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NITI Aayog

PATHWAYS TO PROGRESS:

ANALYSIS AND INSIGHTS INTO

INDIA'S INNOVATION STORY

SCIENCE AND TECHNOLOGY DIVISION
NITI AAYOG | SEPTEMBER 2025

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NITI Aayog

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ANALYSIS AND INSIGHTS INTO INDIA'S INNOVATION STORY

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Dharmendra Pradhan

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आज़ादी का अमृत महोत्सव

शिक्षा मंत्री
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Minister of Education
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MESSAGE

Education has always been the cornerstone of India's progress, and today, more than ever, it is driven by innovation. As our nation advances towards the vision of *Viksit Bharat*, the ability of our young learners to imagine, experiment, and innovate will determine not just their individual futures but the future of the country itself. No doubt, knowledge creation and knowledge application can work in tandem to help India sustain its growth in an increasingly competitive global landscape.

I am happy to know that the report titled **"Pathways to Progress – Analysis and Insights into India's Innovation Story"** has been prepared by NITI Aayog, reflecting on how education is deeply intertwined with innovation. It reminds us that innovation is not the preserve of research labs or industries alone; it begins in our classrooms, in our higher education institutions, and in the everyday act of learning. The seeds of creativity and critical thinking sown during schooling mature into groundbreaking ideas in universities, laboratories, and startups.

The National Education Policy (NEP) - 2020 has placed a strong emphasis on fostering curiosity-driven learning, flexibility across disciplines, and greater integration of skilling, technology and innovation in education. These reforms are designed to nurture holistic individuals who are not just employable but also entrepreneurial, capable of creating new knowledge and value. Equally important is the need to strengthen the ecosystem that connects education to industry and government. Innovation can achieve excellence only when it is inclusive and democratized across the country. The creativity of rural communities, the ingenuity of grassroots innovators, and the aspirations of first-generation learners are the defining features of India's innovation story. Through digital platforms, skill-development programmes, and regional research hubs, the opportunities to innovate are made accessible to every child, in every corner of the country.

I believe this report will serve as an important guide for policymakers, educators, and industry leaders in strengthening the education-innovation continuum. More than that, I hope it inspires our students to see themselves not just as learners but as innovators – capable of shaping new solutions for India and the world. The task before us is to build an education system that is not only world-class in knowledge delivery but also unmatched in its ability to spark discovery, creativity, and transformative innovation.

(Dharmendra Pradhan)

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Azadi Ka Amrit Mahotsav

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Message

Innovation stands as the defining feature of economic and social progress in the twenty first century. For a nation such as India, endowed with talent, entrepreneurial spirit and youthful aspiration, it is both our foremost strength and our greatest responsibility. As we advance towards the vision of Viksit Bharat @ 2047, innovation will be the principal force through which our demographic dividend is transformed into enduring prosperity, competitiveness and leadership on the global stage.

The report ***"Pathways to Progress – Analysis and Insights into India's Innovation Story"*** provides a timely and comprehensive account of the evolution of India's innovation ecosystem. It chronicles the policy measures undertaken by government, the dynamism of our start up community, the rise of state level initiatives and the creativity visible at the grassroots, while also recognising the systemic challenges that remain in respect of scale, funding and global integration.

At NITI Aayog, we regard innovation not as a sectoral pursuit, but as a cross cutting enabler for transformation across the economy and society. The road ahead calls for the strengthening of institutions, diversification of funding models, investment in deep tech research, and above all, a commitment to ensuring that innovation is inclusive and sustainable.

I commend this report to all stakeholders. May it serve both as a reflection of the progress achieved and as a roadmap for the journey ahead, inspiring collective endeavour in building an innovation ecosystem that is distinctly Indian in its inclusivity, yet globally competitive in its ambition.

-Sd-

(Suman Bery)

स्वच्छ भारत
एक कदम स्वच्छता की ओर

डॉ. जितेन्द्र सिंह
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भारत सरकार

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Minister of State, Prime Minister's Office,
Ministry of Personnel, Public Grievances and Pensions,
Department of Atomic Energy & Department of Space,
Government of India

MESSAGE

Science and technology have always been the engines of national progress. For India, they are more than just instruments of economic growth; they are pathways to solving some of our most pressing challenges. As the pace of technological change accelerates across the world, the need for India to strengthen its innovation ecosystem has never been greater.

The report ***"Pathways to Progress – Analysis and Insights into India's Innovation Story"*** is a timely and important contribution to this effort. It captures, with both breadth and depth, the evolving contours of our innovation landscape – the successes we can celebrate, the gaps we must urgently address, and the opportunities that lie ahead. What stands out in this report is its emphasis on systems thinking: that innovation cannot be confined to a single institution or sector, but must be the product of collaboration between government, academia, industry, and society.

India has made significant strides in recent years. Our scientists and entrepreneurs are demonstrating that innovation can emerge not only from elite laboratories but also from grassroots ingenuity. The rise of India's vibrant startup ecosystem, coupled with our strong digital public infrastructure, is a testament to this shift.

Yet, as this report rightly points out, there are systemic challenges that must be addressed with urgency: fragmented efforts, inadequate funding for deep-tech research, weak university-industry linkages, and insufficient commercialization of intellectual property. These are not minor shortcomings but structural barriers that demand coordinated policy responses. A modern innovation ecosystem requires us to move beyond incremental change and embrace reforms in regulation, financing, and institutional design.

Our vision must be global in scope and inclusive in character. India cannot aspire merely to catch up with global innovation leaders; we must aim to set benchmarks of our own by investing in frontier technologies, fostering interdisciplinary research, and encouraging risk-taking in entrepreneurship. At the same time, innovation must serve the broader social purpose of building resilience in rural communities, promoting sustainability, and empowering our citizens with skills for the future.

This report provides a roadmap for how we can achieve these goals. It is not simply an analysis but an invitation – to policymakers, industry leaders, researchers, and young innovators, to come together in building a future where India is recognized not only as a participant in the global innovation landscape, but as a leader shaping it.

I see innovation as both our greatest challenge and our greatest opportunity. The choices we make today will define India's place in the world tomorrow. I commend this report for laying out those choices with clarity and conviction.

(Dr. Jitendra Singh)
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MESSAGE

Innovation today defines the strength and resilience of nations. For India, the ability to generate new knowledge, translate it into practical applications, and scale solutions rapidly will be central to achieving our long-term development goals. Science and technology must serve not only as engines of growth but also as tools of equity, sustainability, and resilience. In this context, the report ***"Pathways to Progress – Analysis and Insights into India's Innovation Story"*** is both timely and necessary.

What makes this report significant is its comprehensive treatment of India's innovation ecosystem. It brings together perspectives on government-led missions, state-level initiatives, industry contributions, and the growing energy of our startup ecosystem. It also situates India's progress within the global innovation landscape, benchmarking us against international indices and drawing attention to areas where we must accelerate efforts.

From a policy standpoint, India has made commendable strides, yet, as this report clearly outlines, systemic challenges remain. Funding for deep science remains inadequate and unevenly distributed. University-industry linkages are not yet robust. Coordination across ministries and between central and state governments often suffers from fragmentation. And while grassroots innovation flourishes, its integration into mainstream markets and policy frameworks is still limited.

These challenges require more than incremental reforms; they require systemic solutions. We must invest in creating strong intermediary institutions that can translate research into industry-ready technologies. We must strengthen intellectual property protection and accelerate commercialization pathways. We must also build greater global linkages, ensuring that Indian innovation is not inward-looking but integrated with global value chains and research networks.

At NITI Aayog, our role is to help build this systemic perspective – to identify gaps, assess outcomes, and guide evidence-based policymaking. Our engagement with States/ UTs has shown us that innovation capacity must be strengthened at every level of governance, not just at the national level. The future will depend on the ability of states, industries, universities, and communities to work in tandem, supported by an enabling national policy framework.

I commend this report for bringing clarity to these issues and for offering a roadmap that is practical yet ambitious. I am confident it will stimulate dialogue and action across stakeholders, and help India move steadily towards its aspiration of becoming a global innovation leader.

V.K. Saraswat.

(Dr. V. K. Saraswat)

New Delhi

स्वच्छ भारत

WIPO
WORLD
INTELLECTUAL PROPERTY
ORGANIZATION

Message

India is a country of long history and deep culture, and its spirituality and ideas have shaped humanity and our world from ancient times to the current day. It is also a country of immense human talent, which is increasingly devoted to innovation, technology and entrepreneurship. Harnessing the full potential of a country of its scale and size is no mean feat, but India's innovation journey has made huge strides in the past decade.

This transformation is evident from India's place in WIPO's rankings of the world's most innovative economies, the Global Innovation Index (GII), which ranked India 81st globally in 2015. A decade later, through visionary reforms that have tapped on India's research, technology and entrepreneurial energies, India has climbed to 38th position in the 2025 edition of the GII, the highest ranking for any lower-middle income economy and for any country in Central and Southern Asia.

India's strengths shine through in areas such as ICT services exports (1st globally), domestic market scale (3rd), and late-stage venture capital deal activity (4th). Its innovation outputs rank 32nd overall, ahead of its inputs ranking of 52nd—demonstrating an ability to turn strong investment into even stronger results.

As well as its position in the country rankings, India's innovative capacity is also evident in the WIPO's Ranking of World's Top 100 Innovation Clusters. In 2025, four Indian clusters—Bengaluru (21st), Delhi (26th), Mumbai (46th), and Chennai (84th)—rank among the world's top 100, placing these crucibles of innovation on a par with many of the developed world's most dynamic cities. Bengaluru's leap into the global top 25 exemplifies this.

Another sign of India's growing innovation prowess is the steady increase of intangible investment in the country, which reached over $70 billion in 2022, having risen by an average annual rate of 6.6% since 2011, the highest rate among all the economies featured in WIPO's study of intangible investment published in July 2025. Software and databases accounted for half of intangible investment in 2022, a clear signal of the rising importance of digital infrastructure and data capabilities in India's economic future. India's cumulative stock of intangible investment is equivalent to almost 10% of its GDP, underlining its transition toward a knowledge-driven economy.

India's competitiveness in the race for new technology and a share of the global digital economy is also manifest in its rapidly rising IP filings. Patent applications more than tripled from nearly 21,750 in 2014 to about 76,250 in 2024. Trademark applications more than doubled over the same period, while industrial design filing activity rose almost sixfold. As a major market, India attracts patent filings from all around the world, but domestic patent filings surpassed foreign applications for the first time in 2022—a powerful indication that Indian innovation is increasingly being shaped by its own people and enterprises.

These achievements are rooted in initiatives such as the 2016 National IPR Policy, the Atal Innovation Mission and Prime Minister Narendra Modi's call to "ideate in India, innovate in India, make in India and make for the world." Together, they have fostered a culture of innovation that stretches from world-class R&D hubs to classrooms where millions of children are being equipped with the tools to imagine and invent.

The "Pathways to Progress" report vividly captures this dynamism as well as India's intellectual property (IP) journey. This publication reflects not only the achievements of Indian innovators but also our shared vision of harnessing creativity, technology and knowledge as forces for inclusive and sustainable development.

I wish to acknowledge with gratitude our close collaboration with India's Department for Promotion of Industry and Internal Trade, the Indian Patent Office and NITI Aayog.

As India advances towards its Viksit Bharat 2047 vision and in a year that marks the golden anniversary of WIPO's relations with India, WIPO is committed to ensuring that IP continues to empower and enable Indian entrepreneurs, innovators and creators.

Daren Tang
Director General
World Intellectual Property Organization

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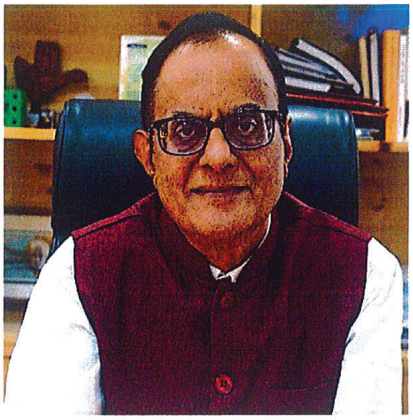

MESSAGE

The arc of human progress has always been defined by the power of ideas, by the courage to experiment, and by the persistence to transform discoveries into solutions. For India, standing at the cusp of a new technological era, innovation is not simply an aspiration; it is a necessity for shaping a resilient, inclusive, and globally competitive future.

India's innovation trajectory has evolved and in the past decade, strategic reforms, institutional strengthening, and cross-sectoral collaboration have driven innovation-led growth across academia, industry, and government. This progress reflects a national commitment to leveraging technological advancement not only for economic development but also for promoting social equity and environmental sustainability. By embracing the 3Is framework i.e., Investment, Infusion, and Innovation, new pathways will be unlocked for growth, enabling the nation to move beyond the middle-income barrier and shape a resilient, inclusive, and future-ready knowledge economy.

The report ***"Pathways to Progress – Analysis and Insights into India's Innovation Story"*** offers an important reflection on where we stand today and where we must go. It reminds us that innovation is not a linear process confined to laboratories and research institutions. It is a dynamic ecosystem shaped by government, researchers, entrepreneurs, investors, industry, and civil society, each playing a critical role in advancing knowledge and translating it into societal benefit.

India's innovation efforts are closely aligned with the United Nations Sustainable Development Goals, targeting key sectors such as healthcare, renewable energy, agriculture, and digital transformation.

India's innovation journey continues to gain momentum, our startups are addressing complex challenges with remarkable agility, our researchers are shaping global discourse in emerging technologies, and our national missions are expanding the frontiers of possibility. As our aspirations grow, so does the opportunity to deepen impact by harmonizing frontier science with locally rooted solutions, and by blending global leadership with the ingenuity of grassroots innovation.

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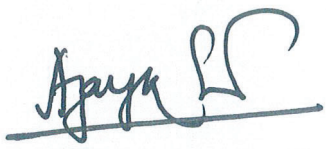
A robust national innovation ecosystem must rest on three pillars. First, a long-term vision that anticipates technological shifts and aligns investments accordingly. Second, deep institutional capacity that enables discovery, risk-taking, and commercialization. Third, societal integration, ensuring that innovation does not remain an elite exercise but permeates everyday life, improving livelihoods, empowering citizens, and fostering sustainability.

There is a need to embed science, technology, and innovation in India's development pathways. The future of India's innovation will depend not just on policy support but on the ability to embrace interdisciplinarity, foster ethical and responsible innovation, and create global linkages while nurturing indigenous strengths.

This report stands as a timely and valuable contribution, offering a balanced reflection on India's innovation achievements and the challenges that lie ahead. By presenting actionable pathways for future policy and practice, it encourages a collective vision of innovation as a national mission. With shared commitment and collaboration, India is well-positioned to emerge as a global leader in knowledge, discovery, and innovation-led development.



(Ajay K. Sood)

Dated: 15th September, 2025

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Message

Innovation is not merely an outcome of research or entrepreneurship; it is the spirit of possibility that drives a nation forward. India's history has always been intertwined with innovation, from the ingenuity of its ancient knowledge systems to its cutting-edge achievements. Today, in an era defined by rapid change and global uncertainty, innovation is no longer a choice for India; it is the foundation of our economic strength, social equity, and global leadership.

The report ***"Pathways to Progress – Analysis and Insights into India's Innovation Story"*** captures the essence of India's innovation journey – its aspirations, its strengths, and its unfinished tasks. It provides a panoramic view of how India has nurtured innovation across multiple fronts: through bold government initiatives, dynamic state-level policies, the growing vitality of industry and startups, and the remarkable creativity of grassroots innovators who embody the spirit of inclusive progress.

The report also acknowledges the challenges we face. Fragmented efforts, limited funding diversity, regulatory bottlenecks, weak linkages, and gaps in skills and infrastructure continue to constrain our full potential. Recognizing these challenges is essential, for they highlight the areas where our collective energies must be directed. Innovation flourishes when ecosystems are coherent, coordinated, and collaborative, and building such an environment remains our foremost priority.

The true test of our innovation ecosystem will not only be measured in patents or global rankings, but in how effectively we translate ideas into impact – improving lives, creating opportunities, and shaping a sustainable future.

The report is, therefore, both a reflection and a call to action. It reflects the strides we have taken, while challenging us to think bigger, act faster, and collaborate more deeply. I hope this report serves as a guide for policymakers and practitioners, a source of inspiration for entrepreneurs and researchers, and a reminder to all of us that India's innovation journey has only just begun.

With vision, persistence, and collective will, we can ensure that innovation becomes the defining strength of India's growth story, one that is inclusive, sustainable, and globally respected.

(Deepak Bagla)

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Foreword

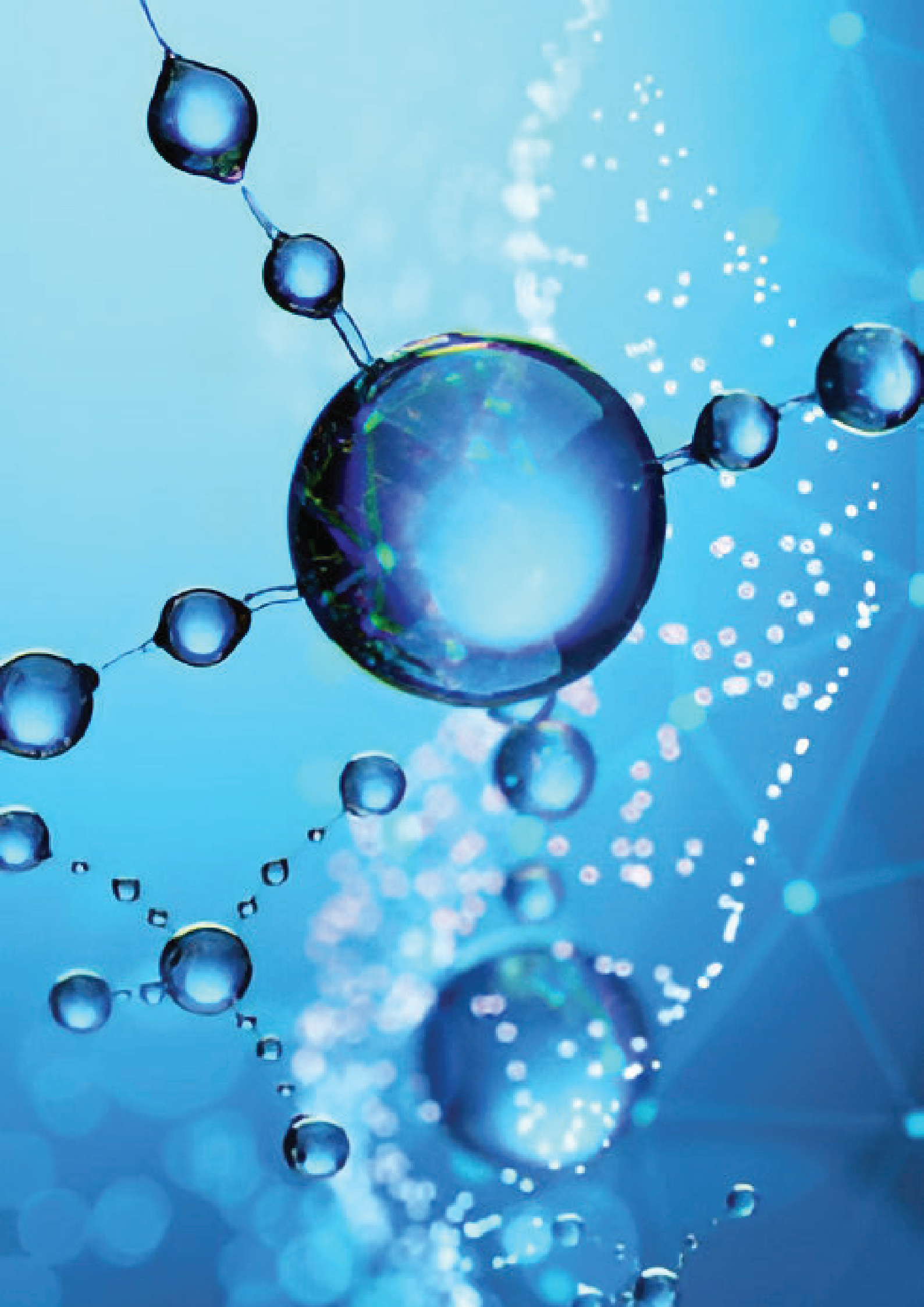
It is with immense pride that we present this report, **"Pathways to Progress: Analysis and Insights into India's Innovation Story"**. This document reflects a concerted effort to capture the evolution, achievements, and challenges of India's innovation ecosystem, providing insights that are both timely and critical for the nation's aspirations. Over the past decade, India has witnessed remarkable transformations in its innovation landscape, spanning the growth of startups, the expansion of technology incubators, the strengthening of research institutions, and the emergence of grassroots innovations that have reached millions across the country. Yet, as this report underscores, the journey of innovation is ongoing, requiring continuous investment, collaboration, and vision.

The purpose of this report is two-fold. *Firstly*, it seeks to document and analyze India's efforts towards accelerating innovation, mapping national, state, and industry-led initiatives while highlighting the interplay between institutions, policies, and actors that drive knowledge creation and application. *Secondly*, it aims to identify gaps and challenges, whether in funding models, regulatory frameworks, talent development, or technology commercialization, and to outline forward-looking strategies that can accelerate India's progress in the global innovation landscape. By doing so, it aspires to serve not only as a reference but also as a roadmap for collective action across government, academia, and industry.

India's journey in innovation has been characterized by diversity and dynamism. From frugal and grassroots innovations that address pressing social challenges to technology led ventures that have the potential to redefine industries, India has consistently demonstrated the ability to harness creativity for impact. This report situates these achievements within a global context, benchmarking India against international indices and highlighting both areas of progress and opportunities for improvement. In doing so, it provides a comprehensive and nuanced understanding of where India stands today and the steps required to strengthen its innovation capacity for the future.

