate institutional design, aligned incentives, and coordinated action across the research ecosystem.

India's sunrise sectors offer a unique opportunity to build such partnerships

India's economic trajectory, demographic advantage and manufacturing ambitions position it strongly in several frontier domains where research and innovation can generate disproportionate impact. This report identifies four priority sunrise sectors—Biofutures, MedTech, Advanced Manufacturing and Next-Generation Mobility—where India can build global competitiveness through targeted R&D collaboration.

Across each sector, India faces specific technology gaps—from flexible biorefineries and next-generation biomaterials to Advanced Driver Assistance System (ADAS) capabilities, advanced Electric Vehicle (EV) chemistries, semiconductor-grade components and digital manufacturing infrastructure. Mapping these value-chain challenges to actionable research problem statements provides a starting point for universities and companies to form structured partnerships. This also ensures that research agendas are anchored in India's industrial priorities and global market opportunities.

Executive summary (cont'd.)

Building the institutional and policy architecture for effective collaboration

- To convert India's research potential into sustained innovation outcomes, the country must strengthen the institutional and policy architecture that supports industry–academia collaboration. New-age universities, including International Branch Campuses (IBCs), can play a catalytic role by bringing agile governance, interdisciplinary research and global industry linkages that complement the capabilities of legacy institutions and help diffuse modern practices across a wider set of HEIs.
- Equally important is enhancing researcher autonomy and embedding targeted incentives, including flexible funding mechanisms, excellence clusters, IP-linked rewards and performance-based funding, to drive high-quality research and sustained industry engagement.
- Flexible partnership models such as shared R&D funds, affiliate programs, thematic Centres of Excellence and jointly governed corporate–university labs can further reduce frictions and make collaboration more predictable. A coherent policy environment is also essential to align national missions, interministerial schemes, Anusandhan National Research Foundation (ANRF) funding windows, Startup India initiatives, state-level innovation programs and private-sector R&D incentives.
- Finally, strengthening institutional capacity for technology transfer, intellectual property (IP) management and partnership governance through professionalized technology transfer offices (TTOs), liaison offices, regulatory sandboxes and streamlined procurement pathways will be critical to accelerate research translation and commercialization.

A vision for India's future research ecosystem

- A successful future-state ecosystem would feature robust governance, high-quality research across diverse institutions, strong industry participation and globally competitive translation pathways.
- This report outlines an **ideal future-state scenario for 2035**, in which India operates a globally competitive, innovation-led research ecosystem characterized by:
  - R&D investment reaching 1.5% to 2% of GDP, with a strong rise in private-sector funding
  - 5 to 10 globally relevant breakthrough technologies developed each year
  - 5 to 10x increase in technology-transfer revenues through efficient commercialization pathways
  - A robust pipeline of deep-tech start-ups originating from universities and research parks.
  - World-class Centres of Excellence and applied research facilities, co-governed with industry
  - India emerging as a global R&D hub, attracting leading universities and corporations
  - Clear socio-economic impact, including high-skilled job creation and strengthened export competitiveness

The way forward: A shared action agenda

Progress toward these future-state outcomes will depend on sustained, collaborative action by all key stakeholders:

- **Government** must set clear national R&D goals, Incentivize private sector to increase R&D share, unify research governance, enhance commercialization infrastructure, and enable faster regulatory and procurement processes.
- **Industry** must shift from transactional sponsorship to co-designing research agendas, expanding industry mentorship, co-funding labs and testbeds, embedding researchers in universities, and identifying ways to transform Global Capability Centres (GCCs) and Multinational Corporations (MNCs) to strategic R&D engines.
- **Academia** must build institutional capacity for partnership management, incentivise applied research and commercialization alongside publications, develop programs that allow working professionals to upskill and foster interdisciplinary research that directly serves industry needs.

1

The state of industry-academia research collaboration in India

Standing on decades of scientific progress, India is poised to make its leap as a global research hub driven by deep industry–academia partnerships and breakthroughs in frontier technologies

Over the past decade, India's research ecosystem has evolved rapidly — with rising scientific output, stronger institutional networks, and an increasing focus on translating research into innovation and enterprise. Landmark policy measures such as the National Education Policy 2020 and the Anusandhan National Research Foundation have set the stage for a more integrated, impact-driven research landscape. Industry–academia partnerships, start-up incubation and patent filings have all gained momentum, signaling a growing culture of innovation. Yet, a great deal remains to be done — from expanding public and private R&D investments to strengthening partnerships, technology transfer mechanisms and enhancing research quality and global competitiveness.

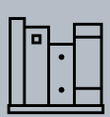
Key highlights of India's current research ecosystem are outlined below:

Research funding

- India's R&D expenditure is ~0.65% of GDP – lower than global average of ~2.49%.[1]
- Research is heavily supported by government, accounting for ~50% of the share.[1]
- India's R&D expenditure per researcher was $160,000 (PPP) during 2020–21.[1]

Research Institutions

- HEIs account for 12.5% of India's ~8,000 R&D institutions; only 1.7% of all HEIs are research-oriented.[2]
- Institutes of National Importance received 39% of the funds compared to Tier 2/3 universities receiving 20% of funds for R&D projects in 2021.[3]



Research Output

- India emerged as the world's third largest research producer in 2024, supported by a 4.3x increase in output since 2010.
- Research quality continues to be a concern with low H-index and citation score compared to peer nations.
- NIRF top 100 institutions account for 60% of all research publications with IITs leading the way.[4]

Innovation and Commercialization

- India witnessed a steady rise in the number of patents filed, with 92,000 applications in 2024.[5]
- Share of patents filed by Indian residents increased from ~37% in 2020 to 56% in 2024.[5]
- In 2025, India held the 38th position in the Global Innovation Index, an increase of 8 spots compared to 2021, demonstrating a thriving innovation culture within the country.

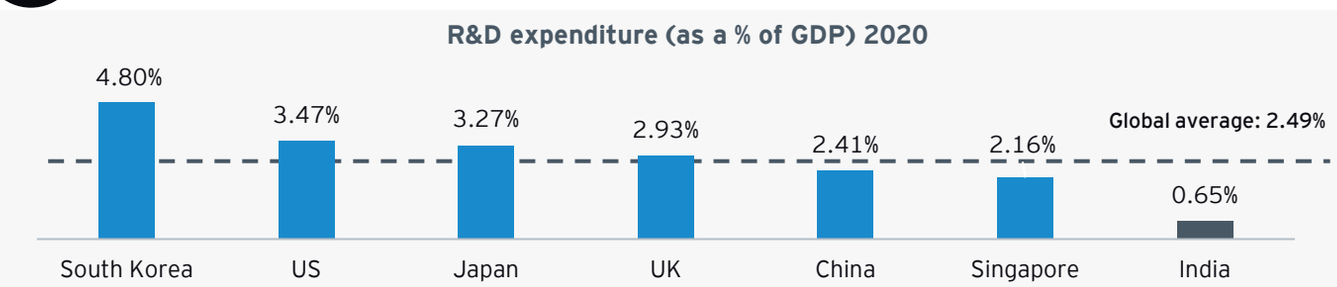
Areas of Research

- India's research output remains heavily concentrated in STEM disciplines, with engineering accounting for 52% and life sciences/medicine and natural sciences contributing 17% each.
- Between 2019 and 2023, coronavirus, nanotechnology, photocatalysis and deep learning were the top four research topics with the highest number of published papers.
- Pharma/drugs, IT and transportation are the top three sectors receiving industrial R&D support.[1]

Source: 1. Department of Science & Technology Report, 2. NSTMIS_DST_R&D Directory, 3.NSTMIS_DST_Grants, 4. NIRF Report 2024, 5. DPIIT_Annual_report 2023-24, 6. TOI, 7. The Hindu, 8. TOI, EYP Research

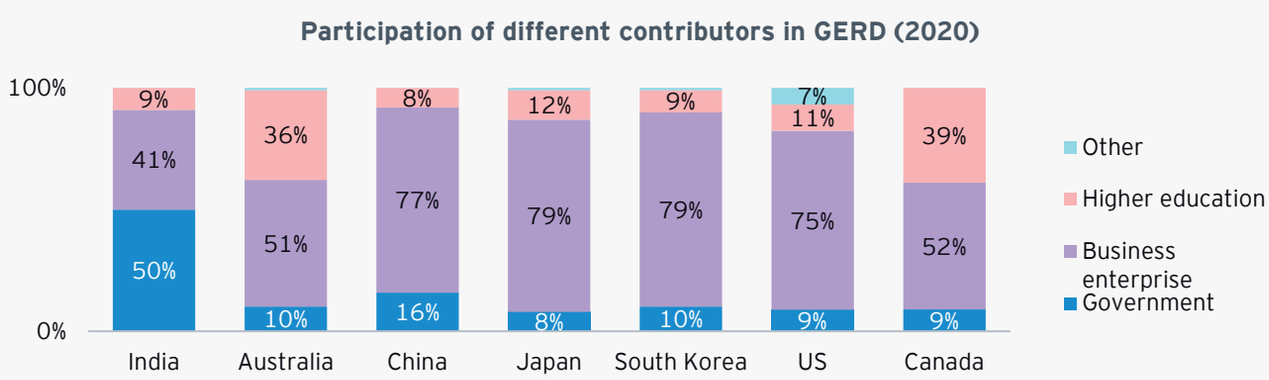
India's research ecosystem is under-funded compared to its peers, with the government continuing to be the principal driver of research activity

Research funding



Sources: World Bank website

- India's national R&D expenditure (as a % of GDP) has seen a downtrend from ~0.82% in 2010 to 0.65% in 2022.[1]
- In India, the government accounts for nearly 50% of the total Gross Expenditure on Research and Development (GERD), whereas in developed economies such as the US, Canada, Japan and South Korea, government contribution is significantly lower—7 to 12%.
- Academic institutions contribute around 9% to India's GERD, a share that is broadly comparable to several other countries in the comparison set (e.g., Australia at 10%, South Korea at 10%, the US at 9%).
- In most developed and emerging economies, business enterprises dominate GERD, accounting for more than 70% of total research expenditure in countries like China, Japan, South Korea and the US. In contrast, the business sector contributes only 41% of GERD in India.



Sources: Department of Science & Technology Report

- 84% of the R&D expenditure incurred by Central Government sources came from 12 major scientific agencies – DRDO (30.7%), DoS (18.4%), ICAR (12.4%), DAE (11.4%), CSIR (8.2%), DST (6.8%) and DBT (4.4%), followed by the rest[1]. This translates to ~42% of R&D expenditure being incurred in restricted sectors such as defense and atomic energy.
- India's R&D expenditure per researcher was $160,000 (PPP) during 2020-21, substantially behind other economies – China, Japan, South Korea ($250,000, PPP); Germany, Israel (above $300,000, PPP) with the US highest at $450,000, PPP[1].
- Access to private funding remains highly concentrated among top-tier institutions such as the IITs, IIMs and a few select HEIs that maintain strong industry linkages. In contrast, most Tier-II and Tier-III institutions continue to rely heavily on government grants, signalling the need for more deliberate private-sector engagement in their research programs.
- DST launched a landmark Research Development and Innovation (RDI) Scheme Fund of INR1 lakh crore in 2025 to catalyze private sector R&D investment in sunrise and strategic sectors (DeepTech, AI, biomanufacturing, etc).[2]

Source: 1. Department of Science & Technology Report , 2. ANRF website, EYP Research

India's research ecosystem is skewed towards Tier 1 institutions; only 1.7% of Indian universities are research oriented

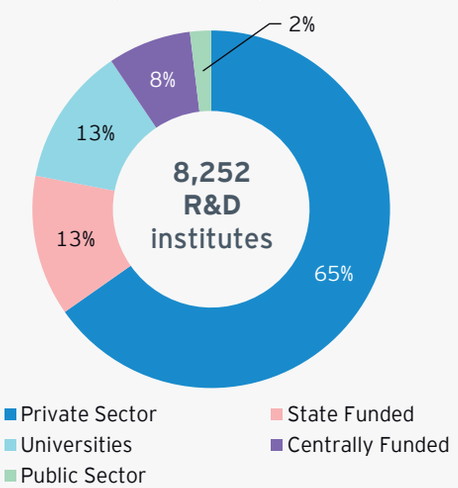
Research Institutions

India's research ecosystem

- Academic institutions (HEIs)
- Private sector companies
- Govt. agencies and departments
- Research foundations
- Science and technology parks