As we release this report, we hope it will inspire renewed focus on building a robust, inclusive, and globally competitive innovation ecosystem. By scaling successful models, fostering collaboration across sectors, supporting emerging technologies, and strengthening the policy and institutional framework, India can continue its journey towards becoming a global innovation leader. It is my sincere hope that this report will serve as a catalyst for dialogue, planning, and implementation, and that it will support policymakers, innovators, and stakeholders in realizing the immense potential of India's innovation story.

(Prof. Vivek Kumar Singh)



Executive Summary

Innovation has emerged as one of the most powerful drivers shaping nations in the 21st century, serving not only as a catalyst for economic growth but also as an enabler of social transformation, global competitiveness, and resilience. For India, innovation holds special significance, as it carries the dual potential to propel the country into the ranks of leading knowledge economies while simultaneously addressing longstanding developmental challenges in health, education, agriculture, sustainability, and inclusive growth. Recognising this, NITI Aayog has undertaken this report, ***Pathways to Progress: Analysis and Insights into India's Innovation Story***, to provide a comprehensive assessment of India's innovation journey, benchmark its performance against global peers, evaluate structural strengths and weaknesses, and lay out actionable pathways for the future.

The report begins by establishing the motivation and objectives of this exercise, emphasising the need for a holistic understanding of innovation. Innovation is no longer limited to scientific discovery or technological invention; it encompasses the generation, diffusion, and application of ideas across economic, cultural, and social domains. The report argues that innovation flourishes in ecosystems that combine enabling policies, institutional frameworks, skilled human capital, financial incentives, and collaborative engagement among academia, industry, and government. Accordingly, it defines innovation in a broad sense and examines the variety of models that shape it – from state-led mission programmes and market-driven entrepreneurship to grassroots creativity and frugal innovations that address context-specific challenges.

Over the past decade, India's innovation ecosystem has expanded rapidly, underpinned by strong government initiatives. Mission-mode programmes such as the Atal Innovation Mission, Make in India, Digital India, and Startup India have created nationwide momentum, fostering a culture of experimentation and entrepreneurship. Complementing these, sector-specific initiatives by central ministries and departments have promoted innovation in biotechnology, electronics, space, renewable energy, and other strategic areas. Intermediary organisations and technology boards have bridged research and commercial application, while funding schemes and innovation councils have strengthened academic and research institutions, enabling them to contribute meaningfully to the broader innovation landscape. States have emerged as active players, launching innovation missions, startup policies, and sector-specific incubators, ensuring that innovation extends beyond metropolitan hubs. The private sector and industry associations have also invested significantly in research and development, often establishing collaborative platforms, corporate accelerators, and innovation challenges. India's grassroots and social innovators remain an integral component, demonstrating frugal, high-impact approaches that cater to local needs. National events such as the India International Science Festival and Startup Mahakumbh have further amplified the visibility and vibrancy of the ecosystem.

India's global innovation performance reflects steady progress. The country has risen consistently in international benchmarks, such as Global Innovation Index (GII), where

India has improved ranking from 81st in 2015 to 38th in 2025. India now hosts the world's third-largest startup ecosystem, with over a hundred unicorns, and has shown sustained growth in publications, patents, trademarks, and other intellectual property indicators. Leadership in geographical indications and the creative economy highlights India's rich cultural and knowledge assets. While these trends affirm India's position as a credible global innovation player, gaps remain in the commercialisation of research, expansion into high-technology exports, and development of deep-tech ventures.

A closer examination of the ecosystem reveals both dynamism and asymmetry. The startup ecosystem thrives as a driver of employment, product development, and market expansion. Inclusive innovation, particularly in frugal and social domains, extends technological solutions to underserved populations. Yet, university-industry-government collaboration, essential for translating research into practical outcomes, remains relatively weak compared to international standards. Structural and institutional challenges persist, including fragmentation across ministries and states, skewed funding models, inadequate support for early-stage and deep-tech ventures, regulatory and bureaucratic hurdles, uneven infrastructure, and critical skills gaps in frontier domains such as artificial intelligence, biotechnology, and semiconductors. Weak intellectual property frameworks, limited global integration, and underdeveloped state-level innovation policies further underscore the need for systemic strengthening.

Looking forward, the report presents a strategic roadmap to strengthen India's innovation ecosystem. It advocates scaling successful models across regions, diversifying the role of technology business incubators into robust intermediaries, and prioritising knowledge creation and dissemination through investment in research, development and open science initiatives. Encouraging mobility between academia and industry will enable cross-pollination of ideas and skills, while dedicated funding and infrastructure will support deep technologies. Reforming intellectual property policies to improve protection and commercialisation, establishing science, technology, and innovation intermediary bodies, and creating an overarching coordinating entity will provide coherence to the ecosystem. Strengthening state-level capacities through decentralised funding, shared infrastructure, and targeted training will ensure that innovation is geographically balanced and inclusive.

The report concludes that India's innovation journey has reached a pivotal moment. The foundations of a vibrant ecosystem are in place, but the next phase must move beyond capacity building to achieving leadership in advanced technologies and inclusive innovation models. The task ahead is to integrate fragmented efforts, deepen collaboration among academia, industry, and government, and embrace bold reforms that align India's innovation system with global best practices while addressing domestic priorities. By weaving together scale and inclusivity, and frontier science with grassroots ingenuity, India has the potential to emerge as not only a global innovation hub but also a nation where innovation directly enhances societal well-being, economic resilience, and sustainable development.

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CHAPTER 1
Introduction

The capacity to produce scientific and technological knowledge (S&T) and to convert this knowledge into innovative products or processes serves as a fundamental driver of economic growth and development. Science, Technology, and Innovation (STI) functions as a powerful engine that drives productivity, boosts competitiveness, generates employment opportunities, and provides solutions to societal problems. In the present century, Science and Technology have been pivotal in shaping the world we live in, and is going to remain central to our future.

A key catalyst for successful STI exploitation lies in the development of an enabling Innovation Ecosystem - a complex adaptive dynamic framework/system comprising interdependent actors, institutions, and networks that collectively enable the generation, diffusion, and application of knowledge. An enabling ecosystem helps to integrate research, industry, policy, and societal elements to propel technological progress and economic development. Not only it supports creation of new knowledge but also facilitates translation of the knowledge into socio-economic goods.

An innovation ecosystem can be distinguished under the following subsystems:

a. ***Knowledge Generation and Talent Development*:** This subsystem involves the creation and diffusion of scientific and technical knowledge, as well as the development of human capital. The primary stakeholders are public research organizations, higher education institutions, and training systems in developing the skills and capabilities needed for innovation.

b. ***Commercialization and Resource Mobilisation*:** This subsystem concerns the translation of knowledge into marketable products and services, supported by financial and physical infrastructure. Commercialization occurs within a broader ecosystem that includes startups, large firms, suppliers, investors, and distribution channels. Venture capital firms, incubators, and technology parks, advanced laboratories, and digital platforms that support development,

c. ***Governance and Policy Framework:*** Governance encompasses rules, regulations, and institutional coordination that shape innovation dynamics.

d. ***Collaboration and Knowledge Flow*:** This subsystem focuses on networks, partnerships, and open exchange of knowledge across sectors.

e. ***Societal and Market Demand:*** This subsystem reflects the demand-side drivers of innovation, including user needs, public engagement, and sustainability imperatives.

A robust innovation ecosystem is a catalyst for development, continually shaping the economy through new ideas, technologies, and transformative solutions; ensuring sustainable development, global competitiveness, and an enhanced quality of life for future generations. This has been the driving force behind human progress, revolutionizing industries, and everyday life. It underpins major breakthroughs such as the internet, artificial intelligence, biotechnology, and renewable energy reshaping communication, healthcare, education, and economic systems. Innovations in automation, space

exploration, and digital transformation continue to redefine global industries, enhancing productivity and connectivity.

STI serves as the operational core of an enabling innovation ecosystem for converting knowledge into economic and social values. However, the distribution of S&T capabilities remains uneven, creating significant disparities in innovation capacity across regions of the world. Bridging this gap calls for developing national strategies, bringing the different stakeholders together for creating an enabling ecosystem. India has been making systematic efforts through innovative policy, creating different types of institutions and intermediary organizations that are promoting diverse stakeholders' engagement. STI is thus emerging as an essential catalyst for India's economic advancement and transformation. India's increasing emphasis on STI is nurturing new industries, revitalizing traditional sectors, and establishing the nation as a frontrunner in emerging technologies.

The journey of India in promoting science, technology and innovation started with the **Science policy resolution of 1958**. The early approach focused on building capacities within the scientific institutions through infrastructure development and expected the knowledge generated to flow into the society. An approach which shows alignment primarily with the linear science/technology push model of innovations. The **Technology Policy of 1983** directed attention towards technology development. It was primarily driven by the desire to create indigenous technology competency and technology development. However, it still followed a linear model of innovation. The **Science and Technology Policy of 2003**, tried to integrate science and technology as not distinct entities but moving towards an ecosystem that promotes intermediary organisations that can help in translational research. However, there was no marked shift away from the linear model of innovation.

The **STI Policy, 2013** underlined the key role of S&T activities for innovation and drew attention to sustainable and inclusive development. Post 2014, Innovation, Entrepreneurship, Inclusive development, and Societal considerations have assumed the centre stage in policy frameworks. This has led to a shift towards interactive models of innovation in policy frameworks and institutional structures. The *triple helix model* is being strongly promoted through funding support, PPP models, institutional changes etc. Further, the *quadruple helix model* is also getting increasingly reflected in policy discourse with structures created to develop strong civil society engagement.

India's innovation ecosystem is diverse and can deliver stratified and smooth innovation and technology delivery subsystems, which can further be pronounced to larger missions in STI. Despite the distinction between technology delivery and the STI ecosystem, they both need to be aligned with national agendas to create an ideal stream of fundamental and emerging ideas. The rise of technology-driven development has been paving the way for India's strong STI ecosystem. This emergence can be hastened by highlighting the importance of aiding the ideation stages while concentrating on new technologies that require direction and an implementation ecosystem, facilitating greater adoption of opportunities.

India's aspiration to evolve into a Developed India, driven by science, technology, and innovation, has been articulated by the government through a transformative initiative referred to as the "**Innovation Landscape for Viksit Bharat".** This initiative places a significant focus on research, entrepreneurship, and skill development, thereby nurturing an environment where the youth can engage in pioneering discoveries and technological progress. It underscores India's technological landscape, which emerges from a rich tapestry of institutions, ministries, departments, and state councils.

India as a nation is committed to strengthen its innovation ecosystem for the socio-economic development of the country, as also reflected from the various initiatives taken at different levels. The Hon'ble Prime Minister of India has in his address on 79th Independence Day (15th August 2025) highlighted: *"India has been **reforming, performing, and transforming,** … the government is committed to creating a modern, efficient, and citizen-friendly ecosystem, where laws, regulations, and processes are simplified, entrepreneurship is encouraged, and every Indian can contribute to building a Viksit Bharat. …. These reforms are aimed at creating a **supportive ecosystem** for innovation, entrepreneurship, and economic growth."* Emphasizing the role of states, he called upon the states to build a conducive environment for new ventures- *"There should be competition between states to attract maximum investors. Their policies should change or mould as per global requirements"*. Thus, there is a clear resolve from the top leadership of the country to put in all possible efforts in Science, Technology and Innovation to act as the key driver of socio-economic development of the country.

1.1 Motivation

The pursuit of innovation and inclusive development is essential for sustainable economic growth, social equity, and environmental responsibility. As one of the rapidly advancing economies globally, India acknowledges that technological progress and research-oriented solutions are vital for tackling intricate challenges across various sectors. Innovation serves as a catalyst for industrial transformation, boosts productivity, and reinforces leadership in global markets, thereby acting as a fundamental engine of economic expansion. Moreover, fostering inclusive development ensures that the benefits of innovation reach all societal segments, thereby diminishing inequalities and creating equitable opportunities for advancement.

India's approach to innovation is intricately linked with the United Nations Sustainable Development Goals (SDGs), emphasizing solutions in areas such as renewable energy, healthcare, digital transformation, and agriculture to address urgent issues like climate change, food security, and public health. Furthermore, investments in STEM education, skill enhancement, and research frameworks are empowering the workforce, nurturing a knowledge-based economy. By bolstering its resilience and adaptability, India is preparing itself to effectively navigate global disruptions, including pandemics, climate change, and the rise of new technologies. A robust science, technology, and innovation (STI) ecosystem is crucial for ongoing economic growth, social inclusion, and technological independence.

As India continues to develop its research and development infrastructure, startup ecosystem, and collaborations between industry and academia, innovation will be instrumental in shaping the nation's future, propelling socioeconomic advancement, technological pre-eminence, and sustainable development. A multi-faceted strategy to promote a culture of innovation and innovation led growth is now a central component in India's progress. Various initiatives and programs, both mission mode ones as well as institutional interventions, have been shaping India's innovation story during the last 10 years. India's decade of innovation has been marked by policy-driven progress, industry-academia collaboration, and a thriving entrepreneurial ecosystem.

Since 2014, India has achieved significant advancements in establishing a robust Science and Technology Innovation Ecosystem through the creation of extensive support frameworks, strategic policy measures, and focused initiatives. These endeavours have notably improved India's position in global innovation, led to an increase in patent applications, and bolstered its technological prowess. India is now among the countries with a very large startup ecosystem. However, there is a need for identifying, analysing, and characterizing the various initiatives at different levels. Such an effort can create an environment suitable for building synergies across the innovation ecosystem and suggest a strategic plan for future efforts for India to emerge as the innovation capital of the world. A well-integrated innovation-driven strategy can help ensure economic resilience, enhanced quality of life, and a future-ready society, making inclusive and sustainable development a global priority. This serves as the primary motivation behind this work.

1.2 Objectives

This report is an attempt to present an overview of innovation systems and structures created in India during the last ten years, to assess their impact measured in terms on international benchmarks, to analyse and characterise them, to identify major challenges and gaps, and to suggest steps and initiatives to be taken as we prepare to take the road ahead.

In a sense it can also serve as a form of compendium or a knowledge repository consolidating key insights in the Indian innovation ecosystem, particularly focusing on the initiatives and support structures created for the purpose during the last 10 years. It provides stakeholders with a structured overview of innovation frameworks, trends, and initiatives at multiple levels across the country. India's innovation story as reflected in various international benchmarks is also looked into to get a sense of the impact of the various initiatives taken. The report then attempts to characterize the different initiatives in the quest to identify the systemic features of different initiatives.

An attempt is made to identify major challenges and gaps in the Indian innovation ecosystem. Finally, a strategic roadmap for the future of the Indian innovation journey is presented comprising actionable insights. By enabling informed decision-making, the report will aim to strengthen innovation ecosystems, fostering technological self-reliance, economic advancement, and sustainable development.

"Innovation and Entrepreneurship are key drivers of Economic Growth, Social Progress, and Environmental Sustainability in the 21st Century."

Innovation serves as a catalyst for industrial transformation, boosts productivity, and reinforces leadership in global markets, thereby acting as a fundamental engine of economic expansion. The pursuit of innovation and inclusive development is essential for sustainable economic growth, social equity, and environmental responsibility. Different countries across the world have followed varied approaches to innovation, which to some extent has also guided their economic growth and overall development.

CHAPTER 2
Defining Innovation Ecosystem

2.1 Defining Innovation

There are many ways of understanding Innovation. Centrality of the Innovation concept comes from the initial works of Joseph Schumpeter[1] who argued that Innovation is the fundamental economic force, constantly reshaping the economy. Schumpeter drew a sharp distinction between Innovation and Invention; Invention as the discovery of new knowledge or technology whereas Innovation is the economic application of inventions or ideas to create value. Schumpeter, who is regarded as one of the most influential scholars in the field of innovation and economic development, defined Innovation as the *carrying out of new combinations that disrupt economic equilibrium and drive development.* These are not mere improvements but fundamental changes that transform how resources are used in the economy. Drawing from empirical observations, Schumpeter argued that every time an innovation (new product, process, business model) appears, it disrupts existing technologies, firms, and markets [Creative Destruction]. The old ways of doing things are destroyed or made obsolete. This destruction makes space for new growth, productivity, and industries.

Schumpeter did not limit innovation to technological innovation; rather categorized innovation into five types namely:

(i) New products (introduction of a new good - something consumers are not yet familiar with, or a new quality of a good);

(ii) New methods of production;

(iii) Opening of New markets;

(iv) New sources of supply, and

(v) New organisational forms that include creation or destruction of monopolies, institutional arrangements that change the structure of industry or competition, etc.

A stylised representation of the Schumpeter innovation model[1] is shown in Fig 2.1.

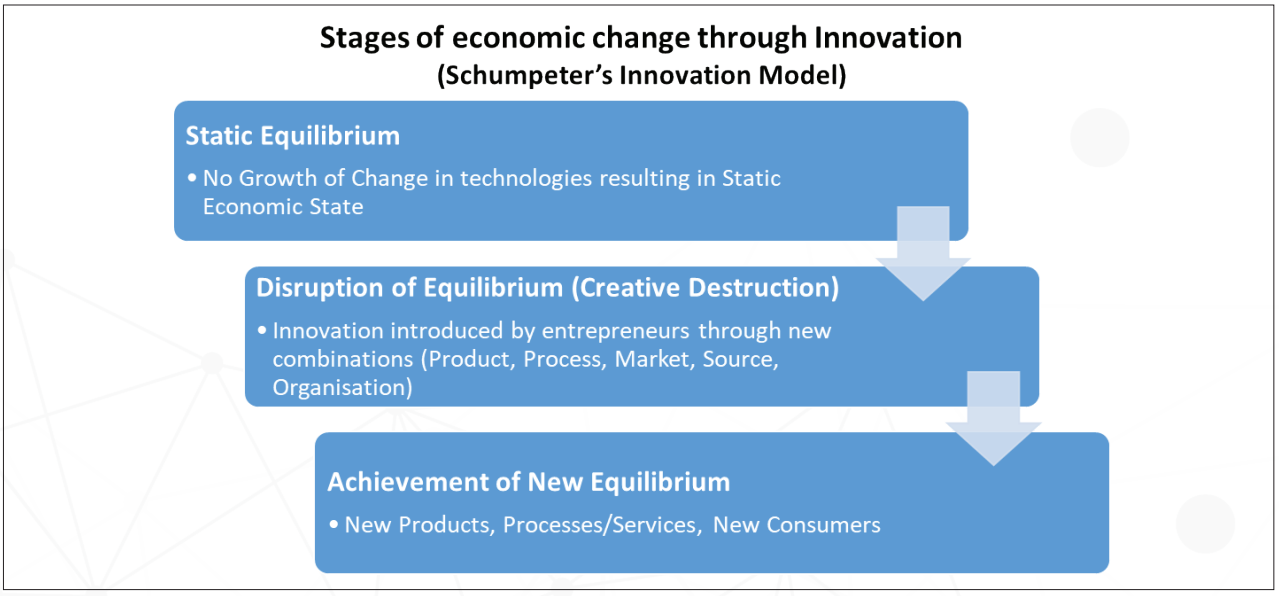

Figure 2.1: Economic changes under the Schumpeter's Innovation model

Within this understanding, Schumpeter defined Entrepreneur as the key agent of change which introduces these "new combinations" into the economic system, helping

to translate ideas into practice. **Thus, Innovation, in practical terms, can be understood as the translation of an idea (invention) into practice; as the process of creating, improving, or applying new ideas, technologies, or methods to solve problems, enhance efficiency, and drive progress.** The GII Report of 2025, in its Appendix I, also attempted to put forward a definition for innovation, attributed to the Oslo Manual 2018, which states that "an innovation is a new or improved product or process (or combination thereof) that differs significantly from the unit's previous products or processes and that has been made available to potential users (product) or brought into use by the unit (process[2])".

Innovation can take various forms incremental, disruptive, or radical and spans across industries, from healthcare and technology to business and social development. The landscape of innovation has transitioned from the mechanization characteristic of the Industrial Revolution to a contemporary economy that is intricately linked through digital technologies. From Joseph Schumpeter's perspective, industrial revolutions can be understood as massive waves of "Creative destruction" driven by clusters of radical innovations. However, later innovation studies drew attention to incremental innovation, highlighting that within each revolution, countless incremental innovations enabled the scaling, diffusion, and optimization of those breakthroughs.

The Industrial Revolution (18th-19th century) marked the beginning of large-scale technological and economic transformation, fostering a culture of mechanisation, automation, and industrial progress. Innovations such as the steam engine, mechanized textile production, and mass manufacturing revolutionized industries, increasing productivity and global trade. The Second Industrial Revolution (19th-20th century) introduced electricity, automobiles, and telecommunication, laying the foundation for modern infrastructure. The 20th century saw unprecedented advancements with the rise of computing, aerospace, biotechnology, and the internet, fuelling globalization and knowledge-based economies. The shift from industrial-based economies to digital-driven economies has positioned science driven technology at the core of innovation. Innovation and entrepreneurship have been fundamental drivers of every industrial revolution, shaping economies and transforming societies. Each wave of industrial advancement has led to disruptive economic shifts, fostering wealth creation, increased productivity, and improved living standards.

The ongoing Fourth Industrial Revolution (Industry 4.0) is characterised by the emergence of cutting-edge technologies such as artificial intelligence, blockchain, quantum computing, and biotechnology etc., leading to a paradigm shift in industries and global economies. It builds on previous industrial revolutions but is characterized by the blurring of boundaries between the physical, digital, and biological spheres, enabled by Cyber-Physical Systems that integrate real-world processes with computational intelligence. These advancements are not only revolutionising traditional sectors but also creating new opportunities for sustainable growth and digital transformation. Innovation also plays a pivotal role in achieving the United Nations Sustainable Development Goals (SDGs) by driving technological solutions across multiple sectors, including healthcare, clean energy, education, and smart infrastructure. Research and innovation are deeply

[2] OECD/Eurostat, 2018 https://doi.org/10.1787/9789264304604-en

embedded across SDG targets, ensuring progress towards a more inclusive, resilient, and sustainable future.

2.2 Innovation Models and Dynamics

In order to facilitate effective strategies to promote innovation in the Indian institutional ecosystem, it will be important to understand the historical models of innovation. Different models of innovation have emerged mainly to explain empirical phenomena - meaning, what was actually happening in the real world of firms, industries, and economies. This has helped to shape STI policy and strategies for creating an enabling ecosystem for supporting research and innovation. Broadly speaking, there are six major generations of models for describing the interactions between the major and minor stakeholders in an economy. As the global understanding of Innovation as a process improved, so have these models from a linear to a more complex systemic approach involving several factors both intrinsic and extrinsic to the ecosystem (Rothwell, 1994[3]; Marinova and Phillimore, 2003[4]; Tidd, 2006[5]; Berkout *et al.*, 2006[6]). Traditional innovation models often followed a linear approach to the process of innovation. Two of the dominant linear models are Technology Push Model (Science Push) and Market Pull Model (Demand Pull).

The Technology push model assumes a step-by-step sequence of discovery to application; scientific research leading to technological development, culminating in marketable innovations (Bush 1945). This model emerged from early empirical observation (1950s-60s) in the USA that showed that many innovations (e.g., in defence, aerospace) started from government-funded basic research. On the other hand, studies also showed many innovations often started from practical problems or market needs, not basic research. This led to the "demand-pull" model that posits that the market signals the development of new technologies based on its demand, which then guides scientific inquiry.

New empirical research during the 1980s pointed out that successful innovations involved complex feedback loops. This led to more advanced models of innovation proposing a non-linear framework emphasizing on the iterative and interconnected nature of innovation processes; learning-driven, and networked processes. The Chain-Linked Model, for instance, illustrates multiple feedback loops between different stages of the innovation process, highlighting that innovation often involves revisiting and refining earlier steps based on new insights and challenges. A successful innovation was the outcome of many cycles of design failure, addressing science challenges, feedback from operational testing of the prototypes, and revisits to basic research before successful production.

System models, particularly the Innovation System Framework further expanded this perspective by considering the broader environment, including various networks and institutions that influence and support innovation activities. The key aspects of this framework are that Innovation is an Interactive process; and Institutions serve as instruments to promote interactions between various actors. The Innovation System Framework can be distinguished primarily under four analytical units namely: National Innovation System (NIS), Regional Innovation System (RIS), Sectoral Innovation System

(SIS), and Technological Innovation System (TIS). This distinction is important as otherwise policies risk being too general or misaligned with the actual needs of sectors or regions or technology. The analytical units complement and reinforce each other and the strong interactions between them is reflected in a robust STI ecosystem.

Within the broader Innovation System, The **Triple Helix model** focuses on the interactions between the three key institutional spheres University, Industry and Government. It can be distinguished under three types (models) namely the 'Statist Model', 'Laissez-Faire', and the 'Hybrid Triple Helix' model. The Statist model is a government dominated structure, a Top-Down centralised model with innovation driven by the government controlling and directing innovation. The other configuration is the Laissez-Faire model where each of the actors performs its traditional functions independently with minimum overlaps. The most desirable model is the Hybrid Triple-Helix Model in which there are dynamic interactions among the three actors- universities, industries, and governments. In a Hybrid Triple Helix model, the three actors increasingly assume overlapping roles such as universities engaging in entrepreneurship firms in basic research, and government in venture funding and R&D cooperation. *As the STI ecosystem evolves and becomes more robust, we see a shift towards the Hybrid Triple structure.*

The **Quadruple Helix model** extends the Triple Helix by adding a fourth helix, the Civil Society. The inclusion of civil society that includes media, culture, and citizens is a recognition of the role of civil society in shaping innovation. It is an acknowledgement of the critical influence of societal needs and public engagement in shaping innovation outcomes. This inclusion reflects a more holistic approach, where public opinion, cultural contexts, and media play integral roles in the innovation ecosystem. The role of Government becomes highly influential in bringing civil society in the innovation process; ensuring that innovation aligns with societal needs, inclusiveness, and sustainability.

An inclusive Science, Technology, and Innovation (STI) ecosystem reflects a Quadruple Helix model exhibiting strong linkages between the four-helix: university, industry, government, and civil society

Shorter technology lifecycle, innovation becoming more expensive, and risky, many innovations developed within a firm not able to successfully translate into products, saw emergence of a new model adopted by some firms. They were sourcing external knowledge to enhance internal innovation (inbound processes), and— allowing internally developed ideas to flow outward for external use through licensing, partnerships, or spin-offs (outbound processes). Thus, firms were not relying solely on in-house research and development ('closed innovation'), firms were actively collaborating with universities, startups, customers, suppliers, and even competitors to co-create and commercialize innovations. This changing approach was captured by Chesbrough (2003) who termed this as the Open Innovation model. Open Innovation has emerged as one of the key drivers of a successful Triple Helix and Quadruple Helix ecosystem. Figure 2.2 highlights the innovation models discussed.

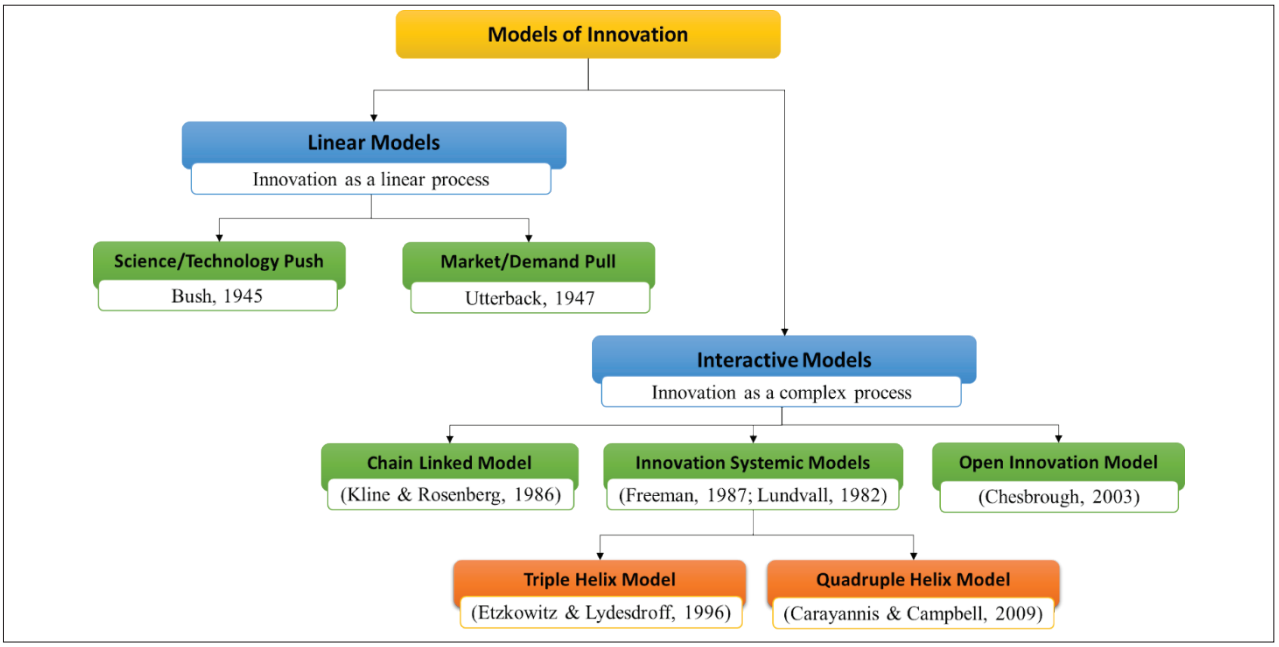

Figure 2.2: Categorisation of different models of Innovation Process

2.3 Creating an Enabling Ecosystem for Innovation

Innovation ecosystems are multifaceted networks that bring together various stakeholders—including academia, industry, government, and civil society—to collaboratively drive the development and diffusion of new ideas, technologies, and processes. The major stakeholders of an innovation ecosystem primarily can be delineated as follows:

a. Academic Institutions: Universities and research organizations serve as the bedrock of innovation ecosystems by conducting foundational research and nurturing talent. Their role in generating new knowledge and fostering critical thinking is indispensable for technological and social advancements. The science driven technologies that are shaping new innovations have translated the traditional role of academia to become one of the key players in bringing new innovations, startups emerging from academia, academia-industry partnerships in co-development of new technologies and innovations, etc.

b. Industry: Businesses, ranging from startups to multinational corporations, translate academic research into marketable products and services. They provide practical applications for theoretical concepts, driving economic growth and addressing consumer needs. The increasing influence of science in making innovations successful is reshaping Industry engagement with academia. More instances of partnerships between industry and academia are happening such as for scaling up technologies emerging from universities, co-development of technologies in niche areas, creating new opportunities for university spin-offs etc.

c. Government: Evolving technology landscape is motivating new forms of engagement which calls for policy frameworks that enable stronger linkages among diverse

stakeholders. This is leading to more active involvement of the government for creating new regulations in emerging technologies, addressing more effectively the market demand, creating science technology parks, knowledge clusters etc. This changing role is helping in fostering a new wave of innovations and today's most pressing needs.

d. Civil Society: Non-profits, community organisations, and the general public ensure that innovation aligns with societal values and needs. Their involvement fosters citizen participation, citizen science and deeper societal engagements. They are the key drivers of frugal and grassroot innovations addressing social challenges through innovative solutions.

The synergy among these stakeholders is crucial for a thriving innovation ecosystem. For instance, incubators and accelerators provide supportive environments for startups, offering physical spaces and shared resources that facilitate idea exchange and technological development. Such collaborative platforms exemplify how diverse actors can work together to drive innovation. The interplay among academia, industry, government, and civil society forms the foundation of innovation ecosystems. Their collaborative efforts are essential for fostering environments where new ideas and technologies can flourish, ultimately leading to societal and economic advancements. For organizations to achieve meaningful and scalable innovation, they must cultivate a holistic ecosystem that integrates values, structural flexibility, systematic processes, employee motivation, technological tools, and an inspiring corporate culture.

Innovation ecosystems are thus an outcome of the combination of key enablers that collectively foster the development and dissemination of new ideas, technologies, and processes. Understanding of the Innovation models and enablers have guided the development of the STI ecosystem by framing suitable policies and strategies for implementation. A robust innovation ecosystem is underpinned by a confluence of enablers, including supportive political frameworks, skilled human capital, financial and infrastructural support, intermediary organizations, and a culture conducive to innovation. Recognizing and strengthening these enablers can significantly enhance the capacity for innovation and drive sustainable economic growth. Different types of knowledge, capability and skills, financial resources among others are needed to translate the idea into practice.

A successful innovation ecosystem is embedded within a larger enabling environment that supports knowledge creation, collaboration, entrepreneurship, and market access. It also helps to address risks associated with market demand, business, technology, organization, network, volatility of government policies and regulations. A broader enabling ecosystem comprises supportive policies, institutions, infrastructure, financial systems, and a culture that fosters innovation and risk-taking. A stylized representation of the key components of an enabling ecosystem are highlighted in **Figure 2.3**.

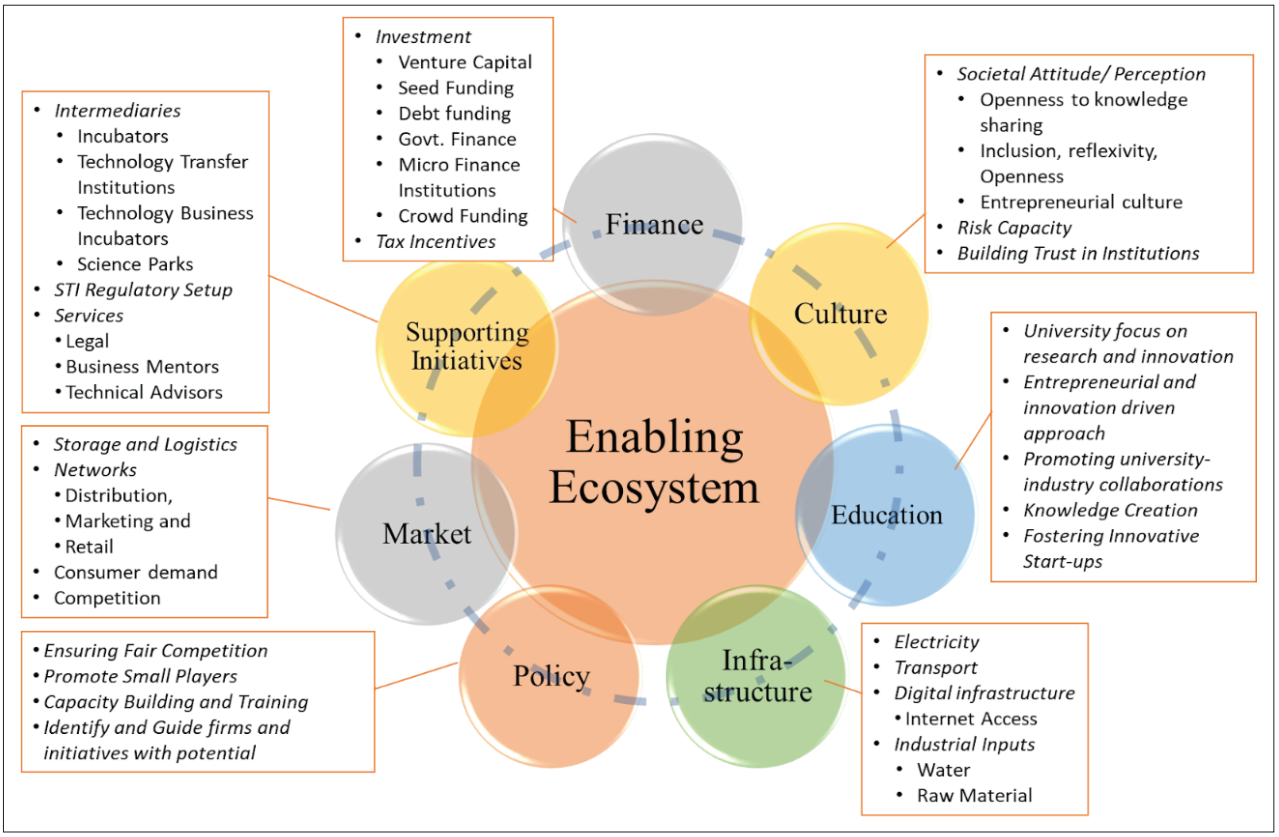

Figure 2.3: Key Components of an enabling ecosystem

This conceptualization of the components of the enabling system is one of the central pieces of the analysis presented in this report. The different missions, schemes, and initiatives of the level of central and the state governments are looked at through this analytical lens. At the same time, an analytical characterization of the various initiatives is undertaken with the objective of identifying challenges and gaps in the Indian innovation ecosystem and the steps to be taken as we take the road ahead.

CHAPTER 3
The Indian Innovation Ecosystem

The Indian Science, Technology and Innovation (STI) ecosystem consists of multiple subsystems at the levels of centre and states, sectors, technologies etc. with different ministries, departments, industries, state governments and communities playing important roles in shaping the innovation ecosystem. Over the past decade or so, the approach and strategies of several of these subsystems have contributed to promote innovation driven growth. New policy mechanisms are being created to address the different components of an enabling ecosystem with a strong focus on promoting partnerships with the different stakeholders.

As a result of a collective of such efforts, significant progress has occurred as reflected in India's performance across several international benchmarks. These include, the **Global Innovation Index**, where **India's position improved from 81 in 2015 to 38 in 2025** among 139 economies;[7] and the **Bloomberg Innovation Index 2021**, where it is the **only South Asian Country among the top 50** (and the position improved from 54th in 2019 to 50th in 2021 among 95 countries).[8] India has excelled in generating knowledge, being among the top 5 in terms of research publications. It is **ranked 6th in terms of Intellectual Property Filings** with more than 1,00,000 patents granted by the Indian Patent Office between 2023 to 2024.[9] **India is the world's third largest startup hub with more than 1,57,000 registered startups**, and more than 100 of them becoming Unicorns.[10]

This chapter attempts to present and highlight some of the major initiatives undertaken by the government and other actors to create an enabling ecosystem for innovation. In **Section 3.1,** the key policies, schemes and initiatives of the Indian Government that focused on promoting innovation are presented. Thereafter, in **Section 3.2**, a broad overview of State level policies and initiatives contributing to capacity building and strengthening the National Innovation ecosystem is provided. Some of the initiatives are highlighted to provide a glimpse, while a more detailed account of the state level interventions can be found in the India Innovation Index of NITI Aayog.[11] **Section 3.3** highlights some of the important innovation programs led by the Industry and Industry Associations. At the same time, there are several examples of innovations coming from grassroots inventors—ordinary individuals within communities (including those in rural or resource-limited areas) which have received hand-holding and support from targeted initiatives and schemes. Accordingly, some examples of schemes to promote grassroots and societal innovation activity are discussed in **Section 3.4**. These initiatives cover multiple sectors, target specific beneficiaries, and achieve set objectives with many of them having overlapping or homologous approaches and objectives. The final **Section 3.5** lists some of the recent major events and activities in the innovation space organized by government, industry bodies and other entities.

3.1 National Initiatives to promote Innovation

The role of government in establishing as well as strengthening an enabling innovation ecosystem has become critically important in the current era of knowledge-based and innovation-driven economies. The innovation models highlight the changing role of the government, acting as a bridge and partner in successful translations of research to commercialisation. Its role in promoting inclusive and sustainable innovation and bringing the different stakeholders together are underscored. In the last decade or so, one can see a strategic shift in Indian government policy; introducing a range of policies and initiatives to foster a culture of creativity, technological advancement, and entrepreneurship. These efforts span across ministries and sectors, integrating research, education, industry, and community development. A good example of the Indian government's enabling role is the creation of India's Digital Payment platform that has led to a surge in fintech innovation and financial inclusion.

For clarity of presentation and understanding, the major initiatives of the government of India can be categorised under following four categories:

(i) **Mission mode initiatives** which are implemented across domains, ministries, and sectors. Examples of these are Atal Innovation Mission, Startup India, Make In India, and several national missions in areas like solar, supercomputing, biotechnology, semiconductor, skill development, natural language translation, deep ocean exploration etc.

(ii) **Important interventions by ministries and departments** which are aimed at promoting Innovation and Entrepreneurship. Examples of these are initiatives and focused programs of DST, DBT, DPIIT, DSIR, MeitY, MoE, MSME etc.

(iii) **Intermediary and facilitative organisations** focused on promoting STI, Entrepreneurship and grassroots innovations. Examples of these are, BIRAC, NIF, NCSM, TBIs, Knowledge Parks, TDB, and several CoEs established across the country. These also include initiatives to foster community and individual innovations and support to scale up these innovations.

(iv) The **Support structures created at academic and research organisations** for Science, Technology & Innovation. Examples of these include different programs like INSPIRE, IMPRINT, COEs, Tech Parks etc.

Together these initiatives address the various aspects of the innovation ecosystem and contribute to developing different components of the enabling ecosystem.

3.1.1 System wide Mission Mode Initiatives Focused at promoting innovation activities

Some of the most well-known initiatives include the Startup India, Atal Innovation Mission, Make in India, National Missions (Solar, Quantum, Interdisciplinary Cyber Physical Systems, Super Computing, Semiconductor etc.), Digital India (Aadhar, Bhasini, Digi Locker, UPI, IndiaStack etc.).

(i) Atal Innovation Mission: A multi-level initiative to develop innovation ecosystem

The Atal Innovation Mission (AIM) was launched in 2016 by the Government of India under NITI Aayog (www.aim.gov.in). Its core objective was *to foster a culture of innovation and entrepreneurship* across the country. It aimed to *create a structured and scalable innovation ecosystem*, by promoting innovation at all levels, from schools and universities to research institutions and startups. To this end, the main interventions under AIM include the establishment of ***Atal Tinkering Labs (ATLs)*** to encourage innovation at institutional level, ***Atal Incubation Centers (AICs)*** for supporting technology development, deployment, and commercialization; and ***Atal Community Innovation Centers (ACICs)*** to build a robust innovation ecosystem in unserved areas and engage communities. While these centres act as hubs of activity providing necessary enabling infrastructure to innovators, several programs focused at assisting innovators were also started. These include, the ***Language Inclusive Program of Innovation (LIPI)*** to assist innovators who do not use English, ***Applied Research and Innovation for Small Enterprises (ARISE)*** **Challenges**, ***Atal New India Challenges*** etc.