R&D institutes in India

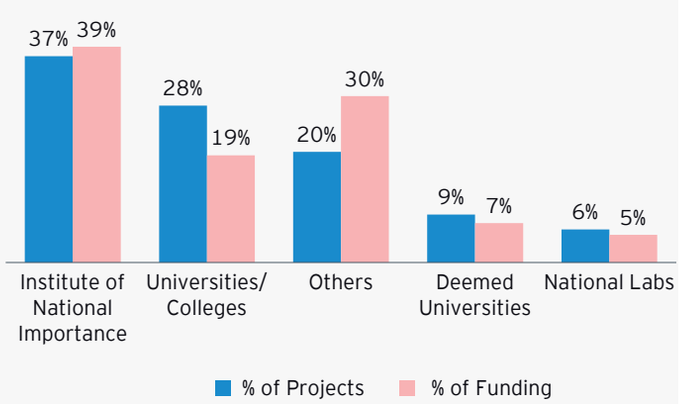
Distribution of R&D institutes in India (2024-2025)



Source: NSTMIS_DST_R&D Directory

Note: Private/public sector notation refers to R&D labs in companies,

Distribution of extramural R&D projects by types of institutes (2020-21)



Source: NSTMIS_DST_Grants

Note:
1.Institute of National Importance includes IITs, AIIMS, IIMs, IISERs, NITs and ISIs.
2.National Labs are research laboratories under central govt. & autonomous institutes

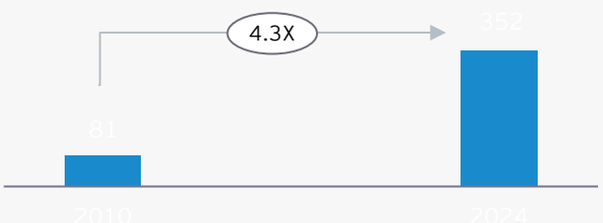
- HEIs account for ~12.5% of India's 8252 R&D institutes. Consequently, just 1.7% of all the country's educational institutes (58,6000 institutes) prioritize research.
- Tier 1 institutes (Institutes of National Importance) received ~37% of R&D projects with 39% of funds, compared to Tier 2 and Tier 3 universities that received 28% of projects with 19% of funds[1].
- The rise of dedicated research centers and the rapid growth of incubation facilities reflect a strengthening industry-academia interface. As of 2023, India had 650 start-up incubators and ranked third globally, behind the US and China[2].
- In 2017, there were 13 Atal Incubation Centers (AICs) in India, established under the Atal Innovation Mission (AIM). This number has risen to 69 AICs by 2022, significantly improving entrepreneurial capabilities of HEIs.
- Universities are increasingly harnessing industry linkages by monetizing research through consultancy engagements, with IIT-Madras demonstrating significant prowess at 1,168 consultancy projects in 2022-23.

Source: 1. NSTMIS_DST_Grants 2 Tice, 3 PIB , 4. AISHE report 2021-2022, EYP Research

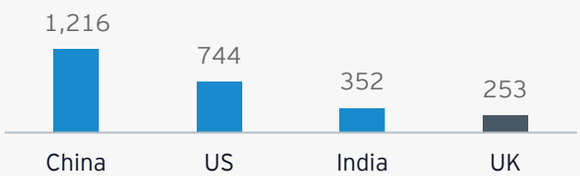
While India ranks fourth globally by volume of research papers, lower citations per paper and H-index signal concerns about research quality

Research output

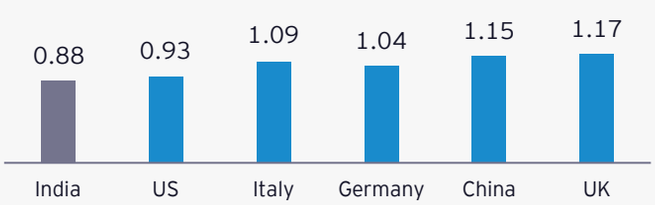
Research output in publication (in 000s)



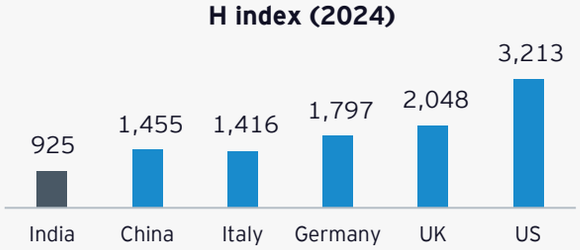
Number of research papers (in 000s), 2024



Citations per document (2024)



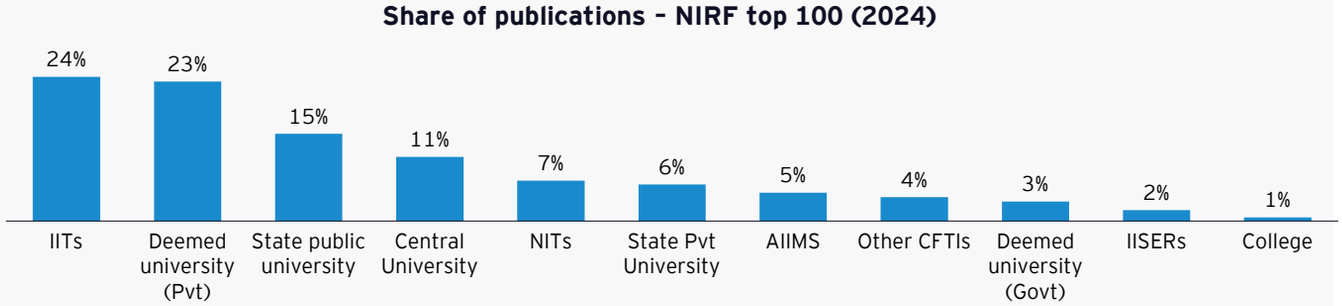
H index (2024)



Sources: SCImago

- India ranked third globally in research output in 2024, reflecting a 4.3-fold increase since 2010.
- While overall research output and global rankings have improved in recent years, the quality and impact of research remain limited, as reflected in the country's low citation rates and H-index scores.
- Rankings offer a useful indicator of research performance. Global frameworks such as QS and THE focus on research output, citations and academic reputation, while national systems like NIRF give additional weight to industry linkages and alignment with SDGs.
- 54 Indian universities featured in the QS World University Rankings 2026 – a five-fold rise from 2015. Eight Indian universities featured in the world's top 100 for citations per faculty[1].

Share of publications – NIRF top 100 (2024)



Source: NIRF Report 2024

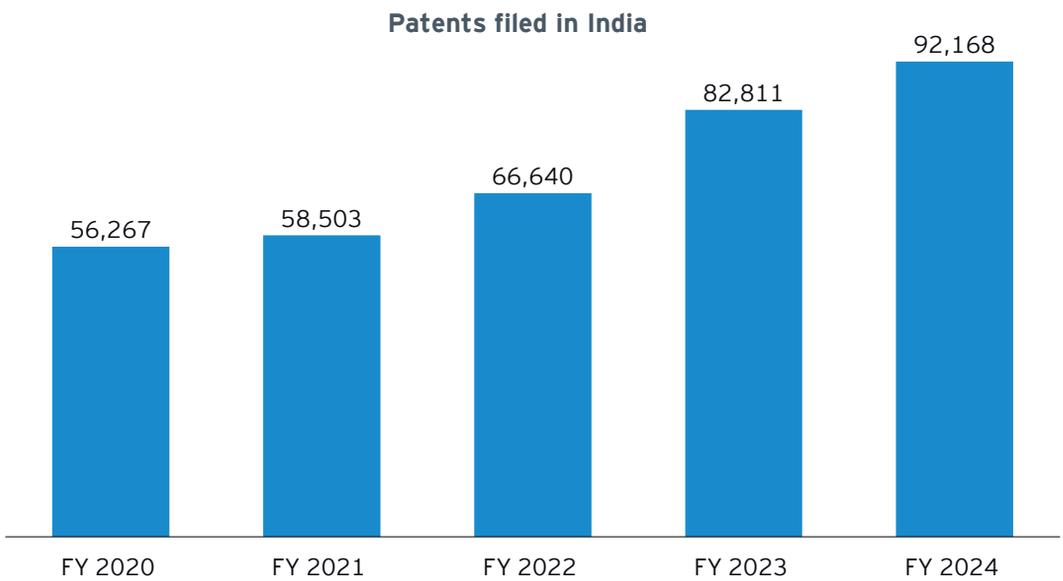
- NIRF top 100 institutions account for 60% of all research publications. Of these, IITs lead the way with ~25% of all publications[2].

Source: 1 QS rankings, 2 NIRF Report 2024 EYP Research

While the number of patents filed in India has witnessed healthy growth, commercial viability continues to be a concern due to limited practical value

Innovation and commercialization

India's research ecosystem has shown consistent progress in translating academic and industrial innovation into intellectual property. The steady growth in patent filings reflects increasing R&D intensity across sectors, though ensuring commercial viability and practical application remains a key challenge.



Source: DPIIT_Annual_report 2023-24

- The steady rise in patent filings in India underscores the expanding footprint of industrial research and innovation across the country. While this reflects positive momentum in R&D activity, it is important to interpret this metric with caution. A significant proportion of patents remain non-commercialized or low-impact, often filed for compliance or recognition purposes rather than practical application. This highlights the need to strengthen mechanisms that encourage the translation of research into market-ready innovations.*
- According to DPIIT, over 92,000 patent applications were filed in FY24, a 38% rise from FY 2022. This acceleration highlights the deepening innovation pipeline in India.[1]
- Much of this growth is being driven by the rise of deep-tech start-ups and frontier research in domains such as artificial intelligence (AI), the Internet of Things (IoT) and neurotechnology. Within applied sectors, healthcare has emerged as a leading focus area, with significant patent activity in medical imaging, diagnostics, report generation and testing. This reflects a broader national shift toward technology-enabled solutions.
- Encouragingly, the share of patents filed by Indian residents has also increased sharply—from 37% in FY20 to 56% in FY24—driven by a rising awareness of intellectual property rights and improved institutional support. However, despite this progress, India's contribution to global patent filings remains modest at ~2%, highlighting the need for continued emphasis on commercialization, IP enforcement and ecosystem-level capacity building to sustain innovation-led growth.[1]

* Dr. Sandeep Sancheti, Vice President (Research Relations & Academic Advisory), Elsevier (India)

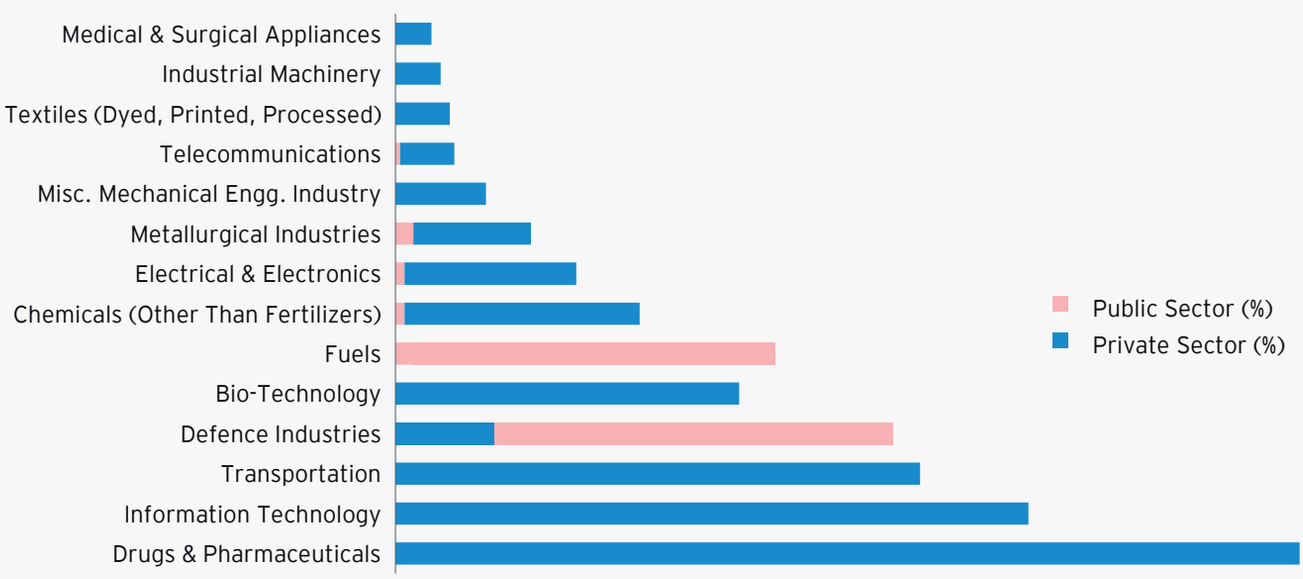
Source: 1. DPIIT_Annual_report 2023-24, Primary Interviews, EYP Research