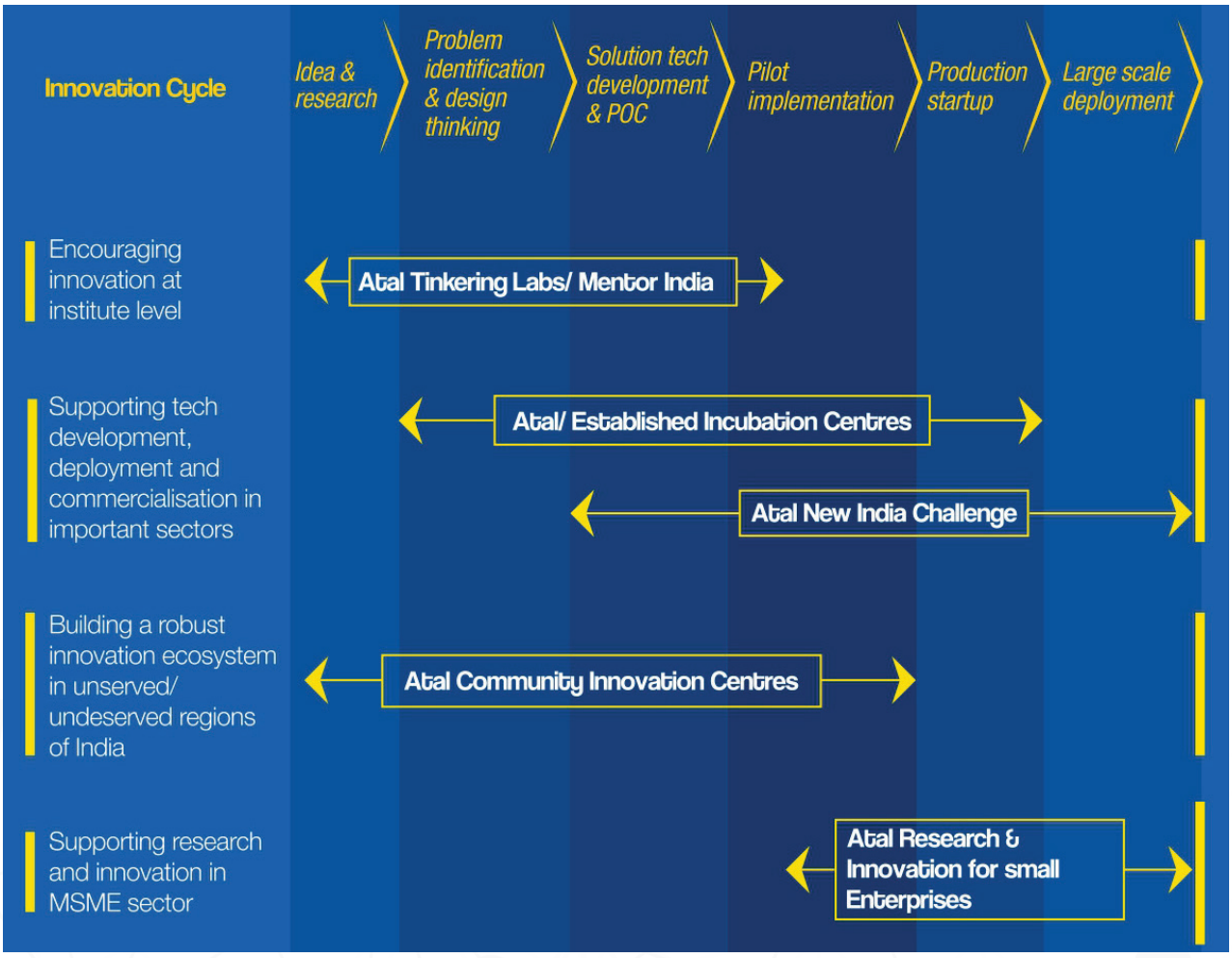

Figure 3.1: AIM initiatives and their target system
(**Source:** Adopted from the AIM website)

AIM has made significant strides with a strong emphasis on education, technology, and grassroots innovations. It has mobilised over 6200 mentors of change and facilitated development of more than 60 domestic and 20 international partnerships between

public-private institutions. The figure below is an indicative representation of the major achievements of AIM.

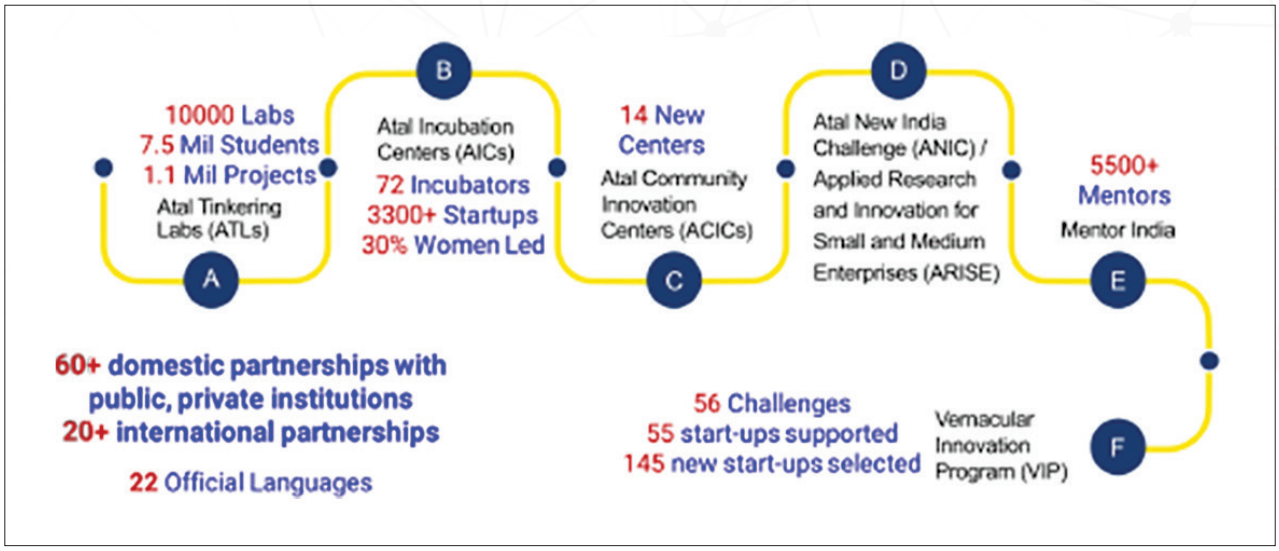

Figure 3.2: Major Achievements of the Initiatives of AIM (updated upto 2024)

(ii) **Startup India**

One of the flagship programs of Govt. of India, the **Startup India Initiative,** launched in 2016, aimed to create a robust startup culture by providing mentorship, funding access, and regulatory support (www.startupindia.gov.in). It was implemented through an Action Plan[12] which had components focused on providing support to startups. This included enhancing infrastructure such as incubation centres, making patent filing easier along with IPR facilitation services and conducive regulatory environment. The Department for Promotion of Industry and Internal Trade (DPIIT) has also established the *Startup India portal* to provide a networking database for stakeholders, and a query resolution service was also set up.

New innovative financing models have been designed and implemented. To this end an economic stimulus of *Rs. 10,000 crore as fund of funds for startups* (FFS) was established in 2016 managed by Small Industries Development Bank of India (SIDBI). It is a financial instrument where a government or anchor investor invests in venture capital (VC) or private equity (PE) funds, which in turn invest in startups or companies. The investment by VC or PE is in terms of equity capital implying the investor gets ownership stakes in the startups where they invest. The government is setting up a new Fund of Funds (FFS) with Rs. 10,000 crore corpus. This additional capital infusion in the startup ecosystem is envisaged to promote increase in new ventures and the development of high growth entities. Several government policies were also started following the startup India mission to support startups and foster entrepreneurship. Some key initiatives include, Startup India Seed Fund Scheme (SISFS), which offers financial assistance to early-stage startups for product development and market entry. It provides support for Proof of Concept, Prototype Development, and Product trails.

[12] https://www.startupindia.gov.in/content/dam/invest-india/Templates/public/Action%20Plan.pdf

The Startup India Seed Fund Scheme (SISFS) is a key enabler for startups to cross the Valley of death.

Startup India portal is a very useful point of entry for startups. It also has IDEA Bank– a curated collection of problem statements and sector challenges designed to spark startup ideas. Another enabling portal is the MAARG (Mentorship, Advisory, Assistance, Resilience, and Growth) portal. It is a centralized digital platform enabling DPIIT-recognized startups to connect with mentors—academicians, industry experts, seasoned investors, successful founders—for personalized guidance throughout their lifecycle. Startup India has an accelerator program "StartupShala"—a structured 3-month mentorship and growth initiative run *through* the Startup India platform designed specifically for DPIIT-recognized, early-stage startups.

The Startup India programme is thus building a comprehensive and supportive ecosystem that addresses various dimensions essential for nurturing startups. The various dimensions of support are highlighted in the figure below.

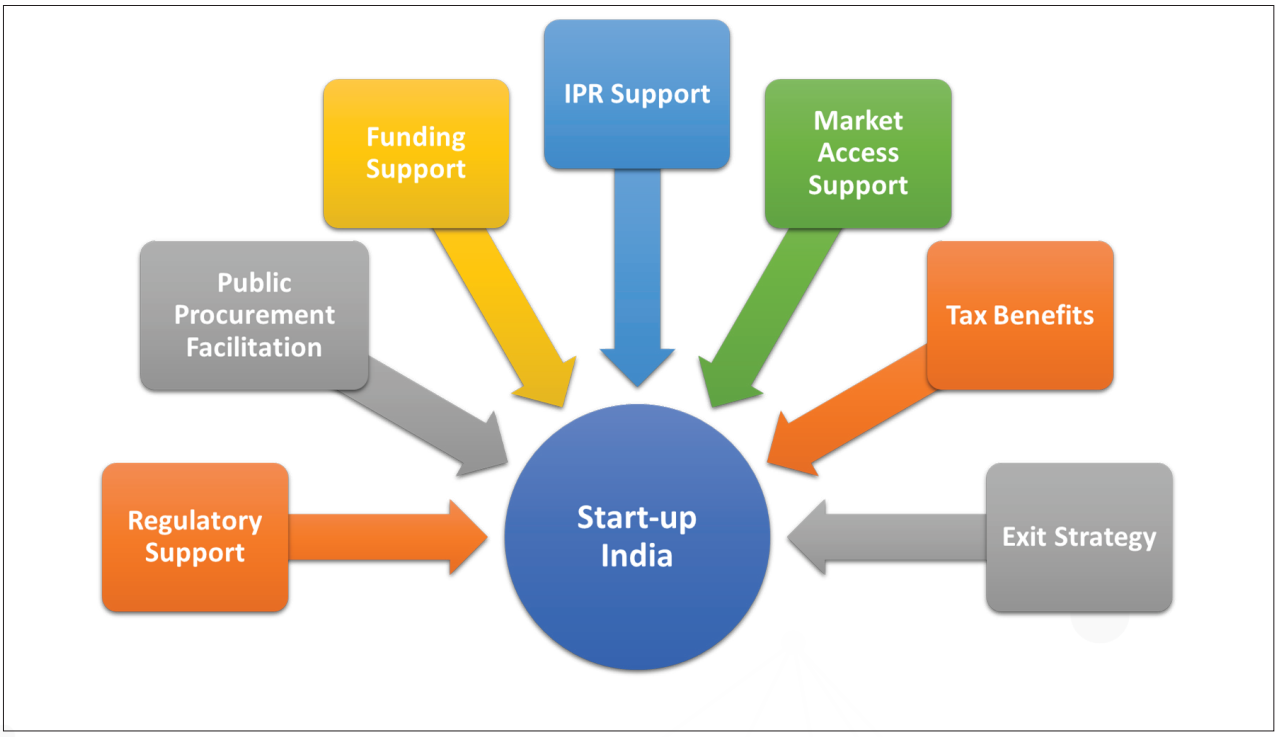

Figure 3.3: Components in the Startup India Initiative

These policies along with several other initiatives by different ministries, organisations and state governments have significantly contributed to India's thriving startup ecosystem with over 1.59 lakh DPIIT-recognized startups until May 2025, making it the third-largest globally. Overall, the Startup India Initiative, spans across different disciplines and sectors of the economy. It can be seen as a call to action, in response to which, several important actors have become active and engaged in innovation activities. The impact of Startup India is such that it has become synonymous with innovation activities. However, it is necessary that a distinction is made between the two, as though startups have a major role in commercialisation of innovations, many more basic R & D activities ought to be supported and facilitated to build a strong innovation system for the country.

(iii) Make in India

This initiative provides an umbrella framework to promote manufacturing capabilities in different sectors. Launched in 2014, it was aimed at transforming the country into a global hub for manufacturing, innovation, and investment across sectors including automobiles, electronics, pharmaceuticals, textiles, renewable energy, defence manufacturing etc. Through this mission, the government started actively encouraging domestic and international companies to manufacture their products in India. Make in India placed special attention to promoting manufacturing processes which harness regional strengths, promote sustainable entrepreneurship, and foster inclusive technological growth across the Indian states. Several steps have been taken to promote high quality local production and to create a favourable market for them.

Image 3.1: Make In India Initiative meeting with PM Sh. Narendra Modi
(**Source:** www.pmindia.gov.in/en/major_initiatives/make-in-india/)

Key Pillars and Focus areas of Make In India

New Processes	• Enhanced business environment more conducive for startups and enterprises. • Digitization and procedural simplifications.
New Infrastructure	• Industrial corridors & smart cities, integrating state-of-the-art tech. and high-speed communication. • Streamlined registration systems and intellectual property rights (IPR) infrastructure. • Identification of industry skill requirements and development of workforce accordingly.
New Sectors	• Foreign Investment allowed in several new sectors to promote inflow of large investors. • Targeted sectoral efforts for attracting both domestic and international investments. • Vocal for Local' initiative to promote indigenous production and consumption.
New Mindset	• Government-Industry partnership to support industrial growth and innovation. • Government as facilitator rather than regulator. • Job creation is key manufacturing and services sectors.

Make In India 2.0 launched encompassing 27 sectors in Manufacturing and Services

Figure 3.4: Major initiatives of Make in India
(Source: https://www.pib.gov.in/PressNoteDetails.aspx?NoteId=153203&ModuleId=3)

Achievements of the mission were primarily in attracting Foreign Direct Investment (FDI) of $667.41 billion between 2014 and 2024; significant improvement in the regulatory and financial regimes, improving the Ease of Doing Business on the basis of which **India made a big jump in the World Bank's Ease of Doing Business ranking, moving from 142 in 2014 to 63 in 2020**. The revised focus on indigenous manufacturing resulted in India becoming the second-largest mobile phone manufacturer in the world and a significant growth happened in electronics and defence manufacturing. The electronics sector grew significantly, with production doubling from $48 billion in 2017 to $101 billion in 2023. India was able to produce world-class naval aircraft carrier INS Vikrant, marking a major step toward reducing dependence on imports and achieving self-reliance in defence. India's exports hit $437.06 billion in 2023-24, thanks to sectors like electronics, pharmaceuticals, and automotive.

(iv) Research, Development and Innovation Fund

The Research, Development and Innovation Fund is the most recent program initiated by the government. The Union Cabinet, led by Prime Minister Narendra Modi, sanctioned the Research, Development, and Innovation (RDI) Scheme on July 1, 2025, allocating a funding corpus of ₹1 lakh crore to enhance R&D and innovation in emerging and strategic category-wise sectors such as artificial intelligence, semiconductors, biotechnology, quantum technologies, and digital agriculture and is being finalized.

This scheme aims to address significant funding deficiencies, support projects with high Technology Readiness Levels (TRL), and facilitate the acquisition of essential technologies, thereby reinforcing India's innovation ecosystem and promoting self-reliance in advanced fields. It establishes a two-tier funding framework, wherein a Special Purpose Fund (SPF) under the Anusandhan National Research Foundation (ANRF) will oversee the corpus, with funds being allocated through second-level fund managers, including Alternative Investment Funds (AIFs), Development Finance Institutions (DFIs), and Non-Banking Financial Companies (NBFCs).

This RDI scheme is proposed with a total corpus of ₹1 lakh crore, all of which is expected to be in the form of budgetary support and will be implemented via constitution of a Special Purpose Fund (SPF) within the ANRF. This will be the 1st level Fund Manager, which shall receive a 50-year interest free loan. Additionally, the scheme suggests the establishment of a Deep-Tech Fund of Funds, aimed at accelerating innovation in critical technologies and enhancing India's competitiveness on a global scale.

By concentrating on translational research, commercialization, and the scaling of innovations, the RDI Scheme seeks to overcome the "valley of death" in the innovation lifecycle, encourage private-sector-led R&D, and expedite the implementation of advanced solutions in vital sectors. The detailed sets of operational guidelines of the program are being created.

(v) National Technology Missions

Several national level mission mode programmes have been launched by the government in key sectors of national importance, including in the areas of new and emerging technologies. These mission mode programmes have provided significant

thrust towards building necessary infrastructure, expertise and knowledge creation in areas such as supercomputing, quantum technology, Biotechnology, solar power generation, semiconductor industry, and digital transformations etc. The major mission mode projects are as follows:

(a) **National Supercomputing Mission**

The National Supercomputing Mission (NSM) was launched in 2015 with the goal to connect national academic and R&D (research and development) institutions. It is creating a grid of over 70 high-performance computing facilities, which would enable India to leapfrog to the league of world-class computing power nations at an estimated cost of Rs. 4,500 crore over a period of 7 years. In Supercomputing, India was ranked at 74 globally and had only 9 supercomputers out of more than 500 in the world. NSM intended to attain global competitiveness and ensure self-reliance in the strategic area of supercomputing technology.

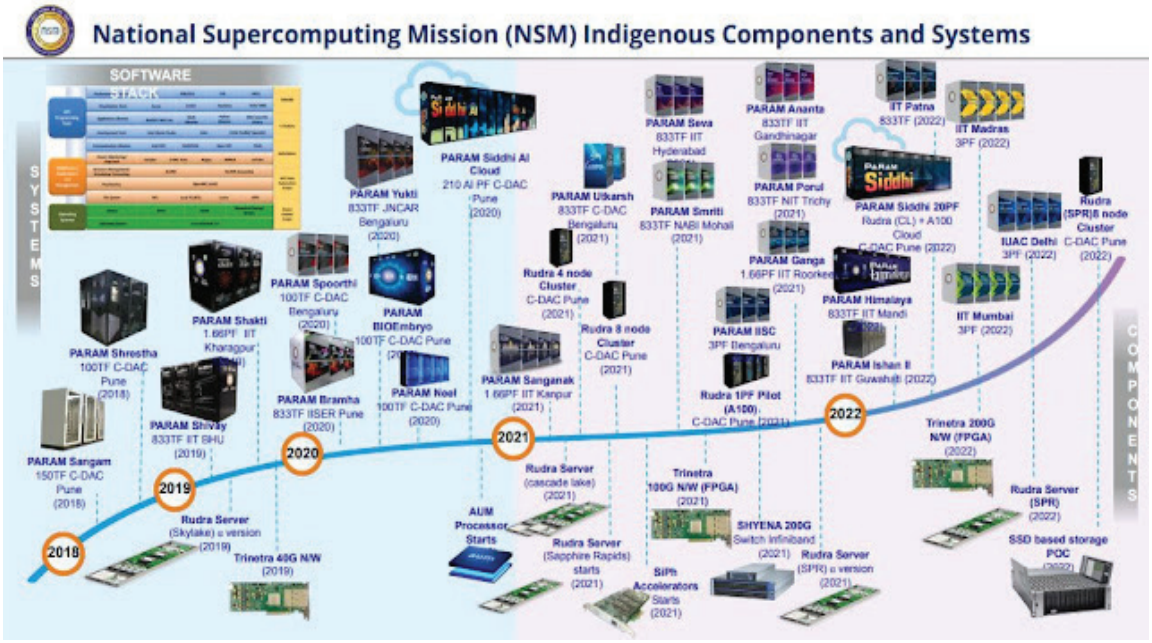

Figure 3.5: Illustrating components of National Supercomputing Mission
(**Source:** https://www.indiandefensenews.in/2022/05/meet-param-shankh-indias-new-indigenous.html)

The application areas considered include: Climate Modelling, Weather Prediction, Aerospace Engineering, Computational Biology, Molecular Dynamics, Atomic Energy Simulations, National Security/ Defence Applications, Seismic Analysis, Disaster Simulations and Management, Computational Chemistry, Computational Material Science and Nanomaterials, Astrophysics, Large Complex Systems Simulations, Cyber Physical Systems, Big Data Analytics, Finance, Information repositories/ Government Information Systems etc. NSM has enabled the development of Indigenous supercomputers, contributing towards self-reliance in the strategic area. As of March 2025, 34 supercomputers have been deployed under the NSM at various academic and research institutions including IITs, IISc, and others.

(b) **Digital India Initiative**

The Digital India Initiative was launched in the year 2015 with the objective of providing government services electronically to citizens through improved online infrastructure and connectivity. Digital India Initiative is mainly focused on three areas:

(a) Providing digital infrastructure as a source of utility to every citizen; (b) Governance and services on demand, and (c) To look after the digital empowerment of every citizen.

The Digital India initiative is built on nine key pillars that aim to transform India into a digitally empowered society. These pillars include Broadband Highways, Universal Access to Mobile Connectivity, Public Internet Access Programme, e-Governance: Reforming Government through Technology, e-Kranti - Electronic Delivery of Services, Information for All, Electronics Manufacturing, IT for Jobs, and Early Harvest Programmes.