India's R&D focus is shifting from traditional STEM and IT to frontier fields such as nanotech and deep learning, opening new avenues for academia–industry collaboration

Areas of research

- India's leading field of research is engineering and technology, accounting for about 52% of total research. The country's next predominant research fields are natural sciences, and life sciences and medicine. While emerging tech R&D has grown in recent years, these three fields continue to occupy the top three spots*.
- Between 2019 and 2023, coronavirus, nanotechnology, photocatalysis and deep learning were the top four research topics with the highest number of published papers[4].
- Industrial sector participation in GERD has been around 40% during the last five years. Public sector R&D units spent 0.30% of their sales turnover on R&D as compared to 1.46% by private sector in 2020–211.
- While defense and fuel sectors' R&D were dominated by the public sector, pharma and IT sectors' R&D was led by the private sector.

R&D expenditure by leading industry groups, 2020-21



Sources: Department of Science & Technology Report

- With a strong legacy of research in life sciences and emerging fields, India's research ecosystem has high potential to collaborate with industry in sunrise sectors such as bioactives, advanced manufacturing and medtech.
- Several industry leaders are actively partnering with universities to research in frontier sectors. Wipro, for example, has collaborated with Indian Institute of Science (IISc) for AI, ML and big data analytics while Tata Power collaborated with IIT-D2 and IIT-M3 (for EV infrastructure, hydrogen technologies, battery energy storage systems and microgrids).

* Dr. Sandeep Sancheti, Vice President (Research Relations & Academic Advisory), Elsevier (India)

Source: 1. Department of Science & Technology Report, 2. Economic Times, 3. LinkedIn, 4. The Hindu, EYP Research

Rewiring India's research ecosystem to deliver globally competitive innovation at scale

India possesses a vast pool of scientific talent and a firm foundation in fundamental research. As the nation accelerates its trajectory towards becoming a global knowledge economy and innovation powerhouse, the focus must now strategically shift towards translating this inherent strength into scaled, high-impact innovation.

The following priority areas represent critical systemic levers where targeted, coordinated intervention can amplify India's research output and solidify its position on the global innovation map.

India's research imperative: Priority areas for system-wide strengthening

Applied research

- Strategically shift a portion of fundamental research towards real-world applications, targeting both complex industrial challenges and pressing societal needs.
- This requires institutionalizing robust tracking and impact assessment systems to create visible, standardized pathways that accelerate the translation of technological gains into tangible economic and social value.

Funding

- While India's research ecosystem has a foundational strength, its full potential remains constrained by existing expenditure levels.
- Diversify and expand the public funding base, while implementing incentives and mechanisms to substantially elevate private sector spending on R&D, bringing it closer to the benchmark set by major global innovation hubs.

Incentives for research

- India can unlock a stronger research culture by introducing meaningful incentives, reducing faculty administrative load, and shifting motivations from compliance to discovery.
- Both faculty, students and industry partners require alignment of research incentives, providing tangible benefits for participation in high-value research.

Research translation

- Enhance tech-transfer outcomes by strengthening IP creation—through clearer ownership policies, robust disclosure processes and proactive patent support—and pairing this with agile, standardized licensing frameworks.
- Equip TTOs with commercialization talent and industry pathways to rapidly translate high-quality IP into market-ready solutions.

Partnership

- India can significantly elevate research outcomes by deepening industry–academia collaboration, ensuring labs work on market-relevant problems with clear pathways to deployment.
- Building structured partnership platforms, co-funded R&D programs and joint talent pipelines will accelerate innovation and translate academic research into tangible economic impact.

Policy

- Strengthen policy execution and compliance to create a stable, high-trust environment that attracts and anchors larger R&D investments.
- Simultaneously, modernize and fast-track operational processes—from equipment procurement to infrastructure approvals—to ensure researchers can utilize world-class tools, thereby accelerating experimentation and improving research productivity and quality.

Source: EYP Research

2

Global models of industry-enabled research and innovation

Deploying incentive-aligned frameworks can fast-track technology translation and commercialization efforts

Globally, leading innovation economies have achieved scale by building structured partnerships between industry, academia and government that align funding, talent and infrastructure with shared goals. This chapter examines international case studies to outline models for collaborative platforms that can support India's efforts to enhance research productivity and accelerate discovery and commercialization. It highlights three types of research initiatives: (i) industry–university collaboration models, (ii) government-backed innovation programs and (iii) institutional research translation platforms.

1 Industry–university collaboration models

Stanford's Industry Affiliate Program: Aligning industry needs with university research

Stanford Engineering | SystemX Alliance

Overview :

- Stanford University has established an Industry Affiliate Program that enables multiple corporate members and Stanford faculty and students to collaborate in a pre-competitive environment.
- Key research areas include hardware–software systems, semiconductors, nanotechnology, energy, mobility and communications.

Engagement model :

- Membership is tiered: Companies can join as Explorer, Associate, or Full-time members, with varying levels of engagement.
- The Alliance operates on a tripartite engagement model, structured around a faculty advisor, a PhD student fellow and an industry mentor. This framework promotes open collaboration, enabling the participation of multiple companies and ensuring research directions are jointly shaped by all partners.

Funding :

- ~80 faculty-level programs at Stanford (~40 in engineering) are funded by industry membership fee, offering companies early access to research, IP and talent—while faculty gain funding and students benefit through internships and joint PhDs.
- SystemX Alliance allocates a portion of member company contributions for Seed Grants. These grants promote research and student engagement.

Outcomes and Impact:

- Developed an ultrathin material that conducts electricity better than copper and could enable more energy-efficient nanoelectronics, scalable 3D reconstruction for X-ray single particle imaging with ML.

Caltech Research Center: Demonstrating deep academic–industry integration through co-located teams and shared infrastructure

Caltech University | Large Cloud Services Provider

Overview :

- The Caltech collaboration with a leading large cloud services provider aims to accelerate innovation across the entire quantum computing stack—covering hardware, software, algorithms and systems. This is being achieved by strategically combining the partner company's cloud and engineering capabilities with Caltech's deep physics and quantum research tradition.

Engagement model :

- Situated on the Caltech campus, this dedicated research center is funded and operated by the company, with Caltech faculty and postdocs working alongside corporate researchers.
- It supports graduate students and postdocs with opportunities to work in an industrial research lab while remaining embedded within Caltech.

Funding :

- The company provides financial support, in the form of funding for graduate fellowships, and computing resources, in the form of cloud credits, to accelerate the work of faculty and students.

Outcomes and Impact:

- The company's cloud quantum computing service continues to benefit from research breakthroughs.

Source: EYP Research

HEIs can consider strategic co-location of research institutes with industry partners to achieve specific goals, including accelerating commercialization and developing talent pipelines

NTU-Alibaba Model: Joint Research Institute for developing talent pipeline

Nanyang Technological University | Alibaba

Overview :

- The Joint Research Institute (JRI) operates through integrated teams, strategically combining the partners' core strengths: Alibaba contributes technology platforms (e.g., Cloud/AI) and real-world problem statements, while NTU provides human-centered AI expertise and campus testbeds.
- Key research focus areas include City Brain, cloud intelligence, data analytics and intelligence, health AI, AIoT technologies, human-centered mobility.
- Over the next five years, the goal is to build effective, accessible and inclusive AI in order to address important societal needs in ageless ageing, new lifestyles and human-centered mobility.

Engagement model :

- The collaboration facilitates bilateral mobility for students, staff and faculty between the two institutions. This is supplemented by a planned crowdsourcing platform designed to engage global researchers with high-priority Alibaba-NTU research problems.
- The Alibaba Talent Programme (ATP) in Singapore is also run through the JRI. Students are full-time Alibaba employees. During the PhD, they are co-supervised by an NTU supervisor and an Alibaba co-supervisor and spend up to 50% of their time at Alibaba premises.

Outcomes and impact:

- Joint publications and applied projects in AI for urban mobility, healthcare and sustainability.
- Industrial Technical Excellence Award in 2020 for developing a sandbox solution that leverages digital twin and AIoT technologies to enhance business continuity and improve energy efficiency.

Liverpool University–Unilever partnership: Embedded research with quick commercialization pathways

University of Liverpool | Unilever

Overview :

- The alliance centers around the Materials Innovation Factory (MIF), a research facility jointly established to drive innovation in formulated materials. The collaboration combines the University's research with Unilever's industry experience to accelerate new material discovery, product development and innovation.

Funding :

- The Materials Innovation Factory (MIF) was capitalized via the UKRPIF project (Research England/UKRI), which mandated a strict 2:1 match funding ratio (£2 private investment for every £1 public). This resulted in approximately £11 million in public UKRPIF support successfully leveraging substantial private co-investment (including Unilever) toward a total capital investment of £81 million.

Engagement model :

- Designed to be "open by design," the University manages the building and core research platforms. Co-located teams from both Unilever and the University share advanced open-access equipment and technical staff.
- Focuses on joint supervision and sponsorship of PhD talent and shared technical expertise. This is supported by frequent embedded placements for staff.

Outcomes and Impact:

- Developed patented enzyme detergents (Persil Wonder Wash Laundry) and microbiome-based oral and skincare products.
- The MIF has attracted ~£100 million in investment to date and anchors the Liverpool City Region's materials innovation cluster, building on earlier joint centers.

Source: EYP Research

Government-backed mission-oriented programmes can maximize innovation impact and R&D returns

2 Government-backed innovation programs

EU Horizon: Mission-driven consortium for transnational R&D

EU Horizon

Overview :

- Horizon Europe (2021-2027) is the European Union's flagship R&D and innovation program, driving large-scale, multidisciplinary projects across the full research spectrum—from fundamental science to market acceleration.
- This is executed through three strategic pillars: Pillar I (Excellent Science) funds top-tier individual research; Pillar II (Global Challenges) addresses mission-driven societal challenges through collaborative R&D; and Pillar III (Innovative Europe), featuring the European Innovation Council (EIC), targets breakthrough innovation by supporting SMEs and start-ups.

Funding :

- With a budget of approximately €93.5 billion, the program demonstrates a leverage ratio of 1.63—meaning every €1 from the EU budget attracts €1.63 in co-funding from other sources (via calls and partners' additional activities).
- ~€25 billion of EU funding committed to partnerships, with an additional €40 billion from partner organizations

Engagement Model : The program utilizes three core mechanisms to structure transnational R&D collaborations:

- Co-programmed: Agreements established directly between the Commission and external public or private partners.
- Co-funded: Joint research programs financed by the EU and national research funders or public authorities from member countries.
- Institutionalized: Long-term, highly integrated partnerships between the EU, Member States and industry, established through special legislation for complex challenges requiring deep, sustained commitment.

Outcomes and Impact:

- 3X increase in top 1% citations with a 20% increase in labor productivity in funded companies1
- 30 Nobel Prizes won by EU-funded research with five times the RoI for every €1 invested in benefits for EU citizens by 2040

NSF I-Corps: Industry -academia partnership model to translate science into market-ready innovation

NSF I – Corps, US

Overview :

- The National Science Foundation's Innovation Corps (NSF I-Corps) program aims to accelerate the commercialization of academic research by promoting entrepreneurship, industry engagement and customer-centric innovation.

Funding :

- Funding for I-Corps supported companies is split into two primary categories: Public Funding (37%) that consolidates all government support, including Federal grants (Small Business Innovation Research (SBIR) / Small Business Technology Transfer (STTR) and non-SBIR/STTR1) and State funding and Private Funding (63%) that aggregates investment from private entities, including Venture Capital (VC), Angel/individual investors and direct funding from private industry or corporate sources.

Engagement Model :

- I-Corps requires teams to recruit an industry mentor and validate market needs before product development
- Research is aligned with industry demand and products are co-developed to reduce risk and enhance the potential for corporate R&D collaborations.

Outcomes and Impact:

- At the system level, the program has demonstrated strong outcomes: 2,500+ teams trained, ~1,400 start-ups launched and US$3.16 billion in follow-on funding raised by I-Corps-derived start-ups
- NSF collaborates with eight US federal government agencies that implement I-Corps programs at different stages, from demonstration to validation.

1. **Congressional authority for the Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR) programs**
Source: EYP Research

Industry consortia have emerged as successful models for large-scale sustainable research engagements

3 Institutional research translation platforms

Catapult Centers (UK)

Overview :

- The Catapult Network comprises nine technology and innovation centers established by Innovate UK (the country's innovation agency) around priority sectors. These are independent, not-for-profit entities partially funded by government, designed to act as translation bridges between academic research and industry commercialization

Funding :

- The UK Government confirmed £1.6 billion in core funding for 2023–2028 — a 35% increase over the previous period.
- The centers operate under bespoke key performance indicators (KPIs) and monitoring frameworks (M&E) to ensure performance and value for money.

Operating Model:

- Catapults "bridge the gap" between research and commercialization through open-access labs, demonstrators, supply-chain consortia and standards/testbeds.
- Government guidance encourages public-sector departments to procure and test innovations via Catapults, accelerating early adoption.

Impact:

- Operate on a user-facility model, where industry pays for access to services/testbeds.
- Catapults also advance technical skills and workforce development. For instance, the Cell & Gene Therapy Catapult runs apprenticeships, national training networks and supports manufacturing job creation.

Fraunhofer Institutes (Germany)

Overview :

- The Fraunhofer Society operates 70+ applied research institutes across Germany, each focused on specific technologies or themes. The institutes serve as key intermediaries between academia and industry, driving applied research and innovation.

Funding :

- Fraunhofer employs a tripartite revenue model, comprising industry contracts, publicly funded projects (EU, federal/state competitions) and base funding (Grundfinanzierung) for pre-competitive research.
- Approximately 70–80% of revenue comes from contract research with industry and public-sector partners, while 20–30% is from government-based funding.

Operating model:

- Operates as a non-profit organization, independent from universities but funded jointly by federal, state and industry sources.
- Institutes have autonomy to engage directly with industry, fostering agility and responsiveness

Impact:

- Fraunhofer holds ~7,000 active patent families with ~500 new inventions in 2024.
- €164 million was earned from the sale of IP and licensing with equity shares in 80+ companies.

Source: EYP Research

Global models of industry-academia collaboration highlight structural and strategic approaches for Indian HEIs

Best practices for India's research ecosystem	
Active industry mentoring	▪ Embed industry practitioners in research and curriculum governance to align university agendas with real-world technology and talent needs. ▪ Co-supervise research and prototype development with industry mentors to de-risk commercialization and accelerate market-ready outcomes. ▪ Enable two-way mobility programs, allowing faculty, researchers and industry experts to work across institutions and firms for deeper knowledge exchange.
Introduce mission-focused competitive funding	▪ EU Horizon and NSF I-Corps highlight the effectiveness of mission-driven programs that combine public and private funding, use competitive calls and emphasize measurable outcomes. ▪ Such programs help align national priorities with industry needs, channel resources toward high-impact research and promote interdisciplinary teams.
Industry-University membership models	▪ Models like Stanford's SystemX Alliance show that multi-tier membership programs—with clear access to labs, talent and research steering—create predictable, long-term collaboration with industry partners. ▪ Such models move engagement away from one-off projects toward continuous, jointly governed research pipelines.
Repurpose few existing CoE and technology parks	▪ Transform select Centres of Excellence (CoEs) and Technology Parks into Catapult-like applied research centers emphasizing industry collaboration, open-access infrastructure and commercialization services. ▪ Establish sector-focused innovation clusters linking academia, research and start-ups, underpinned by seed and venture capital for lab to market support.
Strengthen institutional platforms for technology transfer	▪ Fraunhofer Institutes and Catapult Centers show that dedicated translation platforms—operating as semi-autonomous entities with clear KPIs, open-access labs, testbeds and commercial pathways—can significantly boost applied research, spin-outs and industrial adoption of innovations.
Embed flexible talent development pipelines	▪ Joint PhD supervision, student internships (SystemX) and co-supervised doctoral programs (NTU–Alibaba) ensure continuous talent flow into priority sectors and increase the workforce skilled in applied research and emerging technologies.

3

Identifying India's sunrise sectors for the next decade

India can concentrate its research efforts on four sunrise sectors, with the highest innovation and industrial impact potential

As the global case studies demonstrate, industry–academia collaboration succeeds when national systems align research priorities with high-potential technology domains and structured pathways for translation. Building on these lessons, this chapter turns to India by identifying the sunrise sectors that will define the country's competitiveness over the next decade. By mapping emerging technologies, value-chain gaps and global mission-led approaches, this chapter highlights where India must concentrate its collaborative R&D efforts to unlock strategic advantage.

Biofutures

- Biofutures encompasses synthetic biology, bio-manufacturing, advanced biomaterials and sustainable bio-processes.
- With India's strong pharma base, abundant biomass and growing biotechnology talent, this sector offers significant opportunities to lead in bio-based chemicals, green fuels, precision fermentation and next-generation therapeutics.

Medtech

- Medtech includes medical devices, diagnostics, digital health and assistive technologies.
- India's large healthcare market, increasing regulatory maturity and strong engineering talent position it to become a global hub for affordable, high-quality medical technologies.

Manufacturing and technologies

- This sector spans advanced manufacturing, Industry 4.0, materials engineering, semiconductors, robotics and automation.
- As India seeks to expand its manufacturing footprint, there is substantial potential for R&D in digital manufacturing, smart factories, additive manufacturing and high-performance materials that can strengthen industrial productivity and global competitiveness.

Mobility

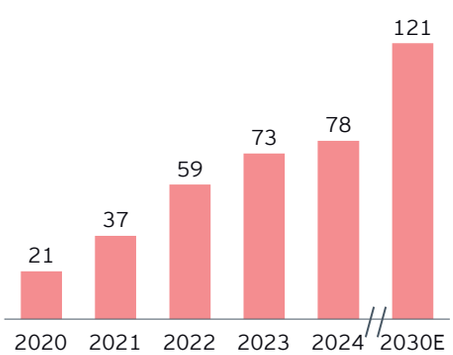
- Mobility covers electric vehicles, battery technologies, autonomous systems and next-generation transportation solutions.
- India's rapid urbanization, EV adoption push and large domestic market create strong opportunities to innovate in advanced chemistries, charging infrastructure, power electronics, Advanced Driver Assistance Systems (ADAS) systems and intelligent mobility platforms.

Biofutures represents a high-potential sunrise sector poised to drive India's next phase of research-led growth

1A Biofutures: Market size and sector contributions

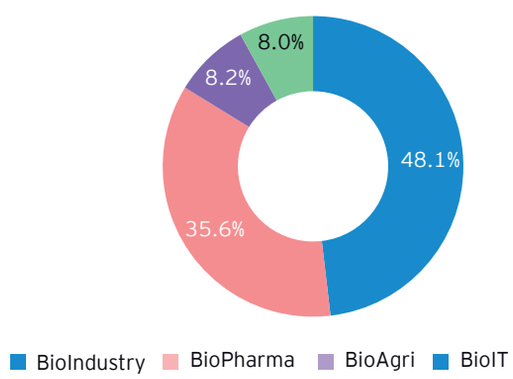
- '**Biofutures**' aligns closely with the term 'bio-industry' referring to the industrial biotechnology sector that develops and manufactures bio products from renewable feedstocks using advanced technologies.[1]
- The segment grew by 23.1%, in 2022-23, reflecting the expanding adoption of bio-based products and processes across industries.
- The bio industry represents ~50% of the total bioeconomy, valued at US$72.6 billion.

Bio industry growth in India 2020-2035 (in US$b)



Source : IBER Report 2024

Contribution to India's bioeconomy in 2023



Source : IBER Report 2024

1B Integrated value chain

	Upstream Feedstock sourcing and pre-processing	Midstream Biorefinery operations	Downstream Product formulations and market applications	End of Life Cycle Circularity and testing services [4]
Bio-based materials and bio plastics[2]	Leverages agricultural feedstock (rice straw, sugarcane, starchy crops)	▪ Involves chemical synthesis producing bio-based polymer, pre cursors and bioplastic granules ▪ Composite development	Industries convert the bio-basaed materials into finished goods for markets like orthopedic and dental implants, scaffolds for tissue engineering	Includes systems for collection, segregation and processing through specialized recycling streams Material characterization encompasses mechanical property testing, thermal analysis, biodegradation in different environments and biocompatibility testing
Bio actives[3]	Depends critically on medicinal plant sourcing and microbial cultivation	This stage involves extraction, purification, standardization and large scale API manufacturing	Targets functional food and beverages (probiotics), dietary supplements clean beauty and cosmetics	
Bio remediation[4]	This stage involves site assessment and sample analysis to determine nature and extent of contamination	Development and provision of biological agents and hyper-accumulator plant species known for extracting heavy metals	Techniques like (In situ and ex-situ treatment) are applied at the contaminated site	

Source: 1.BioFuture_10Year_Roadmap, 2. Biomaterials 3. Bioactives 4. Bioremediation

Flexible bio-refineries, advanced conversion technologies and novel biomaterials that improve material properties form the core high-value research opportunities in India's bio-industry

1C R&D opportunities

Bio-based materials and bio plastic[1]	Bio actives[2]	Bio remediation[3]
▪ Designing of modular and flexible bio-refineries, tailored to local feedstock availability and market demands ▪ Bioplastic production utilizing biological systems like microorganisms or enzymes ▪ 3D printing with bioplastics ▪ Advanced conversion technologies ▪ Novel bio-based materials for improving properties such as self-healing, fire retardancy	▪ Technological advancements that facilitate efficient extraction, purification and formulation strategies. ▪ Advancement in improving the biological properties of Bio actives	▪ Development of circular bioeconomy approaches for bioremediation of pollutants including heavy metals, pesticides, etc. ▪ In situ sewage treatment technologies, treatment packages and microbial dosing for river front discharge points and river ecosystems through bio-augmentation and biomimicry principles

1D CSIRO: Australian R&D collaboration model

CSIRO

- **Overview:** An Australian government corporate entity with a board and chief executive, CSIRO works with industry, government and research communities across six major areas – Energy and Minerals, Food and Fibre, From Wonder to Discovery, Nature, One Health and Tech Economy.
- **Funding:** Dedicated funding streams for industry and researchers (CSIRO Kickstart offers dollar match funding of US$10,000 to US$50,000 for collaborative research),government-funded Incubator(BMTI).
- **Operating model:** Partners with Australia's higher education sector, government and industry to build, maintain and enhance other research infrastructure. Offers incubators for start-ups and SMEs (CSIRO Kickstart, Innovation Connect), CSIRO provides labs and facilities (CSIRO BioFoundry)
- **Industry engagement:** Engaged with almost 5,000 domestic and international, industry and government entities including ~2,000 SMEs, 659 large Australian corporations and 999 overseas corporations. Established BioMedTech Incubator (BMTI) in partnership with Brandon BioCatalyst's CUREator.