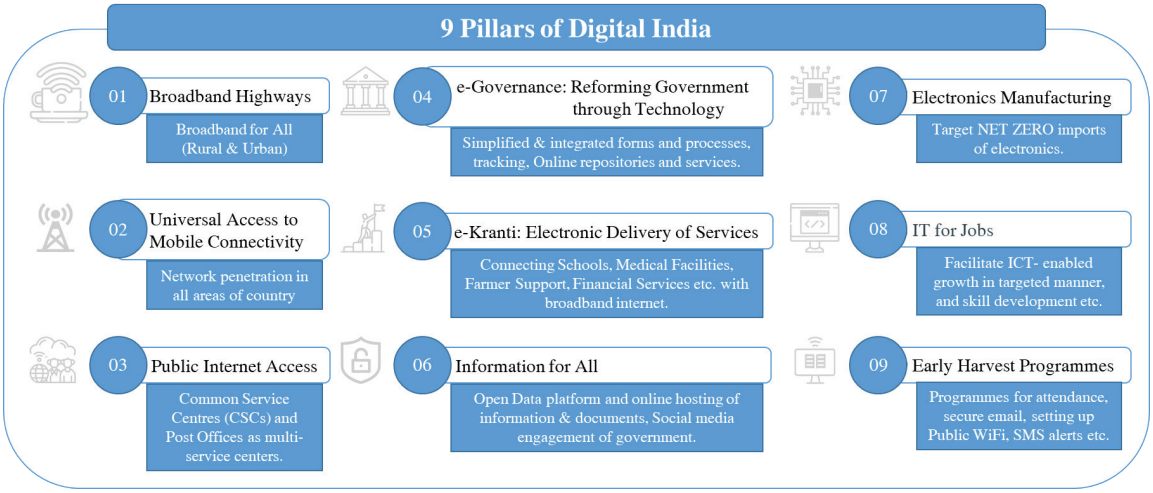

Figure 3.6: The 9 Pillars of Digital India initiative for transforming India (Source: https://www.digitalindia.gov.in/our-pillars/)

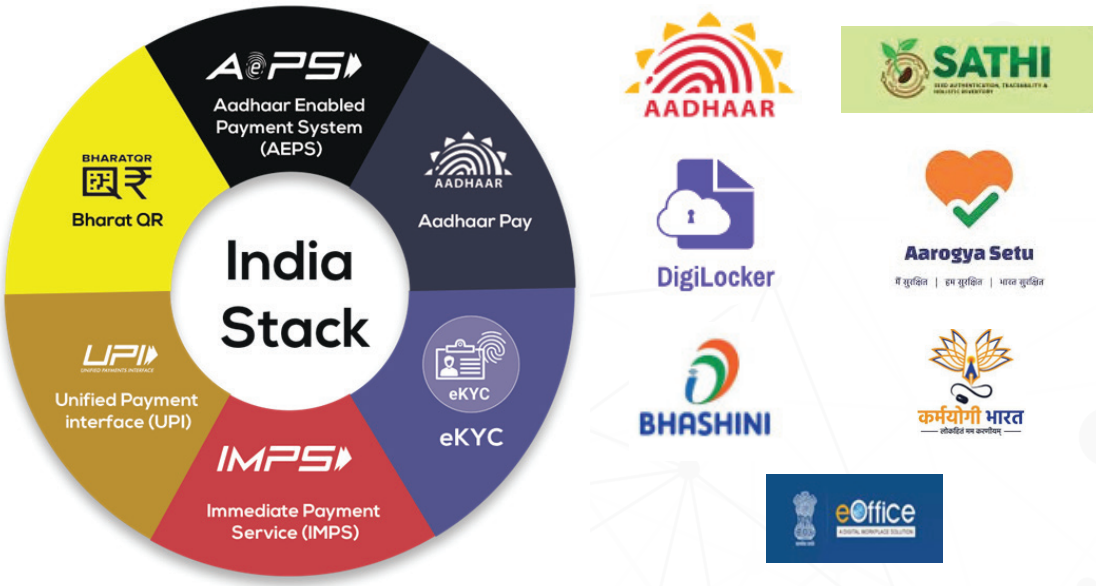

Figure 3.7: Some Components developed under the Digital India

The Ministry of Electronics and Information Technology (MeitY), in collaboration with the **National e-Governance Division (NeGD)**, has played a pivotal role in advancing technological innovation and enhancing citizen-centric service delivery in India. Through flagship initiatives such as **Aadhaar, DigiLocker**, and several other digital platforms, MeitY has significantly contributed to building a robust digital infrastructure that empowers communities, promotes ease of access to public services, and fosters an inclusive digital economy. These initiatives exemplify the government's commitment to leveraging technology for innovation, transparency, and efficient service delivery across the nation. **Unified Payments Interface (UPI)** an Indian Instant Payment Interface launched in 2016 has enabled digitalization of day to day civic, financial, administrative services for the citizens.

API Setu, MeriPehchaan – National Single Sign-On (NSSO), The MeitY Quantum Computing Applications Lab, OpenForge (platform for open collaborative development of e-governance applications), **UX4G, AAINA-Dashboard for Cities** are some of the important projects on in which significant activities are happening under the Digital India Mission in order to develop the national digital infrastructure.[13]

(c) **National Mission on Interdisciplinary Cyber-Physical Systems (NM-ICPS)**

Cyber Physical Systems (CPS) consist of both computational and physical processes integrated to work in synergy specially focused on Human-Computer Interactions. Technologies such as Cybernetics, Internet of Things, AI and their applications in products such as Self Driving Cars, Drones, Smart Home Sensors and systems etc. are categorised as CPS. As these technologies are rapidly becoming common, there was a need to create an ecosystem for them. To address this requirement, a five-year plan was formulated and approved in 2018. The NM-ICPS, implemented by DST has a total outlay of Rs. 3,660 Crores to coordinate and integrate nationwide efforts specifically in translational research in CPS. Three categories of hubs, namely, Technology Innovation Hubs (TIH), Application Innovation Hubs (AIH) and Technology Translation Research Parks (TTRP) were proposed to be established.

It was a comprehensive mission which engaged with various ministries and departments of the government and identified their requirements in terms of technology solutions and support needed. It aimed at complete convergence with all stakeholders by establishing strong linkages between academia, industry, Government and International Organizations. The Mission aimed at development of technology platforms to carry out R&D, Translational Research, Product Development, Incubating & Supporting Start-ups as well as Commercialization. Under the NM-ICPS, 25 Technology Innovation Hubs (TIHs) have been established in reputed institutes across the country. Each hub is a Section-8 Company, an independent entity within a Host Institute and has been assigned a Technology Vertical in the areas of advanced technologies which includes: Artificial Intelligence and Machine Learning, Robotics, Cyber Security,

[13] https://dic.gov.in/digital-infrastructure/

Data Analytics & Predictive Technologies, Intelligent Collaboration Systems, Technologies for Agriculture & Water, Technologies for Mining, Advanced Communication System, Quantum Technologies etc.

The mission has achieved success in several fields, with some notable success stories in form of A drone swarm lighting display (Botlabs Dynamics), India's first commercial chip for secure IoT environments, Digital Entomologist (Awadh at IIT Ropar), 24/7 IT-OT Security Operations Center (SOC) for NHAI (C3iHub IIT Kanpur), and India's first testbed for autonomous navigation for aerial and ground systems. Overall, more than 1500 new technologies and products have been developed, and 900 startups have evolved with assistance from the NM-ICPS underlining its success in creating an ecosystem for CPS research and development in India (www.nmicps.in). The mission has been extended up to December 2027 to further strengthen the CPS ecosystem.

(d) **National Biotechnology Development Strategy (2021–2025)**

The National Biotechnology Development Strategy (2021–2025), aims to position India as a global leader in bio-innovation. It is focused on bringing academia and industry together, and creating an enabling ecosystem for bio-manufacturing, research, and entrepreneurship. Biotechnology has emerged as a vital catalyst for innovation in India, making significant contributions to advancements in healthcare, agriculture, environmental sustainability, and industrial processes. The different programs under NBDS reflect India's strategic commitment to advancing biotechnology innovation as a driver of economic growth and societal impact.[14] The field of biotechnology is grounded in interdisciplinary research, and merges life sciences with cutting-edge technologies such as genomics, synthetic biology, and bioinformatics, facilitating the creation of cost-effective and scalable solutions that address national priorities.

(e) **Indian Semiconductor Mission**

The India Semiconductor Mission (ISM) was initiated in 2021 by the Government of India, under the aegis of MeitY. It has a financial investment of ₹76,000 crore committed towards creating a self-sufficient electronics industry with cutting edge R&D capacity, chip design capabilities, and strong international collaborations. This will strengthen India's position in the semiconductor market, and help it in becoming a key player in the global semiconductor supply chain (https://ism.gov.in/).

The main objectives of ISM included a long-term strategy for development of a sustainable ecosystem for design and manufacturing of semiconductor and display units, along with a trusted semiconductor supply chain and supporting semiconductor design startups with Electronic Design Automation (EDA) tools, foundry services and other suitable mechanisms for early-stage startups.

Objectives of ISM are as under:

(i) Formulate a comprehensive long-term strategy for developing sustainable semiconductors and display manufacturing facilities and semiconductor

[14] https://dbtindia.gov.in/sites/default/files/NBDS_March%202021.pdf

design eco-system in the country in consultation with the Government ministries / departments / agencies, industry, and academia.

(ii) Facilitate the adoption of secure microelectronics and developing trusted semiconductor supply chain, including raw materials, specialty chemicals, gases, and manufacturing equipment.

(iii) Enable a multi-fold growth of Indian semiconductor design industry by providing requisite support in the form of Electronic Design Automation (EDA) tools, foundry services and other suitable mechanisms for early-stage startups.

(iv) Promote and facilitate indigenous Intellectual Property (IP) generation.

(v) Encourage, enable and incentivize Transfer of Technologies (ToT).

(vi) Establish suitable mechanisms to harness economies of scale in the Indian semiconductor and display industry.

(vii) Enable cutting-edge research in semiconductors and display industry including evolutionary and revolutionary technologies through grants, global collaborations and other mechanisms in academia / research institutions, industry, and through establishing Centres of Excellence (CoEs).

(viii) Enable collaborations and partnership programs with national and international agencies, industries and institutions for catalyzing collaborative research, commercialization and skill development.

Following four schemes have been introduced under the aforesaid programme:

(i) **'Modified Scheme for setting up of Semiconductor Fabs in India'** for attracting large investments for setting up semiconductor wafer fabrication facilities in the country to strengthen the electronics manufacturing ecosystem and help establish a trusted value chain. The Scheme extends a fiscal support of 50% of the project cost on *pari-passu* basis for setting up of Silicon CMOS based Semiconductor Fab in India.

(ii) **'Modified Scheme for setting up of Display Fabs in India'** for attracting large investments for manufacturing TFT LCD or AMOLED based display panels in the country to strengthen the electronics manufacturing ecosystem. Scheme extends fiscal support of 50% of Project Cost on *pari-passu* basis for setting up of Display Fabs in India.

(iii) **'Modified Scheme for setting up of Compound Semiconductors / Silicon Photonics / Sensors Fab / Discrete Semiconductors Fab and Semiconductor Assembly, Testing, Marking and Packaging (ATMP) / OSAT facilities in India'** shall extend a fiscal support of 50% of the Capital Expenditure on Pari-passu basis for setting up of Compound Semiconductors / Silicon Photonics (SiPh) / Sensors (including MEMS) Fab/ Discrete Semiconductor Fab and Semiconductor ATMP / OSAT facilities in India.

(iv) **'Semicon India Future Design: Design Linked Incentive (DLI) Scheme'** offers financial incentives, design infrastructure support across various stages of development and deployment of semiconductor design for Integrated Circuits (ICs), Chipsets, System on Chips (SoCs), Systems & IP Cores and semiconductor linked design. The scheme provides "Product Design Linked Incentive" of up to 50% of the eligible expenditure subject to a ceiling of ₹15 Crore per application and "Deployment Linked Incentive" of 6% to 4% of net sales turnover over 5 years subject to a ceiling of ₹30 Crore per application.

(f) **National Quantum Mission**[15]

Led by interdisciplinary teams of scientists, engineers, and policymakers, the mission seeks to accelerate the development and deployment of quantum technologies across various sectors, including healthcare, finance, defence, and beyond. At its core, the National Quantum Mission embodies a strategic commitment to advancing fundamental research, fostering collaboration between academia, industry, and government agencies, and nurturing a skilled workforce capable of leading in the quantum era. It is a nationwide initiative driving cutting-edge advancements in quantum technology.

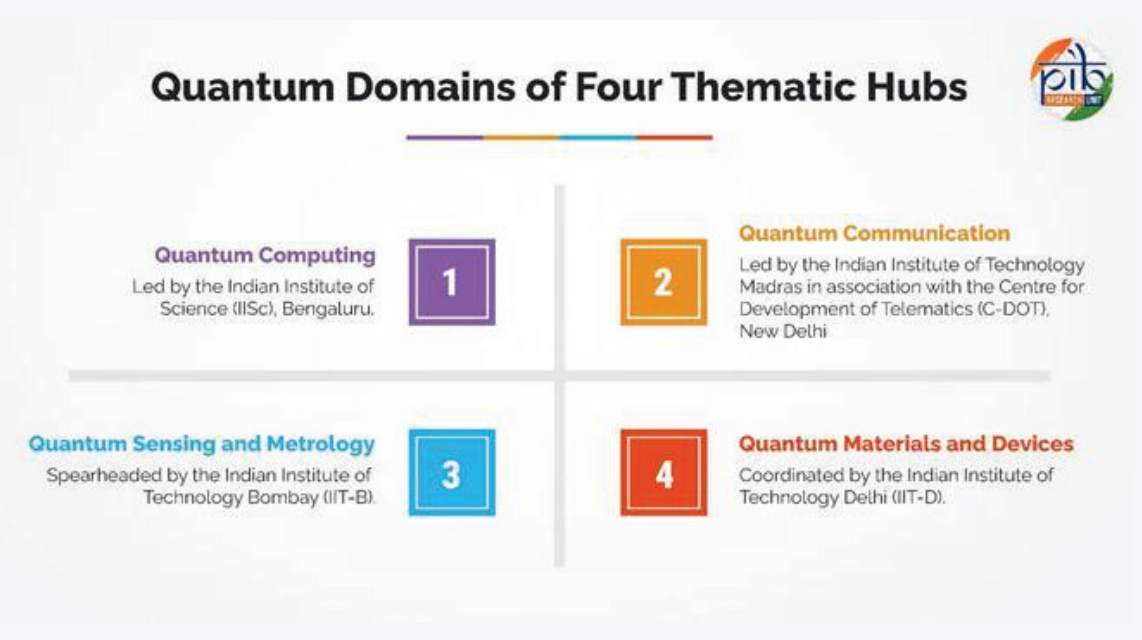

Figure 3.8: Focus areas of Quantum Computing Mission
(**Source:** https://www.pib.gov.in/PressReleasePage.aspx?PRID=2111953)

Approved on 19th April 2023 by the Union Cabinet, the mission is set to span from 2023–24 to 2030–31, with a budget allocation of ₹6,003.65 crore. Through targeted investments in research infrastructure, talent development programs, and public-private partnerships, the mission aims to position the nation as a global leader in quantum science and technology. As part of this mission, four **Thematic Hubs (T-Hubs)** have been set up, bringing together 14 Technical Groups across 17 states and 2 Union Territories.

These hubs focus on technology innovation, skill development, entrepreneurship, industry partnerships, and global collaborations, ensuring a truly national impact. The four T-Hubs selected under NQM collectively involve 152 researchers from 43 institutions nationwide, fostering a collaborative ecosystem to drive research and innovation in quantum technologies.

The National Quantum Mission (NQM) is more than just a technological initiative—it is a strategic step towards securing India's future in the quantum era. With significant investments, world-class research collaborations, and dedicated innovation hubs, the mission is set to propel India to the forefront of the global quantum revolution. This initiative underscores India's commitment to scientific excellence, economic resilience, and national security in a world where quantum technologies are poised to reshape industries and societies.

(g) **IndiaAI mission**

The IndiaAI mission was launched in 2024 with a proposed budget of ₹10,372 crore and a five-year span. The aim is to build a comprehensive ecosystem that fosters AI innovation. To achieve this, the mission envisages equitable access to the computation resources, enhancing data quality, developing indigenous AI capabilities, attracting top AI talent, enabling industry collaboration, providing startup risk capital, ensuring socially impactful AI projects, and promoting ethical AI through its seven pillar programmes (https://indiaai.gov.in/). The mission is implemented by an independent business division under the Ministry of Electronics and Information Technology (MeitY). As part of this effort, 367 datasets have already been uploaded to AI Kosh, India's AI-specific open data repository.

The IndiaAI Foundation Model pillar, which focuses on building large-scale AI models trained on India-specific data, received over 500 proposals since the call was launched. On April 26, Sarvam AI was selected to build India's sovereign LLM ecosystem, including a 120-billion parameter open-source model for public service use cases like Citizen Connect 2047 and AI4Pragati. Now, three more firms have been roped in to work in different areas of AI. One of the firms, Soket AI, has proposed to build an open-source model with 120-billion parameters, optimized for India's linguistic diversity, targeting applications in defence, education, and healthcare. The second firm, Gnani AI has proposed to develop a 14-billion parameter multilingual Voice AI foundation model for real-time speech processing and reasoning. The third firm is Gan AI, which will focus on building a 70-billion parameter multilingual model aimed at achieving superhuman text-to-speech (TTS) capabilities.

The mission aims to foster AI innovation and build domestic capacities in artificial intelligence. It consists of seven key pillars namely, India AI Compute, Innovation Centre, Dataset platforms, Application development initiatives, Future Skills, Startup Financing, and Safe & Trusted AI.

Box 3.1 Missions related to Building Capacity for Clean Energy Production

DST Clean Energy Research Initiative: CERI is a multifaceted program aimed at driving down the cost of clean energy technologies and promoting sustainable development in India. The key objectives and focus areas of the Initiative are a) intensification of research in high-priority areas (like solar energy, building energy efficiency, clean coal, clean energy materials, smart grids, methanol economy, clean fuels, hydrogen, and carbon capture, utilization, and storage), b) funding research and development (R&D) by academic institutions, national laboratories, and industries, c) supporting the development of national research competence and fostering innovation in clean energy technologies, and d) providing opportunities for human and institutional capacity development through fellowships, training, centers of excellence, thematic hubs, and technology platforms. Along with this, several other initiatives focused on promoting clean energy are there in order to contribute to developing a basket of technically feasible, socially acceptable, environmentally sound, and economically viable innovative solutions for a cleaner and more sustainable energy future.

National Green Hydrogen Mission: The Mission will have wide ranging benefits- creation of export opportunities for Green Hydrogen and its derivatives; Decarbonisation of industrial, mobility and energy sectors; reduction in dependence on imported fossil fuels and feedstock; development of indigenous manufacturing capabilities; creation of employment opportunities; and development of cutting-edge technologies. It has an initial total outlay of INR19,744 crore, for promoting strategic interventions for transition towards Green Hydrogen production and sale. The mission is leading to the development of an extensive production, distribution, use and export ecosystem for green hydrogen and its derivatives such as ammonia. As an important milestone, the globally lowest prices for the production of green hydrogen and ammonia have been quoted by the producers at the tender auctions in August 2025.[16]

Breakup into:

INR 17,490 crore	Strategic Interventions for Green Hydrogen Transition (SIGHT) programme
INR 1,466 crore	Pilot projects
INR 400 crore	For R&D activities
INR 388 crore	Towards other Mission components (Miscellaneous)

16 https://www.pib.gov.in/PressReleasePage.aspx?PRID=2153006#:~:text=In%20a%20landmark%20development%20under,discovery%20of%20%E2%82%B955.75%2Fkg

National Small Grid Mission: The National Smart Grid Mission (NSGM) is an initiative of the Indian government, established in 2015 (and became operational in January 2016), to accelerate the deployment of smart grids and manage related policies and programs. It is housed within the Ministry of Power and aims to improve grid efficiency, reduce losses, and integrate renewable energy sources. It involves various stakeholders including DISCOMs, regulators, manufacturers, and the Central Electricity Authority.

3.1.2 Important Initiatives by Central government ministries and departments focused at promoting innovation activities

(i) Department of Science and Technology (DST)

DST plays a pivotal role in promoting innovation, research, and entrepreneurship across India. It coordinates and runs several programmes ranging from research grants, and educational events to international collaborations and infrastructure development to promote scientific temper, support startups, and encourage grassroots innovations. Some of the notable programs of DST include, National Initiative for Developing and Harnessing Innovations (NIDHI), Strengthening, Upscaling & Nurturing Innovations for Livelihood (SUNIL) Programme, INSPIRE etc. The department also supports international collaboration between researchers and firms.

- **National Initiative for Developing and Harnessing Innovations (NIDHI):** A flagship program of DST focusing on leveraging the Indian knowledge economy and providing opportunities for wealth creation. It is built around the vision of nurturing a robust innovation-driven ecosystem by supporting problem-solvers, innovators, and technology-based startups through a structured and stage-wise approach. It encompasses a suite of targeted programs that address different stages of the innovation and startup lifecycle. These include **NIDHI-PRAYAS** (young entrepreneurs: ideas into prototypes); **NIDHI-EIR**, Entrepreneur-In-Residence (risk-mitigation support to early-stage entrepreneurs); and **NIDHI-TBI** (converting innovations into startups) through Technology Business Incubators.

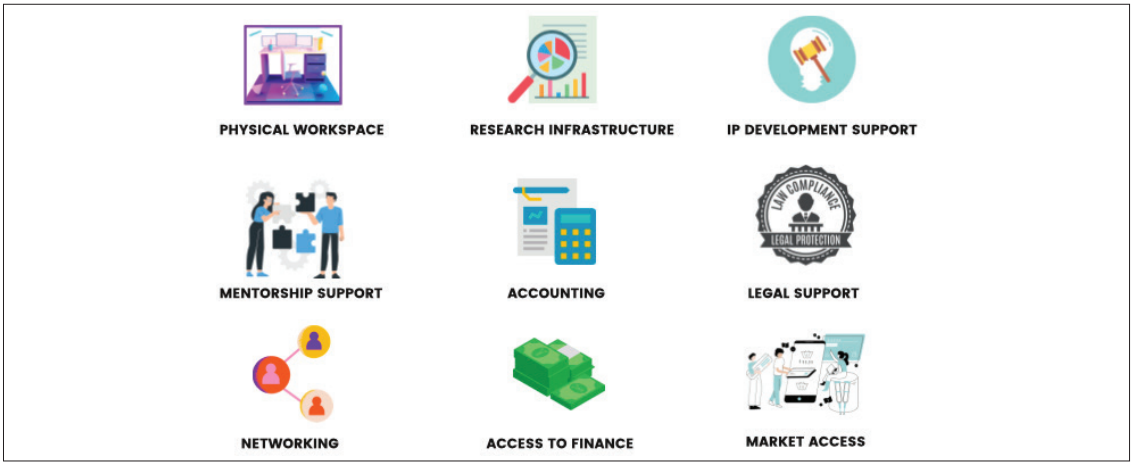

Figure 3.9: DST NIDHI TBI Services

A newer model, **NIDHI-iTBI**, was launched in 2022–23 to promote inclusive innovation through tailored incubation support. Additional components like **NIDHI-Accelerator centres** provide structured scaling-up support, **NIDHI-SSS** (Seed Support System) offers early-stage investment, and **NIDHI-CoE** (Centres of Excellence) facilitate the global competitiveness of startups through access to world-class infrastructure and mentoring. Its key beneficiaries include S&T-based entrepreneurs, startup incubators, academic and R&D institutions, mentors, financial institutions, angel investors, venture capitalists, and relevant government and industry bodies.

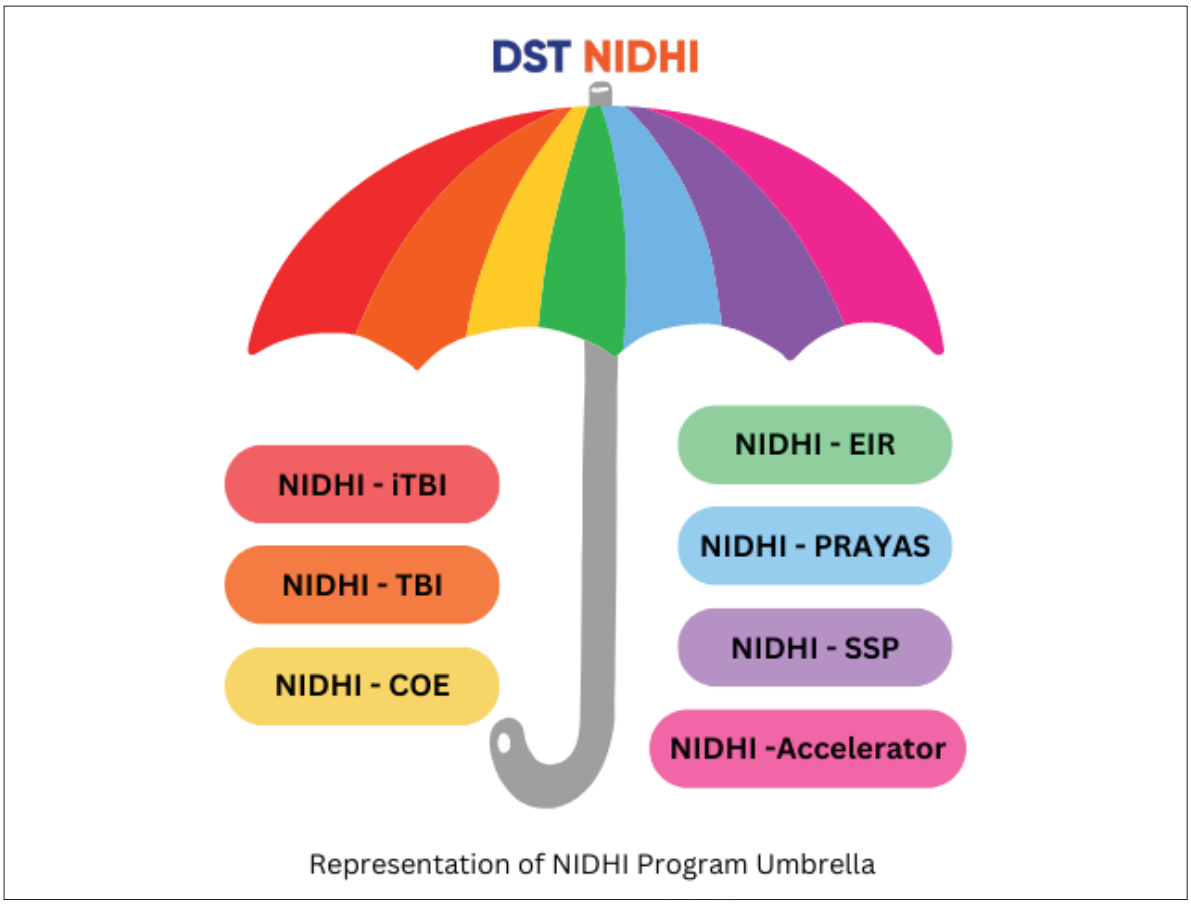

Figure 3.10: A representation of the various initiatives under the NIDHI program
(**Source:** https://nidhi.dst.gov.in/about-department/about-nidhi/)

Collectively, the NIDHI ecosystem plays a critical role in fostering entrepreneurial culture and building a self-reliant, innovation-driven economy.

- **Strengthening, Upscaling & Nurturing Innovations for Livelihood (SUNIL) Programme:**

The SUNIL programme is designed to support grassroots innovations by transforming local ideas into viable livelihood opportunities for the rural and unemployed population, particularly the economically weaker sections (EWS). The programme's objectives include developing a technology delivery and enterprise

creation model to enhance the efficiency of livelihood systems, implementing Technology Interventions for Addressing Societal Needs (TIASN), and fostering the capacity building of Community-Based Organizations (CBOs), NGOs, Knowledge Institutions (KIs), and social startups.

The thematic focus centers on livelihood development, where technology is applied to address socio-economic challenges through local engagement and enterprise creation. Activities involve mapping community needs, developing and demonstrating suitable technologies, strengthening institutional networks, and enabling social entrepreneurship. Funded by the Central Government, support is extended in the form of general and capital grants to participating NGOs and KIs for human resources, R&D, infrastructure creation (like community centres, water structures, labs), training, and dissemination activities. The programme is governed through Group Monitoring Workshops (GMWs) and Expert Committee (EC) reviews, with financial audits conducted by the Comptroller and Auditor General (C&AG) and the Ministry's internal audit systems, ensuring transparency and accountability in implementation.

- **DST-GDC I-NCUBATE Program:** Program aims to catalyse STEM research and technologies from universities, research labs, and incubators across India by transforming innovations into *deep-tech startups* that create socio-economic impact at scale. Designed as a cohort-based Customer Discovery Program for Deep-tech Researchers and aims to catalyse STEM research and technologies from universities, research labs, and incubators across India by transforming innovations into deep-tech startups that create socio-economic impact at scale (https://gdciitm.org/dst/#about). There will be 10 bootcamp style Cohorts under the First Phase of the Program.

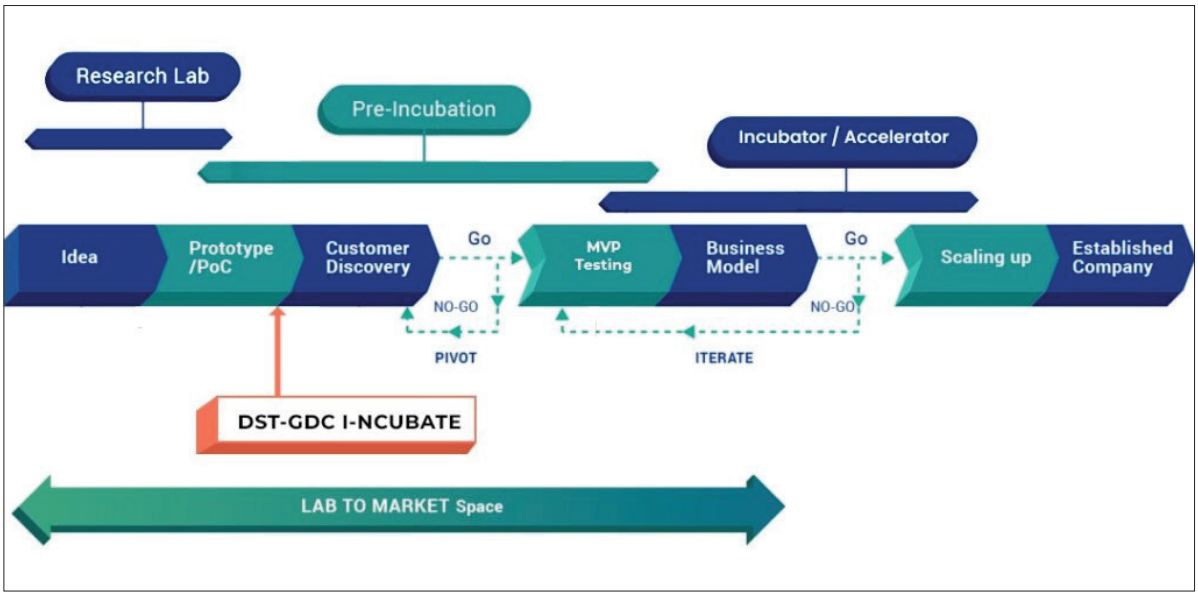

Figure 3.11: Lifecycle model of DST-GDC I-NCUBATE
(**Source:** https://nidhi.dst.gov.in/dst-gdc-incubate-program/)

(ii) **Ministry of Education**

- **Innovation Cell under Ministry of Education**

The Ministry of Education (MoE), Govt. of India has established an 'Innovation cell' with the purpose of systematically fostering the culture of Innovation in all Higher Education Institutions (HEIs) across the country in 2018. MIC has brought the Tectonic shift in Innovation & entrepreneurship ecosystem of our Higher Educational Institutions and School Education through outcome and output-oriented policy and program efforts. The Innovation Cell works on its four pillars of excellence i.e., Policy Intervention; Handholding of HEIs and schools, Faculty & Students; Impact Assessment; and Facilitating National & International platforms for Indian and global students.

The program implements several key activities including the **National Innovation and Startup Policy 2019**, **Smart India Hackathon (SIH)** for practical problem-solving, **Kalam Program for IP Literacy and Awareness (KAPILA)** supporting patent filing, Innovation Ambassador Training Program for faculty mentors, and Innovation, Design, and Entrepreneurship Bootcamps. Institutional support comes through established **Institution's Innovation Councils (IICs)** that nurture ideas into prototypes, while infrastructural support includes Design Innovation Centers and innovation laboratories.

The initiative leverages public-private partnerships to bridge academia-industry gaps and provides funding through institutional budgets, collaborations with government agencies, and initiatives like the MoE-AICTE Investor Network that connects startups with angel investors and venture capitalists. **Figure 3.12** shows the number of IICs established across the country and the impact of these to the common public.

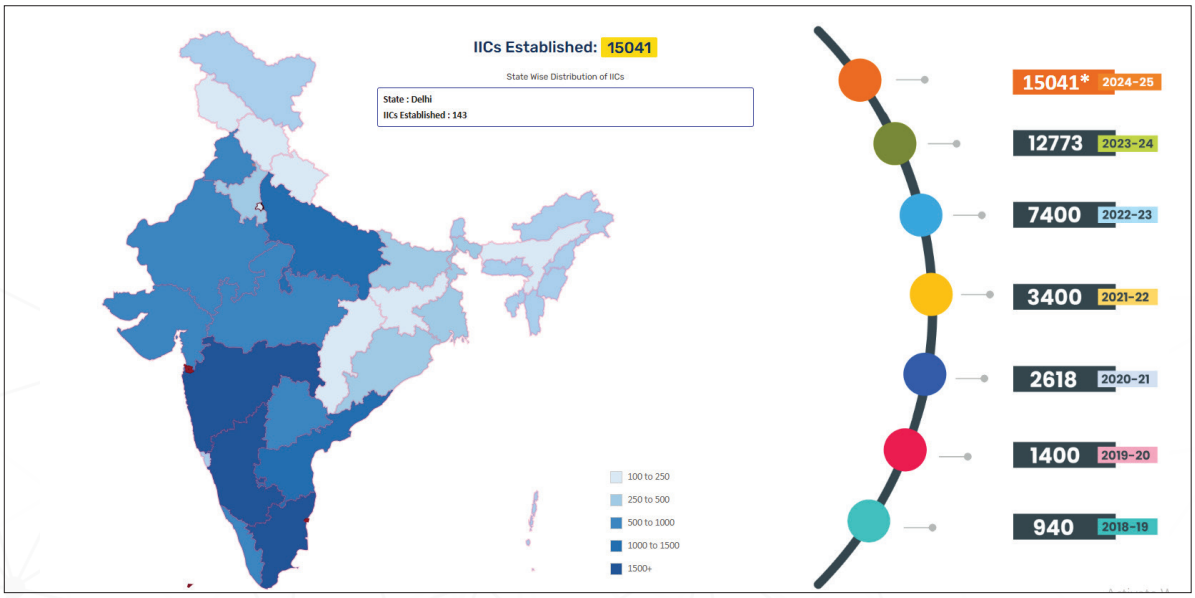

Figure 3.12: Distribution of Innovation Cells across the different states in India
(**Source:** https://birac.nic.in/webcontent/BIRAC_Annual_Report_2020_21_English.pdf)

- **Centres of Excellence In Frontier Areas in Science and Technology - Establishing Infrastructure for Cutting Edge Research**

The Centres of Excellence (CoEs) under the Ministry of Education have made great progress in promoting cutting-edge research and innovation in key sectors. Some major accomplishments include AI-based agriculture projects at IIT Indore and IIT Ropar, where they have created precision farming technologies and data-driven solutions, leading to a significant increase in research funding and publications. The Manekshaw Centres at IIT Guwahati, which focus on defence, are encouraging partnerships between universities and security organizations. Additionally, the Union Budget 2025 has set aside ₹500 crore for a CoE in Education and has introduced new CoEs in Agriculture, Healthcare, and Sustainable Cities. Together, these efforts are boosting India's research and development infrastructure, speeding up the application of technology, and improving innovation capabilities in various sectors.

- **Kalam Programme for Intellectual Property Literacy and Awareness - Financial assistance for Improving IPR awareness and registration**

KAPILA programme was launched on 15th October 2020 with the aim of creating appropriate awareness among researchers and innovators regarding the need of IP filing, mechanism, and methodology involved in filing IP in India as well as globally. The scheme is targeted especially on students and faculty of higher education institutions. Under the KAPILA programme, financial assistance is provided to the institutions that are part of the Higher Education Institutions (HEIs) for filing patents.

Under the programme Institutes interested in organizing the IPR awareness program in Online or Offline modes can register with the ministry. Subsequently, experts from the Patent Office are assigned to address the participants of the institutions about IPR. Besides this an *IP lecture series* is available for all students and faculty members from KAPILA registered Institutions. The objective of the IP series is to sensitize and strengthen the IP ecosystem in educational institutes thus creating a culture of systematically protecting new ideas, research, and innovation. The program also leverages the existing IP experts in India through the *KAPILA Patent Facilitator Network.* This network connects IP professionals with educational institutions across India to provide support for patent search, drafting, filing and intellectual property matters. The registered patent facilitators are a part of a nationwide network of IP professionals and get opportunities to work with educational institutions, support students and faculty in protecting their innovations and conduct awareness sessions for KAPILA-NIPAM (national IP awareness mission) initiatives (https://kapila.mic.gov.in/).

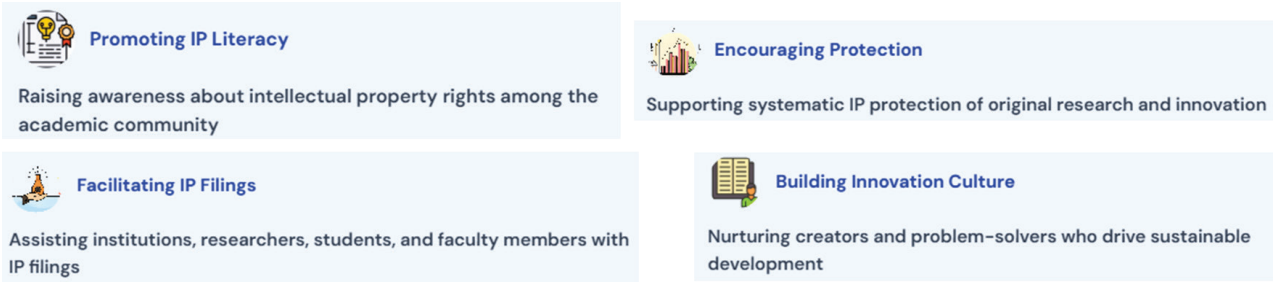

Figure 3.13: The various components of KAPILA initiatives
(**Source:** https://kapila.mic.gov.in/)

(iii) Department for Promotion of Industry and Internal Trade (DPIIT)

The Department for Promotion of Industry and Internal Trade (DPIIT), under the Ministry of Commerce and Industry, Government of India, has launched several initiatives to foster innovation and strengthen India's startup ecosystem. In addition to the flagship Startup India Scheme, described above, DPIIT has collaborated with industry leaders like Paytm to assist fintech hardware manufacturers through funding and guidance. It has partnered with global entities such as the Startup Policy Forum (SPF) to position India as a global innovation hub, enhancing its role in entrepreneurship and technology-driven development.

DPIIT also plays a crucial role in regulatory and strategic support for startups, making intellectual property rights (IPR) services more accessible and offering financial assistance for patent filing and innovation protection. Various workshops and awareness programs are conducted to educate startups about legal and business frameworks. These initiatives collectively aim to create a conducive environment for startups, driving economic growth, employment generation, and technological advancements, ultimately positioning India as a leader in the global innovation landscape.

Besides these, some other programs were created to promote Innovation activities, primarily in promoting startup activity. A Compendium of these programs was prepared by DPIIT and can be referred to for more information on these schemes.[16]

A centralised portal - national single window system (https://www.nsws.gov.in/) has been prepared and commissioned by the DPIIT to provide all services under one umbrella. Under this portal all central and state government schemes to promote innovation and business development are provided along with the facility for startups and investors to get approvals, engage with investors and raise funding.

(iv) Ministry of Electronics and Information Technology (MeitY)

MeitY has several programmes focused on promoting the technology-based startups through various mechanisms, including Incubation, entrepreneurship support, and product development.

16 https://www.startupindia.gov.in/content/dam/invest-india/Templates/public/Draft of Compendium of Startup Specific Initiatives (1).pdf

- **Entrepreneurship Support to Startups - TIDE**

The **Technology Incubation and Development of Entrepreneurs (TIDE) 2.0** scheme is an initiative by the Ministry of Electronics and Information Technology (MeitY), Government of India, aimed at fostering a comprehensive ecosystem to support technology startups and incubation centers across the country. The primary objective of the scheme is to promote tech-based entrepreneurship by facilitating the growth of startups working on emerging technologies such as Artificial Intelligence (AI), Internet of Things (IoT), Blockchain, Robotics, and others, especially in pre-identified areas of societal relevance.

TIDE 2.0 provides holistic incubation support to startups, including access to co-working spaces, mentorship, technical guidance, and networking opportunities. It empowers incubators to deliver end-to-end support for early-stage ICT startups, thus creating a strong foundation for innovation-driven enterprises. Each designated TIDE center is eligible for a grant-in-aid of up to ₹155 lakhs, disbursed in installments. This funding is allocated in two major components: up to ₹30 lakhs for infrastructure development, and ₹125 lakhs for supporting up to five startups, providing up to ₹25 lakhs per startup. Additionally, the scheme encourages activities such as IPR filings, prototype development, and commercialization, thereby aligning startup growth with national priorities in innovation and digital transformation.

TIDE Centers are categorized into three groups:

Type	Function and Activities of the TIDE Centre
G1C	To offer deep support to startups including mentoring, capacity building, industry linkages for further investment avenues. Must also nurture and handhold G3 centres.
G2C	To facilitate aspiring entrepreneurs and students to build high quality startups. Must also nurture and handhold G3 Centres.
G3C	To initiate and evangelize innovation and entrepreneurship ecosystems in unexplored regions. Collaborate with G1/G2 centres for effective handholding and nurturing of startups.

- **Startup Accelerator of MeitY for Product Innovation, Development, and Growth (SAMRIDH) and Meity Startup Hub (MSH)**

The **Startup Accelerator of MeitY for Product Innovation, Development, and Growth (SAMRIDH)** scheme aims to support existing and upcoming Accelerators to select and accelerate potential IT-based startups to scale. Among others, the program focuses on accelerating the startups by providing customer connect, investors connect and connect to international markets. This scheme provides start-ups with a platform to enhance their products and secure investments for scaling their business.

To facilitate MeitY's vision of promoting technology innovation, start-ups, and the creation of Intellectual Properties, a nodal entity called 'MeitY Start-up Hub' (MSH)

has been set up under its aegis. MSH acts as a national coordination, facilitation, and monitoring center to integrate all the incubation centers, start-ups, and innovation-related activities of MeitY. MSH has a mission to build a conducive innovation and start-up ecosystem by bringing together various technology innovation stakeholders and paving the way toward a strong economy built on the twin engines of innovation and technological advancement. It also acts as a hub and ensures synergies among all the incubation centers, Centres of Excellence on Emerging Technologies, and other existing platforms, supported by the Ministry of Electronics and Information Technology for facilitating crisscrossing of technology resources, sharing best practices and ideas across the entire innovation and start-up ecosystem.