Source: 1.Biomaterials ,2. NCBI_Bioactives 3. GSBTM_Bioactives

Medtech represent high-potential sunrise domains poised to drive India's next phase of research-led growth

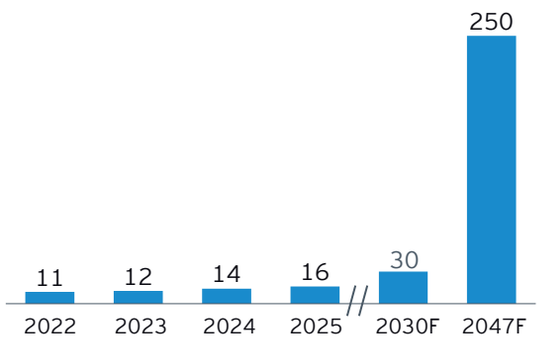
2A Medtech: Market size and growth outlook

- **Medtech** (Medical Technology) refers to the range of technologies, devices, equipment, software and systems used to prevent, diagnose, monitor and treat diseases or improve health. It is a subset of the Indian bioeconomy.
- This sector includes digital and AI-driven healthcare technologies, advanced medical devices and diagnostics, emerging therapeutics and regenerative technologies, and implants and assistive technologies.
- India offers a substantial cost advantage for local medtech manufacturing through a significant uptick in domestic manufacturing (exports increased at 14% CAGR) and a reduction in import reliance(reduced dependency from 80 to 60%).[1]
- The market is expected to grow to US$30 billion by 2030. At present, the market ranks among the top 20 countries globally, with a market share of 1.65%.[2]

Year	2022	2023	2024
FDI in Flow ($Mn)	185	375	477

Source : IBER Report 2024

India medtech market size (US$b)



Source : Unlocking India for the world in MedTech Report 2025, EY Medtech Report

2B Integrated value chain

	Upstream Core components and technology foundation	Midstream Integration and manufacturing	Downstream Service delivery and clinical application
Digital and AI-driven healthcare technologies	Creation of the core technologies includes software integration with hardware like sensors and microchips.	Driven by a strong base of Indian start-ups and tech firms, this stage includes telemedicine platforms, AI diagnostic solution providers and wearable device companies.	Hospitals, insurers, employers and individuals are increasingly adopting digital health to enhance efficiency and enable remote care.
Advance medical devices and diagnostics[1]	This most import-dependent stage involves R&D and manufacturing of high-tech components like sensors, optics, semiconductors and precision-engineered components.	▪ Component manufacturing focused on simple components and sub-assemblies. ▪ Device assembly: Main activity, with MNCs and domestic firms assembling low- to mid-tech devices like IVD kits and disposables.	The distribution network is fragmented comprising importers, regional stockists and local dealers. Hospitals and diagnostic laboratory chains are the primary purchasers and operators of diagnostic tech.
Regenerative technologies and implants[2]	The formulation of printable materials that are biocompatible and can support cellular growth, along with manufacturing the 3D bioprinters and photo biomodulation devices.	Bioprinters create 3D tissue models (skin, liver, corneal) for toxicity testing which must undergo rigorous testing to establish its safety and efficacy for human use.	The primary end-users include patients requiring transplantation or regenerative treatments, pharmaceutical companies using tissue models for R&D and cosmetic companies for safety and efficacy testing

Source: 1. Flevy Management Insights, 2.microbentos.com,us.operonstrategist.com,

Key medtech research opportunities span hospital-efficiency platforms, sensor-based monitoring, AI-driven diagnostics, advanced devices and next-generation regenerative implants

2C R&D opportunities

Digital and AI-driven healthcare technologies[1]

- Solutions improving hospital efficiency and enabling real-time patient management , visualization and surgical planning
- Portable sensor based wearables for in patient monitoring
- AI based early diagnosis of dental pathologies
- Predict drug responses, optimize dosing and identify safety risks in silico clinical trials

Advance medical device and diagnostics[1]

- Advance Imaging systems for improved tumor targeting
- Systems to reduce radiation dose and exposure time
- System to improve diagnostic accuracy and reduce procedural error
- Implant miniaturization and minimally invasive surgical techniques in cardiology and neurology

Regenerative technology and implants

- Developing new bioresorbable materials that degrade safely in the body and enhance the biocompatibility and longevity of existing materials like titanium and polymers[3]
- Advancements in 'In situ' monitoring of the printing process and printed tissues/organs[2]
- Wearable devices that augment human movement, significantly reducing physical strain in manufacturing environments

2D Stanford LifeScience District: University-led biotech park

Stanford Life Science District – Research park

- **Overview:** The Stanford Life Science District is a specialized area within the Stanford Research Park (SRP) dedicated to commercializing scientific discoveries in fields like bioengineering and digital health.
- **Funding:** Stanford University owns the land in Stanford Research Park and uses a ground lease model where it sells long-term ground leases to developers and operators.
- **Operating model:** Research park supported by an extended incubation cell (Alexandria LaunchLabs) offering ready-to-use labs, shared equipment and access to capital for scientist-entrepreneurs. Over 50% of SRP companies employ Stanford University graduates.
- **Industry engagement :** Stanford Research Park currently features Varian Medical Systems, Jazz Pharmaceuticals, Guardant Health and other biotech firms.

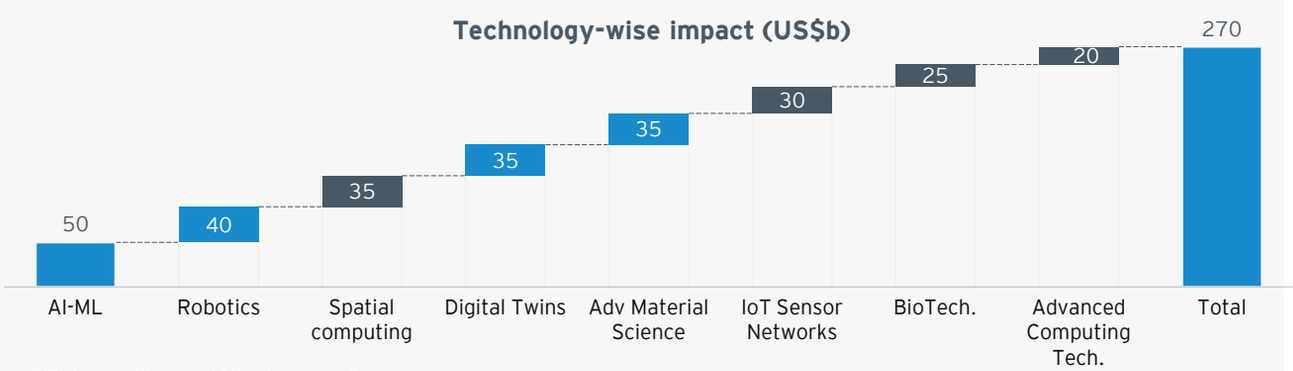
Source : 1.EY Medtech Report, 2. Taylor & Francis, 3.Biomaterials Research paper

Advanced manufacturing: India's pathway to high-value global supply chain leadership

3A Manufacturing and technologies: Sector contributions and growth outlook

- Manufacturing currently contributes only 15% to 17% to India's GDP, compared to 25% to 30% in East Asian economies1.
- Under Viksit Bharat, India has set a target for manufacturing to account for 25% of national GDP by 2047.
- Peer nations have achieved ~2% real GDP growth through technology-driven productivity gains and adoption of frontier technologies across key sectors.[1]
- Four technologies with high potential to drive India's manufacturing transformation: artificial intelligence and machine learning, advanced material sciences, digital twins and robot-driven manufacturing.[1]
- R&D investment in frontier technologies enables this transition, adding US$270 billion by 2035 in additional manufacturing GDP to the Indian economy(projected US$10 trillion in 2035).[1]

Economic assessment of frontier technology in India 2035



Source : NITI Aayog_Advanced_Manufacturing Report

3B Integrated value chain

Technologies within manufacturing	Product and process design	Materials development and sourcing	Manufacturing and production operations	Quality assurance and testing	Logistics and distribution	End-of-life cycle and circularity
Additive manufacturing nanomanufacturing, robot-driven manufacturing	✓	–	✓	✓	–	–
Digital transformation (IOT,Digital Twin,AR/VR)	✓	✓	✓	✓	✓	✓
Development of advance materials	✓	✓	✓	–	–	–
Sustainable manufacturing (circularity; zero-defect manuf.; energy efficiency)	–	✓	–	✓	–	✓

Source: 1. NITI Aayog_Advanced_Manufacturing Report

Digital supply-chain transformation, paired with indigenous material innovation, can unlock India's latent manufacturing competitiveness at scale

3C R&D opportunities

Advanced manufacturing technologies[1]

- Introducing Telerobotics in high risk environments like chemical plants, nuclear facilitator, etc.
- Precision engineering in electronic manufacturing - SMT placement, micro-soldering and PCB assembly

Digital transformation in manufacturing[1]

- AI/ML-powered design copilots—trained on India's industrial design libraries – optimize sector specific designing for MSME
- Autonomous Agentic AI ecosystems in complex assembly manufacturing
- Digital Twins system to virtually design, components before physical prototypes are built

Development of advanced materials[1]

- Thermoplastic composites for defense and railway manufacturing
- 2D materials like molybdenum disulfide in electronics manufacturing - miniaturized thermal management, faster electron mobility – crucial for wearables
- Self-healing elastomers in footwear and leather industry

3D NTU Corporate Labs: Public-private research model

NTU Corporate Labs

- **Overview:** NTU Singapore operates Corporate Laboratories as flagship public-private R&D partnerships that bring together industry leaders and university researchers.
- **Funding:** Corporate Labs are multi-year, multi-million dollar collaborations typically spanning 5 years, with funding ranging from S$24 million to S$66 million per lab supported by the National Research Foundation Singapore (NRF Singapore).
- **Operating model:** Tripartite collaboration as seen between a leading global automotive group, NTU and the Agency for Science, Technology and Research (A*STAR).
- **Industry engagement:** The joint Corporate Lab between a Schaeffler Pte Ltd and NTU is dedicated to advanced industrial robotics research and development (R&D). Its primary objective is to create high-precision sensing and torque-based control systems for industrial collaborative robots (cobots), with direct applications in Industrial IoT and smart factory environments.

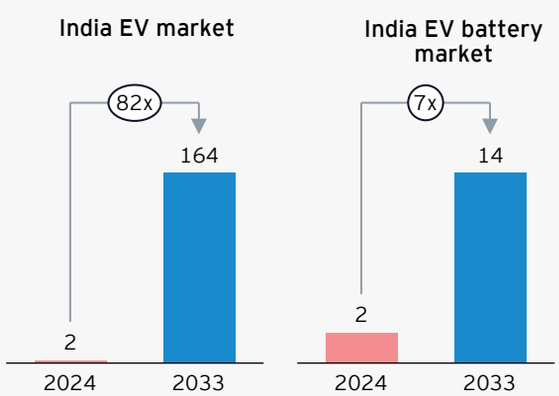
Source : 1. NITI Aayog_Advanced_Manufacturing Report

Mobility: A future-defining domain driving the next wave of industrial growth

4A Mobility: Scale and growth outlook

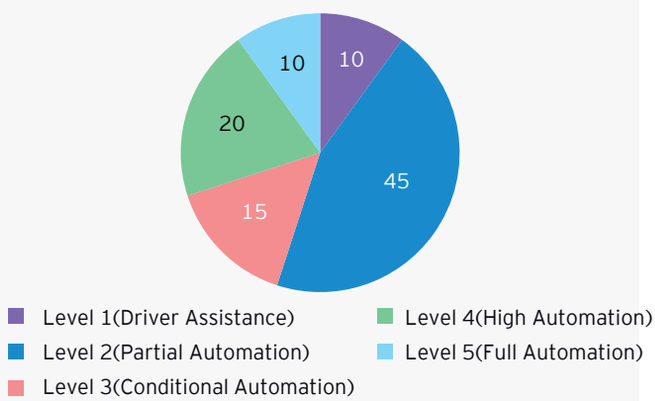
- Mobility includes the development of **Advanced Driver Assistance Systems (ADAS)** suited to local traffic conditions, systems engineering for EVs and autonomous vehicles and the rise of Software-Defined Vehicles (SDVs),where software governs vehicle performance.
- The Indian EV market is expected to grow at a CAGR of 57% to US$164 billion in 2033. Increased EV sales coupled with the National Mission on Electric Mobility will need to be supported by advances in batteries and materials to drive down costs and accelerate the shift to smart and autonomous mobility.1
- The Indian autonomous vehicle market, valued at US$2.6 billion in 2024, is projected to grow at a ~24% CAGR by 2030, supported by over US$1 billion in R&D and growing investments in smart and connected mobility solutions.2 The dominance of Level 1 and Level 2 autonomy highlights significant opportunities for advancing higher-level automation.

India EV landscape (in US$b)



Source : IBEF

India autonomous vehicle market segmentation by level of autonomy (In value %)



Source : Autonomous Vehicle Research Report

4B Mobility – Integrated value chain

Stages	Advance driver assistance system[3]	Systems engineering for electric and autonomous mobility	Materials for EV[4]	SDV and cybersecurity[5]
Stage 1	Environment and scenario definition	System requirements and architecture	Raw material extraction and processing	Centralized electrical/electronic architecture design
Stage 2	Data acquisition and annotation	Model-Based Systems Engineering (MBSE)	Precursor and active material synthesis	Middleware and operating system development
Stage 3	Sensor and hardware dev/adaptation	Component sizing and selection	Component manufacturing	Application software development
Stage 4	Perception and prediction algorithm development	Software and control system development	Cell fabrication and assembly	Cloud infrastructure
Stage 5	Control and actuation logic	System integration and validation	Motor materials and manufacturing	Cybersecurity lifecycle management
Stage 6	Simulations and prototype trials	Testing and safety	Circular economy and recycling	

Source: 1. TOI, 2.Autonomous Vehicle Research Report, 3.EDN, 4. EV Supplychain, 5.Specialized websites (www.mathworks.com, www.elektrobit.com, www.arm.com,www.t-systems.com)

ADAS, cybersecurity, frontier EV chemistries and automotive-grade chip engineering define the core research opportunities shaping India's next-generation mobility ecosystem

4C R&D opportunities

SDV and cybersecurity	Materials for EV	System engineering in EV and autonomous mobility	Advance drive assistance system
Standardized, secure and resource-resilient V2X communication systems tailored for the Indian 5G landscape and traffic environment.[1]	Advanced battery chemistries (solid-state, lithium-sulfur, sodium-ion and metal-air technologies), rare earth free motors and drive train components better suited for the Indian context[2]	Automotive grade semiconductors, chip design and fabrication as strategic opportunities to build self-reliance across the automotive value chain.[3]	Developing large-scale, high-quality, publicly accessible and meticulously annotated datasets specific to Indian driving conditions and advancing ADAS algorithms and sensor calibration for the unique conditions of the Indian road environment[4]

4D Toyota Research Institute: Automotive deep-tech R&D hub

Toyota Research Institute (TRI)

- **Overview:** The Toyota Research Institute (TRI) operates as a core component of Toyota's broader global R&D network and is reinforced by long-term academic collaborations. CSRC's* decade-long partnership with MIT and the creation of TRI-ANN with the University of Michigan in 2016 exemplify Toyota's active engagement with universities for applied and frontier research.
- **Funding:** TRI invested US$22 million over four years for research collaborations with the U-M faculty in the areas of enhanced driving safety, partner robotics and indoor mobility, autonomous driving and student learning and diversity. In 2017, TRI launched Toyota AI Ventures (later rebranded) to invest in early-stage start-ups, offer mentorship and on-site support.
- **Operating Model:** TRI serves as the bridge between fundamental research and product development.
- **Industry Engagement:** The institute maintains partnerships with internal Toyota groups and external academic institutions. One of the major research pillars of TRI in ADAS is scalable approaches to automated driving by developing and evaluating end-to-end models facilitated at TRI ANN.

*CSRC (Collaborative Safety Research Center) was created by Toyota in 2011 to advance mobility safety for industry and society through collaborations with universities, hospitals and other research institutions

Source : 1. www.indiascienceandtechnology.gov.in, 2. NITI Aayog EV Report, 3. PIB, 4. AI for Indian Roads

4

Key drivers of success and way forward

New-age universities will enhance India's research ecosystem by infusing global talent, interdisciplinary thinking and deep industry linkages

The sectoral analysis in the previous chapter highlights not only where India's next wave of innovation will occur but also the enabling conditions needed to activate collaboration across these domains. Translating these opportunities into impact requires a coherent framework that brings together universities, industry and government around shared missions, flexible partnership models and coordinated funding mechanisms. Chapter 4 outlines the institutional and policy architecture needed to operationalize collaboration at scale through the following key success drivers:

1 **Leveraging New Age Universities**

2 **Building an Enabling Research Ecosystem**

3 **Forming a National Coordination Agency**

1 Leveraging new-age universities in strengthening research and innovation ecosystems

- New-age private universities, including multidisciplinary domestic institutions and International Branch Campuses (IBCs) of esteemed international universities, have expanded rapidly in the past decade, driving diversification in India's higher-education system.
- Their deliberate focus on applied, industry-aligned curricula and interdisciplinary learning has positioned them to leapfrog many legacy institutions in research quality and innovation performance. This is reflected in outcomes such as Shoolini University's researchers being listed among the world's top 2% scientists and the university securing the 96th position in THE Impact Rankings 2025.

New-age universities: Drivers of success

Targeted partnerships	▪ Ashoka University has built a dynamic global network with 60+ international partnerships spanning 21 countries ▪ 18 CoEs led by renowned industry practitioners[2]
Interdisciplinary hiring and structure with built in industry linkages	▪ Plaksha hires faculty from top global institutions like MIT, Cambridge, LSE, etc. with leading business figures, tech entrepreneurs and academics actively engaged in program design, research and student mentoring.[3] ▪ Plaksha and Ashoka feature interdisciplinary UG/PG programs (BTech in Robotics & Autonomous systems, BTech in Data Science, Business & Economics, BSc in Computer Sc. and entrepreneurship, etc.)
Flexible capital	▪ Plaksha University raised commitment of INR1,100 crore with 100+ founders and 20+ corporate donors [3]
Mission-driven research	▪ Shoolini University incorporates research at the UG level ▪ It has 100+ labs , 11 CoEs ,1700+ patents filed with 17,000+ citations ▪ Ranked one (citation per paper in QS world ranking Asia 2024) with FWCI score 2.22 at par with top 10 universities in world.[4]

Source : 1.Forbes, 2.Ashoka.edu, 3. Plaksha, 4.Shooliniuniversity, 5.Economic Times

New-age universities will enhance India's research ecosystem by infusing global talent, interdisciplinary thinking and deep industry linkages (cont'd.)

International Branch Campuses

- A vast array of UK, US and Australian foreign HEIs are planning to set up their IBCs in India with a strong mandate on research.
- **Western Sydney University**, ranked first in THE Impact Rankings, is planning to develop a strong research and innovation pipeline in climate resilience, water quality and agriculture in partnership with IITs, ICAR and the UP government. It will also host a business incubator for research commercialization and skill development5.
- **University of Southampton** plans to onboard industry partners from the outset, aligning programs, research and community initiatives with employer needs to ensure strong placement outcomes and real-world impact.
- **University of Liverpool** plans to build its long-standing research and industrial partnerships in India, including collaborations with Hindustan Unilever, AstraZeneca Pharma India, Wipro, Axis Bank and Dream11, by using its Bengaluru campus as a platform to deepen these collaborations.[1]
- **The University of York's Mumbai** campus will position research and collaboration at the heart of its engagement model. This builds on the university's existing partnerships in India, which already deliver impact across areas like health, food security and climate resilience. A core part of the Mumbai campus development is the focus on creative industries research and teaching, anchored by an MoU with the Indian Institute for Creative Technologies (IICT) and linked to York's CoSTAR Live Lab network.[2]
- **University of Aberdeen** intends to build on existing partnerships with more than 200 Indian universities and research centers including IITs, AIIMS, Manipal Academy, ICAR and Delhi University. The proposed branch campus would serve as a hub for academic excellence and global problem-solving with plans to establish a research and innovation office to expand research collaborations and industry partnerships in areas such as AI, energy and life sciences. 3
- **University of Bristol** will leverage its long-standing India partnerships, most notably its new agreement with IIT Bombay focused on translational research, artificial intelligence and entrepreneurship, to anchor a strong research and innovation agenda for its India campus.[1]

How New Age Universities can elevate India's research ecosystem

Complement India's legacy institutions	▪ Leverage STEM capabilities and technology transfer infrastructure of legacy institutions ▪ Engage in tripartite partnerships with industry and legacy institutions for jointly governed labs and project[5]
Human capital development	▪ Faculty exchange fellowships and visiting chairs with faculty of INIs to co-supervise projects and learn interdisciplinary methods ▪ Capacity building workshops on grant writing to international funding agencies, open science practices, PhD clinics, etc.
Commercialization pathways	▪ Lab to market bootcamps by new-age universities for global best practices ▪ Leverage industrial testbeds and pilot facilities in legacy institutions for quick commercial validation for new products

Source : 1. GOV.UK, 2. Aberdeen, 3. York

Successful research ecosystems rely on researcher autonomy, simplified processes and targeted incentives that collectively drive quality, productivity and innovation

2 Building an enabling research ecosystem

Strong research ecosystems depend on giving researchers the autonomy to pursue ambitious ideas while reinforcing this freedom with incentives that reward quality and innovation. Complementing these, targeted incentives such as performance-linked funding, IP-sharing and R&D tax credits ensure that high-quality research and industry collaboration are consistently encouraged and scaled.

Block grants

- Shift to multi-year block grants that universities can allocate freely, linked to periodic quality assessments.
- The UK distributes ~£2 billion/year in flexible "quality-related" (QR) funding based on REF results, allowing universities to invest strategically.[1]

Excellence clusters

- Establish autonomous Centres/Clusters of Excellence with independent oversight bodies and long-term funding in priority areas.
- Germany's Excellence Strategy funds clusters through international peer review and gives them flexibility to set research agendas.[2]

Tenure-like protections

- Introduce or reinforce tenure-like protections to safeguard academic independence in research-intensive institutions.
- In the US, tenure's core purpose is to secure academic freedom for long-horizon research.[3]

Revenue sharing and IP gains

- Establish IP ownership and revenue-sharing rights for universities on publicly funded research so that faculty and student inventors can benefit through royalties or equity. This incentivizes high-quality, commercially relevant research.
- The US Bayh-Dole Act empowered universities to retain IP from federally-funded research triggering major gains in technology transfer and widespread start-up formation anchored in university research.[4]

R&D tax credits and challenge funds

- Provide enhanced R&D tax deductions/credits for firms conducting research with universities or public labs.
- Leverage challenge funds to set mission-driven goals and operate through competitive, milestone-based funding calls.
- The UKRI agency launched a series of themed "Challenges", each requiring mandatory industry co-funding and adherence to downstream milestones. Between 2018 and 2024, award recipients attracted £903 million in private investment.

Performance-based funding

- Link part of university funding to quality-weighed outputs (e.g., weighted publications, PhDs, grant income).
- Norway's "publication points" model allocates ~15% of core research funding using this system.5
- Evaluations show higher publication productivity and greater output in recognized high-quality journals.