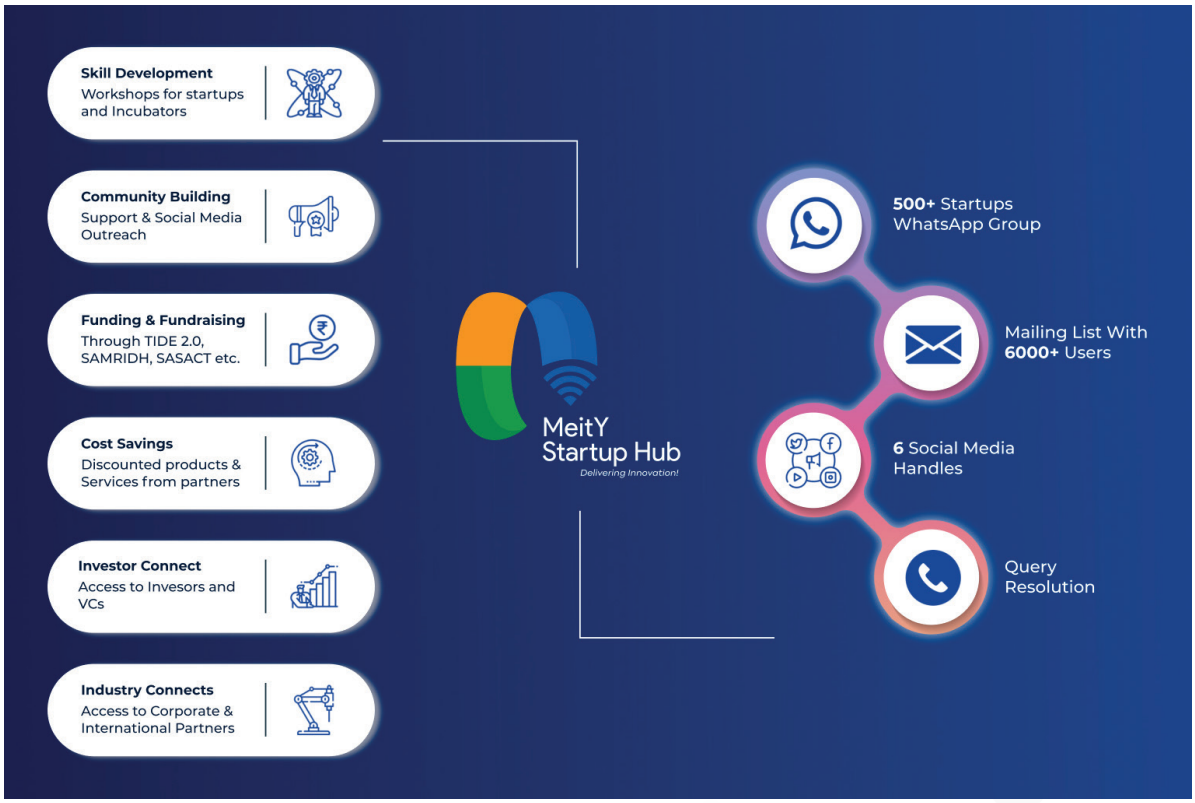

Figure 3.14: Focus areas for activities of the MSH and the services provided by the Hub.
(**Source:** https://msh.meity.gov.in/meityabout)

- **Institutional Support to Startups - GENESIS**

The **Gen-Next Support for Innovative Startups (GENESIS),** was introduced by the Government of India as a strategic initiative aimed at identifying, supporting, nurturing, and accelerating startups, especially in Tier-II and Tier-III cities. This initiative promotes collaborative engagement among startups, government entities, and corporate partners. By emphasizing digitization based on the principles of inclusivity, accessibility, and affordability, GENESIS seeks to enhance regional innovation ecosystems, create job opportunities, and increase economic productivity. The program is structured to scale and sustain the technology startup ecosystem by tapping into the entrepreneurial potential that exists beyond metropolitan areas.

The initiative encompasses a wide array of beneficiaries, including students, educators, aspiring entrepreneurs, startup firms and their employees, academic institutions, incubators, Centers of Excellence (CoEs), accelerators, mentors, investors, and innovation-oriented corporations.

GENESIS facilitates a systematic approach to innovation development through several key interventions:

- Entrepreneur-in-Residence (EiR) Support to assist in validating early-stage startup concepts in smaller cities;
- Pilot Funding Support for startups prepared to test their products after validation;
- Investment Support for startups in need of market capital, aimed at attracting domestic rupee investments into regional ecosystems; and
- Deep-Tech Funding Support for startups focused on creating high-impact, technology-driven solutions.

Overall, GENESIS embodies a comprehensive and inclusive innovation policy framework, empowering Tier-II and Tier-III cities to develop into dynamic centers of entrepreneurship.

(v) **Department of Biotechnology**

The Department of Biotechnology (DBT) in India actively promotes innovation and entrepreneurship within the biotechnology sector through a range of dedicated programs and initiatives. DBT has been at the forefront of driving policy reforms and research initiatives aimed at fostering a bio-based economy that aligns with the nation's environmental and economic goals.

Biotechnology Research Innovation and Entrepreneurship Development (Bio-RIDE): This scheme was approved in the year 2024 and it consolidates previous DBT initiatives into a single framework. The scheme has three broad components: (a) Biotechnology Research and Development (R&D); (b) Industrial & Entrepreneurship Development (I&ED), and (c) Biomanufacturing and Biofoundry. The proposed outlay for the implementation of the unified scheme 'Bio-RIDE' is Rs.9197 crore during the 15 finance Commission period from 2021-22 to 2025-26. Bio-RIDE scheme is designed to foster innovation, promote bio-entrepreneurship, and strengthen India's position as a global leader in biomanufacturing and biotechnology. Bio-RIDE aims to accelerate research, enhance product development, and bridge the gap between academic research and industrial applications. The scheme is part of the Government of India's mission to harness the potential of bio-innovation to tackle national and global challenges such as healthcare, agriculture, environmental sustainability, and clean energy.

BioE3 (Biotechnology for Economy, Environment, and Employment) Policy: The Government of India has introduced several landmark policy reforms in the sector, including approval of the BioE3 Policy in 2025. This policy aims to accelerate innovation-driven research and entrepreneurship in high-performance biomanufacturing.

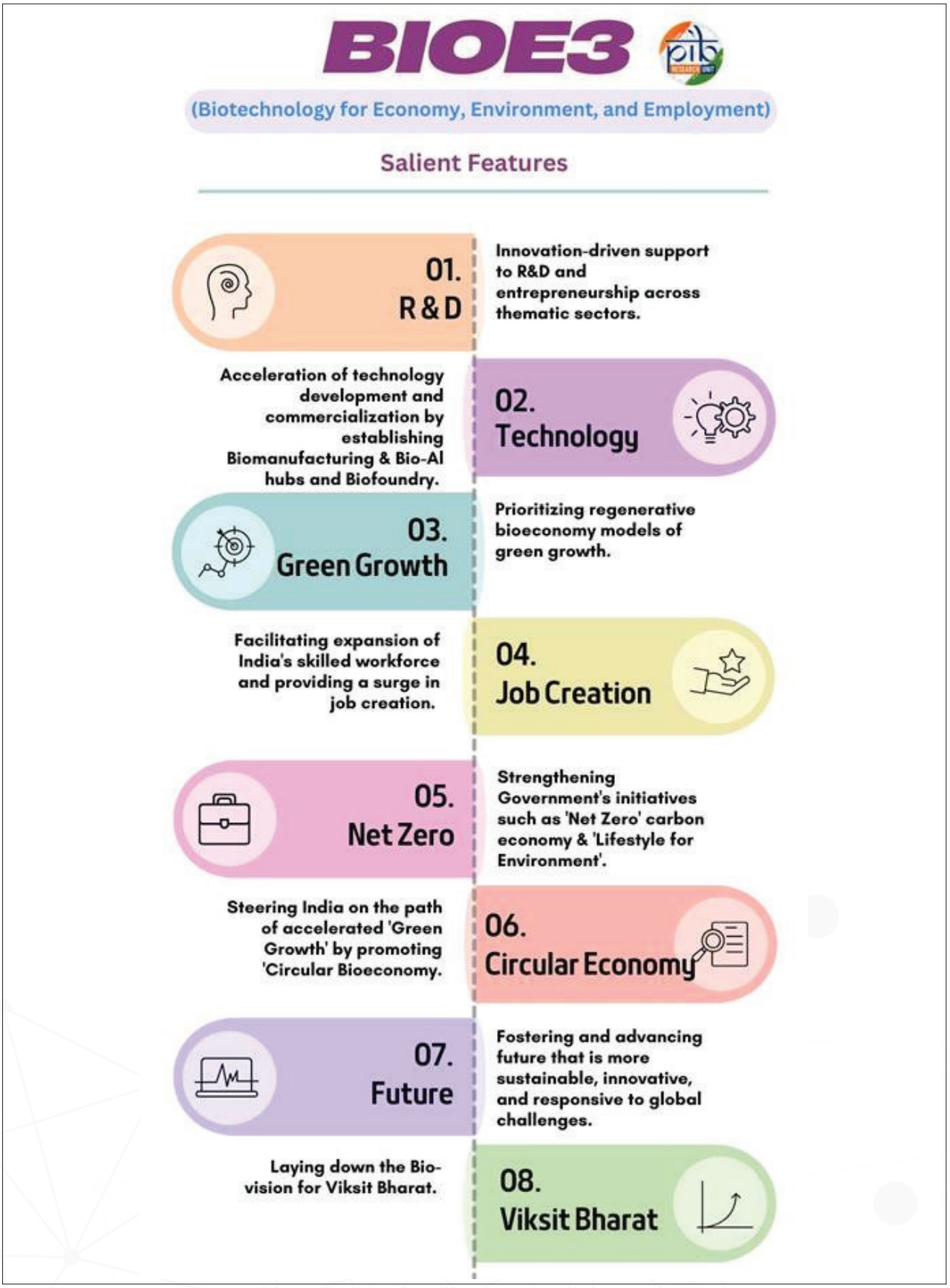

Figure 3.15: BIOE3 Salient Features
(**Source:** https://www.pib.gov.in/PressReleasePage.aspx?PRID=2105774)

DBT has several other programs aimed to promote innovation. Among others, these include Emerging Frontiers in Biotechnology (EFB) Program, and i3c BRIC RCB PhD Program.

The Emerging Frontiers in Biotechnology (EFB) program is designed to promote innovative and high-risk research in emerging areas of biotechnology. It aims to address cutting-edge scientific challenges and create new knowledge and technologies that could have significant societal and economic impacts.

Launched in 2024, **i3c BRIC RCB PhD Program** aims to build a highly skilled workforce with a problem-solving approach to address societal needs. The programme will foster greater academic and research interaction among the institutions of the DBT BRIC (iBRICs), RCB and ICGEB, and will increase the professional networking opportunities for the Ph.D. scholars.

In addition to the programs as above, DBT also runs a not-for-profit Section 8, Schedule B, Public Sector Enterprise, named **Biotechnology Industry Research Assistance Council (BIRAC)**, which recognizes and invests in innovative ideas in the biotech sector. More details about it are presented later in this chapter.

Box 3.2

DBT - ICMR & Covid 19: The DBT's pivotal role in developing and deploying COVID-19 vaccines stands as a symbol of India's innovation excellence, driven by scientific rigor, strategic funding, and robust partnerships. India became one of the largest global producers and suppliers of COVID-19 vaccines- Covaxin. Covaxin, India's first indigenous COVID-19 vaccine developed by Bharat Biotech in collaboration with ICMR and NIV Pune, is a landmark in public health innovation enabled by a robust multi-institutional network. Its development involved over 22 hospitals and medical institutions nationwide, including AIIMS Delhi and Patna, PGI Rohtak, SRM Hospital Chennai, and Sola Civil Hospital Ahmedabad, which conducted phased clinical trials on more than 25,000 participants. Central laboratories such as Dr. Dang's Lab and NIV ensured safety and efficacy testing, while ICMR provided significant funding and trial coordination support. This collaborative ecosystem—spanning research institutions, hospitals, regulatory bodies, and laboratories—demonstrated India's ability to rapidly translate scientific research into large-scale, life-saving solutions during a global health crisis. It not only reinforced the country's ability to respond to health crises but also laid the foundation for a more resilient, agile, and innovation-driven biotechnology ecosystem in the future.

(vi) Department of Scientific and Industrial Research

The Department of Scientific and Industrial Research (DSIR) had launched the **PRISM (Promoting Innovations in Individuals, Start-ups and MSMEs)** scheme for execution during the 2012-2017 period. It aims to support individual innovators, institutions or organizations set up as Autonomous Organization under a specific statute or as a society registered under the Societies Registration Act, 1860 or Indian Trusts Act, 1882.

This scheme is believed to be a successor of the Technopreneur Promotion Programme (TePP).

PRISM is a Unique and valuable scheme which has strived to democratize innovation as a process by extending support to individuals regardless of formal educational qualifications and credentials as well as Start-ups in the early stages of their development process which could promote the innovation supply chain for Micro, Small and Medium Enterprises. The principle of democratization as an objective is laudable and merits special mention.

The **CSIR-New Millennium Indian Technology Leadership Initiative (NMITLI)** is designed to drive innovation-led scientific and technological advancements, enabling Indian industry to achieve global leadership in select niche areas. Unlike conventional industry–institute partnerships, NMITLI emphasizes developing globally competitive technologies in emerging and less-explored markets through innovative funding mechanisms, including an inverse risk-investment strategy (low investment–high risk with high leadership potential). Notable outcomes include cost-effective dental implants with hydroxyapatite and bioglass coatings developed by IIT-Delhi and commercialized widely, the novel TB molecule SUDOTERB that may reduce treatment duration from 6–8 months to 2–3 months, and Bio-Suite, a portable bioanalysis software developed through a consortium of leading research institutions, academia, and industry.

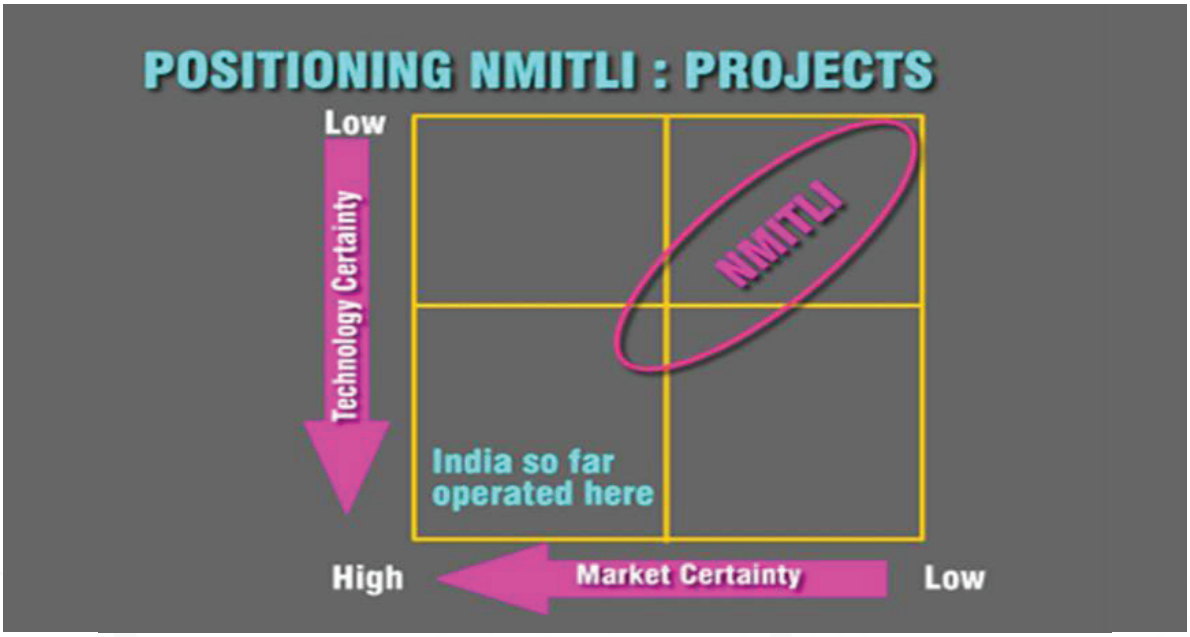

Figure 3.16: Technology and Market Positioning of NMITLI sponsored Projects
(**Source:** https://www.csir.res.in/en/about-nmitli/positioning-nmitli)

National Research Development Council (NRDC) acts as a "one-stop shop" for innovative technologies across various sectors, fostering entrepreneurship and implementing programs for inventors and commercialization. It promotes and commercializes technologies developed in Indian R&D institutions, universities, and industry to transform them into marketable industrial products. Its objective is to bridge the gap between laboratory innovations and industrial application, helping to create marketable products and promote industrial growth in India.

In the fulfilment of its objectives NRDC provides comprehensive technology transfer services, helps commercialize technologies, patents, and supports the startup ecosystem by nurturing, mentoring, and providing handholding to entrepreneurs. To date, as per its website, NRDC has facilitated 5100 technology transfer agreements and has a vast repository of technologies, covering diverse fields. Further, it has also exported technologies and technical services to both developed as well as the developing countries.

(vii) **Ministry of Agriculture**

Agriculture is an indispensable sector which is crucial for the long-term sustainability of any economy. India has a rich tradition of agricultural innovations contributing to economic growth. The Green Revolution introduced crop varieties which ensured food security. Today, climate change and rising population present a different challenge which requires innovative solutions to agriculture and forestry. The Ministry of Agriculture has taken a number of steps to promote and support innovative practices and products in the agriculture domain. One of the most notable mentions here is Agrinnovate.

Agrinnovate India Limited (AgIn): The Department of Agriculture Research & Education (DARE) operates a for profit organisation, Agrinnovate India Limited, which acts as an interface between stakeholders in the agriculture sector (farmers, firms, R&D organisations, Educational institutions etc.) and the Indian Council of Agricultural Research (ICAR). Its purpose is to secure, sustain and promote global agricultural development.

Box 3.3: Overview of Some Agricultural Missions

A broad spectrum of enabling policies and schemes are driving agri-startup innovation across India include Agriculture Infrastructure Fund (AIF), Agricultural Marketing Infrastructure (AMI), e-NAM (National Agriculture Market), PMFME (One District One Product), PMEGP, SFURTI – Cluster-Based Support, Stand Up India Scheme, Credit Guarantee (CGTMSE), Startup India Seed Fund Scheme (SISFS), Digital Agriculture Mission (DAM) – AI, IoT, Blockchain & AgriStack for more innovative rural ecosystems. Several aspects of startup documentation, farmer-centric digital identity, and how entrepreneurs can align with these mission-mode programs to build scalable, inclusive, and sustainable ventures. Besides these financial support is also extended for capacity building through NABARD for rural development, agricultural advancement, infrastructure development, digital and financial literacy etc.

(viii) **Ministry of Development of North Eastern Region (MDoNER)**

MDoNER has implemented several schemes to foster innovation and development in Northeast India. The **North East Science & Technology (NEST) Cluster** was launched with the objective of identifying and addressing the specific challenges of the North Eastern Region (NER) of India through targeted technological interventions, aiming at the region's holistic development. The NEST Cluster is

modelled after the Science and Technology Clusters established under the Office of the Principal Scientific Advisor to the Government of India.

The initiative focuses on four key verticals:

- an Innovation Hub for Grassroots Technologies,
- a Technology Hub dedicated to Artificial Intelligence and Semiconductor development,
- a Centre of Excellence (CoE) for Innovation in Bamboo-based Technologies, entrepreneurial.
- The Science & Technological Intervention for North East India (STINER) is an ambitious initiative designed by the Ministry of Development of North Eastern Region. (MDoNER), Government of India, to enhance the livelihoods of farmers and artisans in the North Eastern Region (NER) through the application of proven scientific and technological solutions.

(ix) **Ministry of Corporate Affairs (MCA)**

Various initiatives have been taken by the MCA for facilitating compliance and easier operations. Among them is the **Self-certification** which allows a DPIIT-recognized startup to self-certify compliance with six labour laws and three environmental laws—without inspections for 5 years unless a credible complaint is filed. It has aligned the definition of "startup" in the Insolvency and Bankruptcy Code 2016. This grants startups more clarity and easing insolvency proceedings. by providing a quicker, less expensive, and more efficient way to close or restructure a business when it can no longer meet its debt obligations. **Fast-track exit (FTE)** provisions are available for DPIIT-recognized startups, allowing them to wind up operations within 90 days, compared to the standard 180-day process applicable to other companies.

(x) **Ministry of Defence**

The Defence Research and Development Organisation (DRDO) has significantly strengthened India's defence innovation landscape by advancing indigenous research, fostering strategic partnerships, and accelerating technology development under the Ministry of Defence. Through initiatives such as the Technology Development Fund (TDF) and Innovations for Defence Excellence (iDEX), DRDO has enhanced collaboration with startups, MSMEs, and academia, promoting rapid prototyping and dual-use technologies. Its contributions in areas like advanced missile systems, electronic warfare, and unmanned platforms have not only reduced import dependency but also stimulated a domestic innovation ecosystem aligned with the Make in India and Atmanirbhar Bharat missions, driving self-reliance and competitiveness in critical defence technologies.

iDEX (Innovation for Defence Excellence) is a key initiative launched by the Ministry of Defence and implemented through the Defence Innovation Organisation (DIO). It is a Section 8 company jointly established by the Defence Public Sector

Undertakings Hindustan Aeronautics Limited (HAL) and Bharat Electronics Limited (BEL). The primary objective of iDEX is to promote indigenous innovation in defence and aerospace, support and incubate startups and MSMEs with the aim to enhance self-reliance in these areas, develop defence grade technologies and dual use products. It reaches out to academia, industry, and innovators by organising the Defence India Startup Challenge (DISC) a periodic open competition to solve specific challenges and explore new opportunities for strengthening Indian Defence. These challenges cover a wide range of domains such as night vision systems, Unmanned Aerial Vehicles (UAVs), Jamming devices, etc. The iDEX DISC programme has built a strong support system for handholding the winners of DISC competition through iDEX "SPARK" (Support for Prototype and Research Kickstart) grants. Winners are eligible for support of up to ₹1.5 crore per project as milestone-based grants for prototype development of solutions proposed through DISC.