Source : 1. QR funding and the REF – UKRI, 2. DFG, German Research Foundation 3.Tenure , 4.Bayh-Dole Act , 5. Norwegian Model

With ANRF, India finally has a unified, mission-driven research funding agency capable of steering the nation's innovation agenda

3 Forming a National Coordination Agency

- India's R&D ecosystem has historically been spread across multiple ministries and statutory bodies, leading to overlapping efforts and differing priorities. While these agencies have played important roles, the system overall has required stronger coordination to enhance industry engagement, improve technology translation and provide more consistent support to higher education institutions.
- To enable this, the Government of India has established the Anusandhan National Research Foundation (ANRF) as the apex body for research funding and governance. ANRF is responsible for setting national research priorities and streamlining oversight across the ecosystem.
- Outlined below is a brief overview of its mandate, capabilities and role in the Indian research ecosystem:

ANRF: A catalyst to becoming a global research and innovation powerhouse

- The Anusandhan National Research Foundation (ANRF) is India's apex institution for strengthening the country's research, innovation and knowledge ecosystem. Established under the ANRF Act, 2023, the Foundation is designed to provide a unified, strategic direction for research funding across universities, research labs, scientific institutions and industry partners.
- Anchored within the Department of Science and Technology (DST), a central goal of ANRF is to significantly increase industry participation in research, encouraging co-funding models and large-scale collaborative missions.
- By servicing as a national anchor for research strategy, program design and funding, ANRF seeks to position India as a globally competitive research and innovation leader, enabling the country to move from incremental advancements to high-impact scientific and technological breakthroughs

ANRF: Program Overview1

Career stage research support

- Grants focused on individual researchers at different career levels to conduction foundational/applied research
- Prime Minister's Early Career Research Grant (PM ECRG), Inclusivity Research Grant (IRG), Advanced Research Grant (ARG), etc., are some prominent examples

Mission Driven Programs

- Grants aimed to drive large, multi-institution and multi-disciplinary research missions addressing high-impact national priorities
- Specific mission-mode programs launched under Mission for Advancement in High-impact Areas (MAHA) program, e.g., EV Mobility mission under ANRF

Capital infusion

- The government has also established a lean business unit under the joint stewardship of DST and ANRF, with DST managing policy and ANRF overseeing execution
- Initial allocation of INR1 lakh crore with potential to expand up to INR5 lakh crore
- Provisions for sector-wise industry engagement with targeted deployment of capital

Leadership spotlight: Dr. Shivkumar Kalyanaraman

- Delivering on ANRF's mandate requires not only robust programme design but also leadership capable of seamlessly integrating industry, academia and government efforts. In this context, the appointment of Dr. Shivkumar Kalyanaraman as CEO provides strong institutional direction and momentum for operationalizing ANRF's vision.
- Dr. Kalyanaraman brings extensive experience in industry R&D and technology strategy, having served as CTO, Energy Industry, Asia at Microsoft and over a decade in leadership role in IBM Research2.
- He is a distinguished Alumnus Awardee of IIT Madras and Ohio State University (2021) and a fellow of IEEE and INAE2. In the past, he has also served as a tenured professor at Rensselaer Polytechnic Institute (RPI), New York and co-director at IBM Research Centre, Brunei.

A complementary National Facilitation Agency can help connect industry and academia to suitable partners, unlocking India's full innovation potential

While the ANRF provides overarching research funding and strategic direction, there remains a need for a dedicated, market-facing agency to drive commercialization. Such an entity could run national licensing or marketplace platforms, aggregate university research, build institutional tech-transfer capabilities and proactively engage relevant industry and academic partners.

Functions for the proposed national agency	
National licensing registry and marketplace	▪ Create a live marketplace that lists licensing opportunities, technologies open for co-development and start-up-ready IP bundles ▪ Publish national pricing benchmarks to reduce asymmetry in valuation, enable fair pricing and build market confidence
Industry partnership facilitation and co nsortium formation	▪ Create a national partner-discovery platform linking universities, corporates, start-ups and national labs ▪ Facilitate formation of industry-led research clusters around sectors such as semiconductors, green hydrogen, quantum and bio-engineering ▪ Provide strategic support for large multi-party mission projects
TTO capacity building and share d services	▪ Develop national TTO operating manuals covering invention disclosure, prior art search, valuation methods, deal structuring, etc. ▪ Offer shared IP legal services for institutions without internal capabilities
Regulatory Sandboxes and Standards Coordination	▪ Operationalize regulatory sandboxes in emerging domains in partnership with sectoral regulators; create fast-track approval routes for technologies that meet safety thresholds ▪ Coordinate with BIS and international standards bodies to align Indian technologies with global standards; create precertification frameworks for prototypes
Peripheral functions	▪ Institute a national IP dashboard with Technology Readiness Levels (TRLs) for prototypes and pilots; link data reporting to funding compliance for HEIs and national labs

UKRI demonstrates how a unified, mission-driven national R&D body can reduce fragmentation and accelerate translation—offering a template for strengthening India's research governance and commercialization pathways.

Case Study: UK Research and Innovation (UKRI)1

Overview

The UK Research & Innovation (UKRI) is an arm's-length, non-departmental public body established by the UK government and sponsored by the Department for Science, Innovation and Technology (DSIT). It serves as the apex organization responsible for funding, coordinating and steering the UK's entire public research and innovation (R&I) ecosystem.

UKRI integrates functions across basic science and frontier research, applied research and mission-oriented programs, technology development and commercialization, industry partnerships and small and medium enterprise (SME) support and Doctoral training and research talent development.

By bringing previously fragmented research councils and innovation bodies under a single governance structure, UKRI enables strategic coherence, efficient allocation of public R&D resources and stronger pathways from research to market.

Governing Structure

I. **UKRI Board**

It is the apex governing body comprising the Chair, CEO, CFO and independent members from academia, industry and policy. Appointed by the Secretary of State (DSIT), the Board provides strategic oversight, approves major investments and ensures alignment with national priorities.

II. **Executive Committee**

Chaired by the CEO and consisting of senior executives from all UKRI councils, the Committee coordinates strategy, budgeting and delivery across the organization.

II. **Sector Councils**

UKRI's nine sector-based councils represent major scientific and innovation domains (e.g., medical research, engineering, biotechnology, social sciences, arts/humanities, environmental science, space/technology facilities, research funding and industry innovation). Each council is linked to specific scientific centers and communities, sets discipline priorities, runs grant programs and oversees doctoral training.

Cross-Council Mission Delivery

Although councils are sector-specific, UKRI delivers national missions (AI, quantum, Net Zero, healthy ageing, etc.) through cross-council collaboration, pooling budgets and expertise across basic science, engineering, clinical research and industrial R&D.

Funding and Investment

UKRI operates through a **dual funding model: Firstly, through Competitive Project-Based Funding**, UKRI gives Research grants to universities, institutes and businesses **(£25,000–£10 million**+), SME innovation loans **(£100,000–£1 million**) through Innovate UK and challenge funds aligned to national missions. In additional, through Core Institutional ("**Block**") **Funding, UKRI gives~£2** billion annually to universities and research organizations. This provides stable, flexible funding for long-term research capability, research infrastructure and PhD ecosystems.

UKRI's networking and collaboration tools: UKRI's translation and collaboration tools form a coordinated national infrastructure to bridge academic research with industry needs.

- Through its network of Catapult Centers, UKRI provides sector-specific testbeds, demonstration facilities and partner-brokering services that help de-risk technology development.
- Innovate UK complements this by running challenge grants, early-stage R&D programs, and SME-focused innovation schemes that stimulate industry-led innovation.
- Additionally, Knowledge Transfer Partnerships embed university researchers within firms for extended periods, strengthening applied research, technology adoption, and firm-level innovation capacity.

Together, these instruments create structured pathways for commercialization and deep, repeatable academia–industry engagement—an approach that India can adapt to scale translational outcomes.

5

The road ahead – Strategic recommendations and action agenda

India's surging investment inflows and rapidly scaling research base signal the country's readiness to transition into a world-leading innovation powerhouse

While Chapter 4 lays out the building blocks of a robust collaboration framework, India's ability to realize this vision will depend on targeted action from government, industry and academia. The final chapter consolidates the report's insights into a strategic action agenda—defining the policy interventions, institutional reforms, financing mechanisms, and accountability structures essential for translating partnerships into national innovation outcomes. Chapter 5 outlines what each stakeholder must do to shift India from isolated initiatives to a coordinated, high-performing research and innovation ecosystem.

Strong fundamentals position India to convert scientific momentum into world-class innovation

- India stands at an inflection point in its research journey—scientific output is rising, patent filings are accelerating, and industry interest in deep-tech is growing.
- India is projected to produce ~18 million STEM graduates by 2027 and ranks among the top countries by annual doctoral graduates, supplying a steady pipeline of researchers and technical hires. [1] To unlock the full potential of this talent base, India must align it with both national and global innovation priorities by integrating international best practices and building a truly glocal, world-class research ecosystem.
- India has ~120 start-up unicorns and ~32,000 deep tech start-ups, increasing by 2,000 start-ups per year. 50% of these are from Tier 2 and Tier 3 cities.[2]
- India has 54 universities in QS World University Rankings 2026 with six in top 250, becoming the fourth most represented country in the rankings behind the US, the UK and China.[3]
- India has crossed a major milestone with cumulative FDI exceeding US$1 trillion, and annual inflows rising 13% in FY25 to nearly US$50 billion, reflecting sustained investor confidence across services and technology sectors. [4]
- With clearer incentives, better funding mechanisms and stronger translational pathways, India can substantially increase commercialization, global partnerships and breakthrough innovation.
- High quality industry–academia partnerships and mission-driven research consortia are the critical levers to move from incremental progress to globally competitive, inclusive innovation at scale

India's 2035 research ambition: What success should look like

Cutting-edge research	**Patents and high-value intellectual property**	**Rapid commercialization of technologies**
5–10 globally relevant breakthrough technologies every year	Raise India's share of global IP from 2%–2.5% to 10%	5x–10x increase in revenues generated from technology transfer
Societal and economic impact	**Internationalization**	**Increased R&D expenditure**
Transforming India into the world's factory with specialized jobs and sustainable development	India emerges as a global R&D destination for top foreign universities and corporates	R&D expenditure of 2%–2.5% of GDP

Source: 1. IndiaToday , 2. Economic Times, 3. PIB, 4. IBEF

A globally competitive research ecosystem requires government, industry and academia to work as an integrated engine of enablement, mentorship and execution

A vibrant research ecosystem thrives when its core stakeholders work in alignment. Government, industry and academia each play a critical role—providing enabling conditions, shaping demand and driving on-ground action. Their contributions are distinct, yet deeply interconnected, forming the foundation for research that is relevant, scalable and impactful. Below, we outline the key role that should be placed by each stakeholder:

Government → Enable

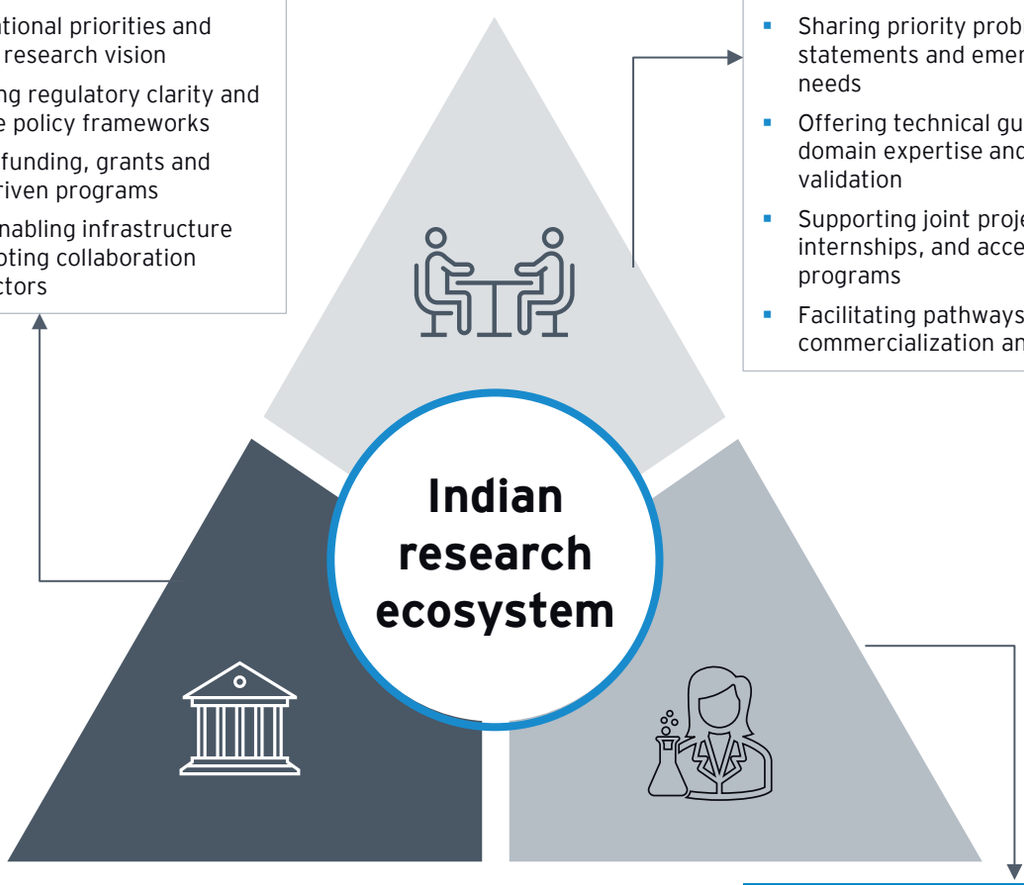
Government can create enabling conditions that allow research and innovation to flourish:

- Setting national priorities and long-term research vision
- Establishing regulatory clarity and supportive policy frameworks
- Providing funding, grants and mission-driven programs
- Building enabling infrastructure and promoting collaboration across sectors

Industry → Monitor

Industry can take on the role of mentoring HEIs and anchoring research in real-world relevance:

- Sharing priority problem statements and emerging market needs
- Offering technical guidance, domain expertise and use-case validation
- Supporting joint projects, internships, and accelerator programs
- Facilitating pathways for commercialization and scale



Academia → Execute

Academia can take a lead role in driving research execution, industry outreach, talent development and knowledge creation:

- Conducting fundamental and applied research
- Actively reaching out to relevant industry partners for mentorship and support
- Building a pipeline of skilled researchers
- Generating scalable commercially aligned research solutions

India can accelerate discovery, translation and innovation to global standards only through a unified and role-aligned research ecosystem. Strengthened coordination across stakeholders will help bridge the gap between research potential and real-world application, enhancing the country's competitiveness in emerging and strategic sectors.

Action agenda for government: Strengthen national R&D capacity by scaling investment, enabling high-impact partnerships and removing policy bottlenecks to accelerate research and innovation

Recommendation	Description
Strengthen national R&D vision	▪ Shift the perception of R&D from a budgetary cost to a driver of national competitiveness and economic value. ▪ Major publicly funded research agencies remain accountable to the CAG for project failures, reinforcing a risk-averse culture
Scale research investment and direct funding to high-performing institutions	▪ Increase GERD to 2%-2.5% of GDP by 2035 (GERD - INR17.7 lakh crore in US$10 trillion-Indian economy) ▪ Incentivize private sector to increase R&D share to 60%-65% of GERD (INR11.5 lakh crore) from current ~40% share ▪ Direct research funding toward high-quality institutions with demonstrated capabilities—strong faculty, robust infrastructure and proven research depth
Enable high-impact research partnerships	▪ Create pathways (schemes/grants) for collaboration between Indian and international HEIs ▪ Allow grants to be shared between institutions for joint research, including faculty and researcher mobility ▪ Incentivize formation of industry-academia consortia and alliances to establish applied research centers with mission-driven competitive funding, open access infrastructure and commercialization services
Strengthen policy mechanisms to accelerate research execution	▪ Establish a predictable R&D assurance framework with timely approvals and consistent policy execution to give MNCs clarity and confidence to scale R&D in India ▪ Link institutional funding to transparent reporting of IP and research outputs, supported by a unified national dashboard that reinforces accountability and performance ▪ Revise ranking frameworks to include metrics that reward not just research output and quality, but also technology creation and translational impact ▪ Introduce regulations enabling faculty involvement in start-ups and industry-funded research, supported by structured incentives and equity/license-sharing models
Create flexible regulatory pathways for high-risk, high-impact research	▪ Create pre-cleared zones for innovation clusters in cutting-edge research areas with relaxed norms ▪ Fast-track procurement and regulatory pathways for research infrastructure/equipment and clinical/field validation ▪ Set SLAs and delegated approvals for university/consortium for procurement of imported equipment
Accelerate technology transfer and commercialization pathways	▪ Establish a national agency to serve as a discovery platform and real-time marketplace for technology transfer ▪ Provide shared IP legal services to support institutions lacking in-house capabilities; develop standardized templates and operating manuals for TTOs and capacity guidelines ▪ Publish national valuation benchmarks to reduce pricing asymmetry, ensure fair deals and strengthen market confidence

Action agenda for academia: Enhance research quality and translation by building commercially-oriented capabilities, deepening industry partnerships and strengthening internal support systems

Recommendation	Description
Strengthen national R&D vision	▪ Allocate 25%–30% of institutional research budgets for investigator-driven fundamental research ▪ Incentivize industry to co-invest in research infrastructure with tangible benefits to industry partners
Build commercially-oriented researcher capabilities	▪ Redesign the researcher training agenda to build stronger capabilities in identifying and advancing research that can translate into commercially viable outcomes ▪ Roll out annual training programs on AI-enabled research tools, grant writing, and frontier methods (target 70%–80% faculty) ▪ Expand global academic partnerships for co-guided PhDs, exchanges, and short residencies ▪ Develop remote and hybrid PG/PhD programs that allow working professionals to upskill without taking extended breaks from employment. These programs should recognize prior industry experience and focus on specialized skill enhancement, enabling large-scale and flexible upskilling of India's workforce
Form high-impact industry and global research partnerships	▪ Expand partnerships with national and global universities to advance high-value research, strengthen faculty capabilities and align with international research standards ▪ Identify industry research gaps and partner with universities through joint labs and co-development models that both de-risk R&D and strengthen talent pipelines (capstone projects, dual placement models)
Develop industry-aligned talent and research pipelines	▪ Align curriculum and research training with industry needs by integrating domain-specific skill tracks, advanced lab modules, and industry-certified micro-credentials ▪ Deploy NTU-Alibaba like model of creating talent pipelines where students/PhD scholars work on company premises for more than 50% of the time and are co-supervised by industry mentors
Develop strong research support capabilities	▪ Professionalize TTOs with dedicated trained staff; target one TTO professional per 75–100 researchers. Deploy outsourcing on need basis ▪ Build an institutional database of labs, TRLs, patents and expertise for industry access ▪ Establish Industry Liaison Offices (ILOs) for partner outreach, proposal support and contract management ▪ Develop standardized templates for NDAs, IP-sharing, joint labs, and sponsored research, supported by a flexible IP framework, to cut negotiation time by 40%–50%
Introduce performance-linked research incentives	▪ Reduce administrative load by 10%-20% to increase protected research time ▪ Introduce "industry-time credits" allowing faculty to spend 10%–20% workload on industry or translational projects ▪ Recognize patents, spinouts, industry grants and TRL progress in promotion criteria ▪ Provide targeted incentives (seed funding, grants, sabbaticals) for high-potential translational research ▪ Develop research support and grievance cells with <30-day turnaround for admin, ethics, and procurement issues

Action agenda for industry: Co-invest in R&D by mentoring researchers, co-developing frontier technologies and leveraging university capabilities to fast-track innovation

Recommendation	Description
Increase research investment	▪ Increase R&D share to 60-65% of India's GERD (INR 11.5 lakh crore) from current ~40% share (INR 96K crore) ▪ Leverage CSR funding to support substantive research activities in universities rather than promotional initiatives
Provide hands-on industry mentorship to academia	▪ Expand industry mentorship by embedding practitioners in university committees and innovation platforms, supporting research prioritization, curriculum co-design and start-up incubation to accelerate talent development and technology translation ▪ Enable early and continuous knowledge exchange with industry to bridge 'valley of death' and accelerate translation ▪ Improve industry–academia alignment through affiliate programs, advisory roles in university decision making bodies and curriculum co-design ▪ Develop sector-wise 'Industry Needs Handbooks', co-authored with HEIs, that clearly define the specialized skills required within each industry (e.g., diagnostics vs. med-tech vs. life sciences). Following this, HEIs can map these into concrete programs, curriculum and lab capability guidance
Partner with academia to pursue long-horizon innovation	▪ Expand innovation bandwidth by tapping into frontier research (AI, materials, biotech, mobility) that universities already pursue, enabling companies to pursue long-shot ideas that would be too risky or expensive internally
Fast-track research translation	▪ Accelerate product development and de-risk innovation through co-developed prototypes, academic validation and catapult-style applied research models that shorten time from concept to market ▪ Run joint IP development and commercialization programs (co-owned patents, licensing pipelines) to expand the company's innovation portfolio without bearing full R&D overhead ▪ Create incubation/acceleration cohorts for sector-specific start-ups within universities to shape future technologies, secure early access to promising ventures, and build long-term talent funnels
Transform GCCs and MNCs into Strategic R&D Engines	▪ Collaborate with the central government to co-create a unified national GCC Policy that harmonizes fragmented state incentives, sets clear pathways for upgrading GCCs into R&D centers, and provides predictable regulatory and approval processes for long-term innovation investments ▪ Position MNCs as partners in national missions, and enable use of CSR funds for pre-competitive, sustainability-oriented R&D initiatives in India

Conclusion

India stands at a pivotal moment in its journey toward becoming a globally competitive, innovation-driven economy. The country's rapidly expanding STEM talent base, rising research output and growing deep-tech entrepreneurship reflect strong foundational momentum. Yet, unlocking India's full potential will require more than incremental improvements—it demands coordinated action, forward-looking reforms, and a deliberate shift toward a high-trust, high-productivity research and innovation ecosystem.

This report underscores the critical levers needed to accelerate that transition: strengthening institutional autonomy, unlocking flexible and diversified funding, and embedding targeted incentives that reward quality, collaboration and translational impact. Equally essential are deeper industry–academia partnerships, globally benchmarked governance models, and mission-driven research consortia that can mobilize talent and resources around national priorities. By enabling universities to operate with greater agility, encouraging industry participation through clear incentives, and promoting accountability through transparent evaluation frameworks, India can build an ecosystem where innovation is not just encouraged but systematically enabled.

With sustained commitment from government, industry and higher education institutions, India has the opportunity to convert its demographic and economic strengths into long-term research leadership. The pathway ahead is clear: create an environment that empowers researchers, strengthens institutional capacity, and aligns incentives with excellence and impact. If India acts decisively now, it can position itself as a world-leading centre of scientific discovery, technological advancement, and inclusive innovation at scale.

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Appendix (cont'd.)

Glossary

AI	**Artificial Intelligence**
AIoT	Artificial Intelligence of Things
AIIMS	All India Institute of Medical Sciences
ADAS	Advanced Driver Assistance Systems
ANRF	Anusandhan National Research Foundation
B2B	Business to Business
B2G	Business to Government
BIS	Bureau of Indian Standards
CSR	Corporate social responsibility
CoE	Centre of Excellence
CSIR	Council of Scientific and Industrial Research
CSIRO	Commonwealth Scientific and Industrial Research Organization
CSRC	Collaborative Safety Research Center
DAE	Department of Atomic Energy
DBT	Department of Biotechnology
DoS	Department of Space
DST	Department of Science and Technology
DRDO	Defence Research and Development Organization
Digital Twins	Virtual replicas of physical products, spaces and processes
EU	European Union
AI	Artificial Intelligence
EV	Electric Vehicles
FWCI score	Field weighted citation impact score
GDP	Gross Domestic Product
GERD	Gross Domestic Expenditure on Research and Development
HEI	Higher Education Institute
ICAR	Indian Council of Agricultural Research
IEEE	Institute of Electrical and Electronics Engineers
INAE	Indian National Academy of Engineering
IP	Intellectual Property
IT	Information Technology
IIM	Indian Institute of Management
IISc	Indian Institute of Science
IIT	Indian Institute of Technology
IIT-D	Indian Institute of Technology Delhi
IIT-M	Indian Institute of Technology Madras
NEP	National Education Policy
PG	Post-Graduate
Ph.D.	Doctor of Philosophy
REF	Research Excellence Framework
R&D	Research and Development
SBIR	Small Business Innovation Research
SMT	Surface mount technology

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