(xi) **Department of Space (DoS)**

DOS is responsible for the implementation of the Indian space programme through its primary agency, Indian Space Research Organisation (ISRO). DoS also governs and coordinates institutions like IN-SPACE, Antrix Corporation, and New Space India Ltd. (NSIL) for commercialization and private sector integration. ISRO has created an institutional mechanism through its Capacity Building and Public Outreach (CBPO) centre to promote joint collaborative research and create entrepreneurial capacity in space research and innovation across the country. These engagements are facilitated through the following programmes: R&D Projects (RESPOND Basket); Space Technology Cells (STCs); Regional Academic Centres for Space (RAC-S); and Space Technology Incubation Centres (S-TICs). For submitting proposals under these programmes, CBPO has established an online portal I-GRASP (ISRO Grant in Aid for Space Research Programmes).

STCs are research hubs established at premier academic institutes—including IITs (Bombay, Kanpur, Kharagpur, Madras, Roorkee, Delhi, Guwahati) and IISc Bangalore—to foster collaborative R&D in space science, technology, and applications. **S-TICs** are regionally distributed incubators; aims to incubate startups by turning academic ideas into space-grade prototypes for future missions. S-TICs support students (final-year, postgrad, and research scholars) in developing proof-of-concepts and prototypes linked to real ISRO missions, in partnership with local industry. S-TICs have designated lead institutions across different regions of India: NIT Agartala for the East, NIT Jalandhar for the North, NIT Tiruchirappalli for the South, Maulana Azad National Institute of Technology (MANIT), Bhopal for the Central region, and Visvesvaraya National Institute of Technology (VNIT), Nagpur for the West. Additionally, NIT Rourkela serves as an additional lead institution for the Eastern region. Through these partnerships, ISRO is strengthening its capability and also developing the space research and entrepreneurship ecosystem in the country.

(xii) **Ministry of Micro, Small & Medium Scale Enterprises**

To foster technological advancement, entrepreneurship, and competitiveness among MSMEs and to support startups, promote R&D, and enhance industry-academia collaboration in small-scale industries, the Ministry of Micro, Small & Medium Enterprises (MSME), Government of India, has launched several innovation initiatives.

One of the key programs is the MSME Innovative Scheme, which integrates incubation, design, and intellectual property rights (IPR) support. Under this scheme, startups and MSMEs receive financial assistance, mentorship, and infrastructure support to develop innovative products and solutions. The Incubation component provides funding to commercialize new ideas and prototypes, while the Design scheme helps MSMEs improve their product design and market appeal. Additionally, the IPR scheme assists MSMEs in patent filing and protecting their innovations.

The government has also established Technology Centres and Business Incubators to provide technical expertise, training, and R&D facilities to MSMEs. Programs like Cluster Development Scheme and Zero Defect Zero Effect (ZED) Certification further promote innovation by encouraging sustainable and quality-driven production. By supporting cutting-edge technology adoption, skill development, and market-driven innovations, MSME innovation initiatives play a crucial role in strengthening India's entrepreneurial ecosystem and boosting global competitiveness.

(xiii) **Ministry of Culture**

The National Council of Science Museums (NCSM), an autonomous body under the Ministry of Culture, Government of India, has developed **Innovation Hubs** across the country to foster scientific creativity, problem-solving skills, and hands-on learning among students, young innovators, and researchers. These hubs serve as dynamic platforms for experimentation, tinkering, and idea incubation, encouraging innovation in science and technology. Each Innovation Hub is equipped with state-of-the-art laboratories, DIY kits, advanced tools, and interactive exhibits to provide a collaborative environment for budding innovators. These centres focus on STEM (Science, Technology, Engineering, and Mathematics) education, enabling participants to work on real-world challenges and develop practical solutions. The hubs also promote industry-academia linkages, mentorship programs, and entrepreneurship development. These hubs are strategically located in science centers and museums across India, ensuring widespread accessibility. Some key activities conducted at these hubs include innovation challenges, workshops, competitions, hackathons, and hands-on training programs. By nurturing a culture of curiosity and scientific exploration, the NCSM's Innovation Hubs play a crucial role in building India's future innovators and fostering a knowledge-driven economy.

Image 3.2: Hon'ble President of India, Ms. D. Murmu interacting with an artisan at an expo
(**Source:** https://www.mid-day.com/news/india-news/photo/in-photos-president-droupadi-murmu-interacts-with-local-artisans-in-indore-102247/3)

The **National Council of Science Museums (NCSM)**, also operates a network of science museums and science cities across India. In fact, NCSM is the largest network of science centers and museums in the world under a single administrative umbrella. NCSM has developed its own nationwide network of 26 science museums and centres. Among 26 centres, divided into North, South, East, North East and West Zones, there are 7 National Level Centres namely Science City, Kolkata, Birla Industrial and Technological Museum (BITM), Kolkata, Nehru Science Centre (NSC), Mumbai, Visvesvaraya Industrial and Technological Museum (VITM), Bengaluru, National Science Centre (NSC), Delhi, National Science Centre, Guwahati, and Central Research and Training Laboratory, Kolkata. Except for Science City, Kolkata, other national-level centres have regional and sub-regional/district-level science centres under their control and are called Satellite Units (SUs). NCSM has also established centers in collaboration with state governments and union territories.

Image 3.3: Display at the National Science Centre, Delhi

Image 3.4: View of the Science City, Kolkata

(xiv) **Initiatives of Office of the Principal Scientific Adviser**

National Mission for Accelerating Growth of New India's Innovations (AGNII) has been launched by the Office of the Principal Scientific Adviser (PSA), to support the national efforts to boost the innovation ecosystem in the country by connecting innovators across industry, individuals and the grassroots to the market and help commercialize innovative solutions. AGNII will provide a platform for innovators to bring their technology ready products and solutions to industry and the market, thereby helping propel techno-entrepreneurship which can usher a new era of inclusive socio-economic growth. The mission includes services across the techno-commercialisation chain required to support and upscale market-ready indigenous innovations. The initiative includes working with government R&D laboratories and academia to help commercialize their innovations; collaborate and value add to existing innovation programs; training and capacity building of scientists, innovators, technology transfer offices and technology license offices. Linking specific needs of industry to research laboratories to enable development of cost-effective marketable solutions is another focus of the AGNII program.

Complementing these are the PSA's **Science & Technology (S&T) Clusters**—eight operational clusters in cities such as Bengaluru, Hyderabad, and Pune that bring together over 150 partners from industry, academia, and government, and have facilitated the commercialization of more than 250 technologies. Together, these

intermediary bodies provide the infrastructure, mentorship, and market linkages essential for translating research into scalable innovations, strengthening India's position in the global innovation landscape.

The **Rural Technology Action Group (ruTAG)**, which is another project by the PSA and operates in seven IITs—Madras, Guwahati, Kharagpur, Roorkee, Delhi, Mumbai, and Kanpur has become a key way to turn scientific research into solutions for rural areas. Since it started in 2004, ruTAG has created over 50 technologies based on what people need, tackling various rural issues, from farming and water management to handicrafts and health. Some of the innovations include vending carts, mango decorticators, motorized looms, and portable cow lifts. In its first phase, 34 technologies were chosen for a nationwide rollout after a thorough review led by the PSA. In 2025, the introduction of the RuTAGe Smart Village Centers (RSVCs) represented the next step forward, with the first RSVC opened in Mandaura village, Sonipat. These centers provide specific technologies like IoT-based fertigation systems, solar solutions, assistive tools, and market-access platforms to groups of 15–20 villages, with the goal of turning them into innovation-driven economic centers. Through this diverse strategy, ruTAG plays an active role in India's innovation ecosystem by speeding up grassroots innovation, facilitating the transition from lab to field, and encouraging inclusive, sustainable growth in rural communities.

The **Manthan platform** is a nationwide effort aimed at encouraging extensive collaboration between the industry and the research community, ensuring that innovation aligns with India's national goals and the UN Sustainable Development Goals (SDGs). It acts as a lively interface where demand-side players like industries, philanthropic groups, government departments, and foreign embassies can share opportunities, challenges, and problem statements. Meanwhile, supply-side participants such as academic and research institutions, startups, student innovators, and grassroots entrepreneurs can offer their proposals and solutions. Built on four main pillars—creating opportunities, submitting proposals, showcasing innovations, and providing virtual collaboration tools, Manthan supports early-stage innovation calls, market-ready projects, Centres of Excellence (CoEs), fellowships, and engaging events like webinars and conferences. By offering a structured approach to challenge-driven innovation, resource mobilization, and stakeholder involvement, the platform enhances India's innovation ecosystem, encourages technology use in new sectors, and backs large-scale social impact initiatives.

(xv) **Ministry of Housing and Urban Affairs (MoHUA)**

The Smart City Mission was launched by the Ministry of Housing and Urban Affairs (MoHUA) in 2015. It is embedding technology led innovation within urban governance aimed at making cities more efficient, sustainable, and citizen-centric. It is a demonstration of deployment of innovation, digital technologies, IoT, and integrated systems to transform service delivery and citizen ease of living. Under this mission the key action points are building an intelligent transport system,

ICT enabled infrastructure, smart grids, smart lighting and other new initiatives for waste management, etc. The mission is creating an enabling governance mechanism and partnerships leading to synergy across inter-ministerial, state, city and urban bodies within that.

The mission has established a strong and novel institutional monitoring model. Real-time digital monitoring dashboards, and independent evaluation mechanisms have been established (https://smartcities.gov.in). A Special Purpose Vehicle (SPVs) has been created for each Smart City which has a company structure with CEO, nominees from state/ULB, and private sector participation). This body is responsible for planning, appraising, approving, releasing funds, and monitoring progress of projects. It has also created two outcome-based evaluation benchmarks namely India Smart Cities Awards and Ease of Living Index.

3.1.3 Intermediary Bodies

In addition to direct support in form of various initiatives and programs, several departments of Govt of India have also created different intermediary bodies with focused mandates and roles. The support provided by some of the major intermediary bodies is listed below.

(i) Technology Development Board

The Technology Development Board (TDB) is a statutory body constituted by the Government of India under the Technology Development Board Act, 1995 to promote development and commercialization of indigenous technology and adaptation of imported technology for wider application. The TDB is the first organization of its kind within the government framework with the sole objective of commercializing the fruit of indigenous research. The Board plays a pro-active role by encouraging enterprises to take up technology-oriented products (https://tdb.gov.in/).

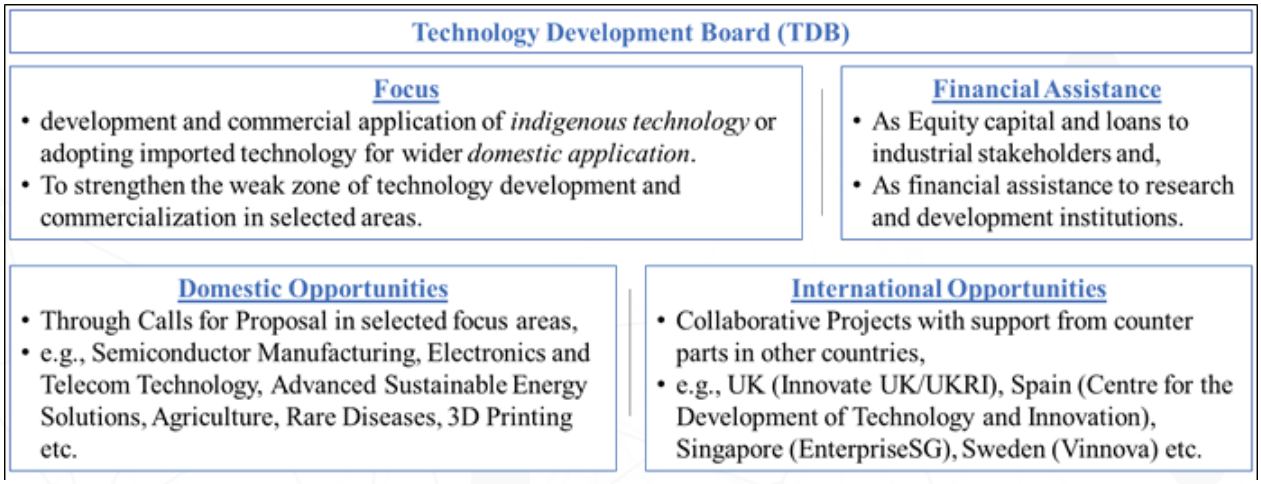

Figure 3.17: Salient Features of TDB for supporting indigenous MSMEs (https://tdb.gov.in/)

The TDB provides financial assistance to Indian industrial concerns and other agencies, attempting development and commercial application of indigenous

technology, or adapting imported technology to wider domestic applications. The key objectives of TDB are: (a) promote new ideas from small enterprises even at the risk of failures, (b) encourage production of competitive consumer products, (c) motivate industries and R&D institutions for product innovation, (d) develop socially relevant and profitable technologies, (e) identify and act in areas requiring strategic interventions, and (f) Invest in core Technological Strengths to Enable India Industry to Stand-up to the competitive pressure and become a global player. In its quest to achieve these objectives, the board facilitates interaction between industry, scientists, technocrats and specialists, creation of new generation of entrepreneurs, and fostering partnerships with other, similar technology financing bodies.

In its financial assistance in the form of Loan, Equity and Grants, the Board does not levy any processing, administrative or commitment charges from the applicant. The financial assistance to the industrial concerns is provided as a soft loan at 5% simple interest per annum. The loan amount is disbursed in tranches based on pre decided technical and financial milestones. A one year moratorium is also provided to the company on completion of the project. TDB may also contribute by way of equity capital in an industrial concern on its commencement start-up and/or growth stages. It is up to 25 % of the approved project cost, provided such investment does not exceed the capital paid up by the promoters. TDB also provides financial assistance by way of grants to industrial concerns and R&D institutions engaged in developing indigenous technologies. The sanction of grants is provided in exceptional cases having importance towards fulfilling national interest.

Connecting academic research (universities, public labs) with industry needs, enabling translation of scientific discoveries into market-ready innovation.

(ii) **Biotechnology Industry Research Assistance Council (BIRAC)**

BIRAC, a not-for-profit public sector enterprise set up by DBT, functions as an intermediary organisation enabling the lab to market journeys especially in the biotechnology sector. It promotes funding, incubation, regulatory facilitation, support to startups and SMEs in biotech, creating linkages between academia, industry and government, proof of concept and prototyping among others resulting in the successful commercialization of homegrown vaccines, diagnostics, therapeutics etc. Its primary objective is to strengthen and empower emerging biotech enterprises, particularly startups and SMEs, to undertake strategic research and innovation aimed at developing affordable products that address critical national needs. Its thematic focus encompasses fostering innovation and entrepreneurship, promoting affordable solutions in key social sectors, empowering startups and SMEs, enhancing innovation capabilities, facilitating the commercialization of discoveries, and ensuring the global competitiveness of Indian biotech enterprises.

BIRAC offers multifaceted support, including institutional support through the establishment of regional centers like **BRIC**, **BREC**, **BRBC**, and **BRTC** to provide localized resources. It also provides infrastructure support by setting up incubation centers, shared facilities, and research infrastructure to aid startups and researchers in their innovation processes. BIRAC's schemes and programs strategically target different Technology Readiness Levels (TRLs). For instance, the Biotechnology Ignition Grant (BIG) supports early-stage innovations, while the Small Business Innovation Research Initiative (SBIRI) laid the foundation for public-private collaboration in early-stage R&D by empowering SMEs to undertake high-risk research and develop market-ready products in areas like healthcare, agriculture, and environmental sustainability. The **Biotechnology Industry Partnership Programme** (BIPP) focuses on more advanced stages of product development and commercialization.

In 2017, the **Bioincubators Nurturing Entrepreneurship for Scaling Technologies (BioNEST)** programme was established, to provide infrastructure, mentorship, and incubation support to startups and entrepreneurs. It aims to promote entrepreneurship by supporting the creation of bio-incubation centers across academic and research institutions, enabling startups to translate scientific research into scalable products. With over 95 bio-incubation centers across India, BioNEST has facilitated more than 1,300 IP filings and enabled over 800 products to reach the market. BioNEST provides critical infrastructure, mentorship, networking, and access to funding and regulatory guidance for biotech startups. These incubators focus on sectors like healthcare, agriculture, industrial biotechnology, and environmental solutions. With over 75 BioNEST centers established across India, the initiative plays a pivotal role in strengthening translational research, supporting early-stage innovators, and driving bio-based economic development in the country.

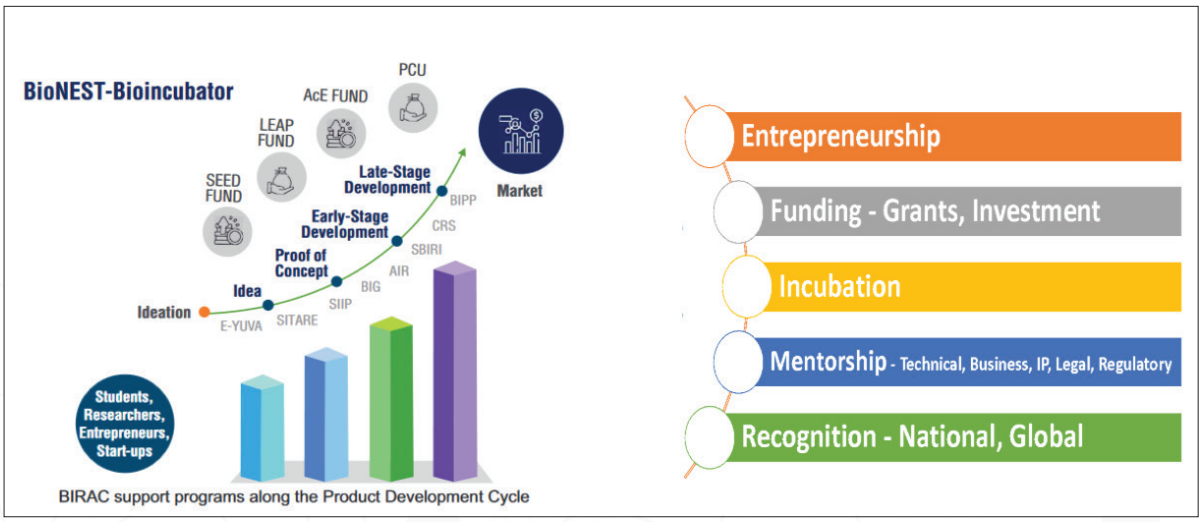

Figure 3.18: Core objectives and strategies of BIRAC's BioNEST
(**Source:** https://birac.nic.in/webcontent/BIRAC_Annual_Report_2020_21_English.pdf)

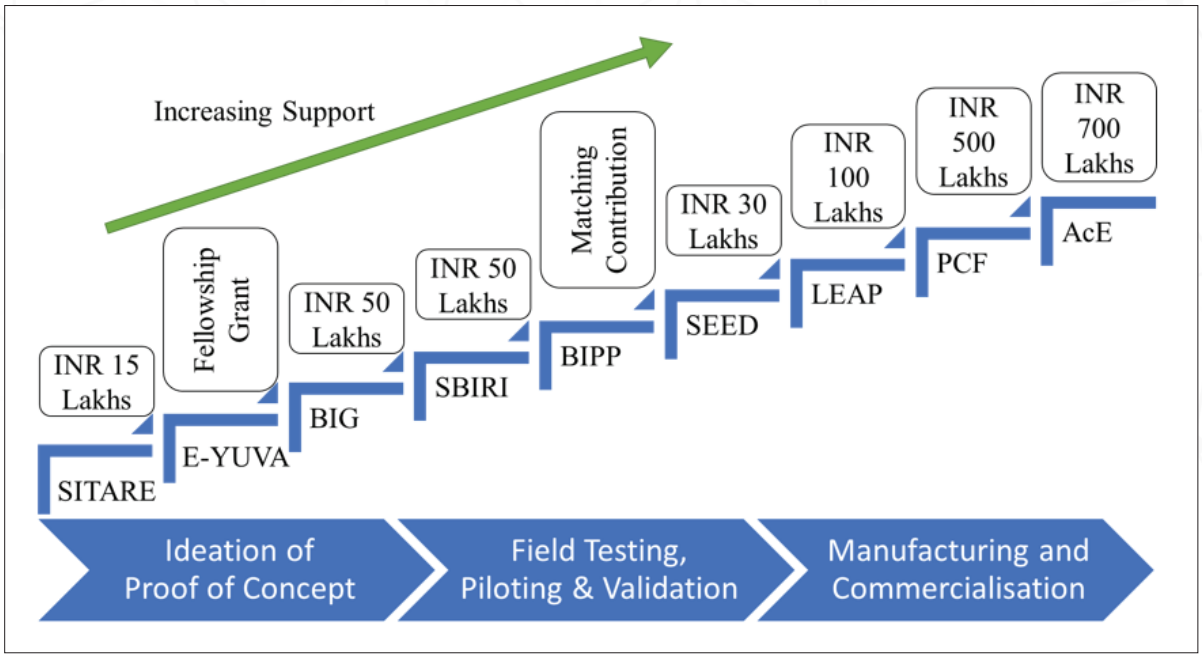

Figure 3.19: Existing catalytic funding across innovation value chain

BIRAC collaborates with international organizations like the Bill & Melinda Gates Foundation, Wellcome Trust, and UK Trade & Investment. These partnerships facilitate joint funding, knowledge exchange, and capacity-building initiative. Various schemes and initiatives are showing a highly positive lab to market translation in this sector. For example, the National Biopharma Mission has provided a pathway for development of institutions that has helped to create a culture, risk and enabling support at the various stages of the lab to market journeys of startups. The emergence of over 3,000 biotech startups is a good example of this.

(iii) **National Innovation Foundation (NIF): Supporting Grassroots and Societal Innovations**

It was founded in 2000 by the Department of Science and Technology, Govt. of India to provide support for grassroots innovations developed by individuals and local communities in any technological field. It specifically focuses on the innovations which emerge without any support from the formal sector (https://www.nif.org.in/). NIF helps grassroots innovators and outstanding traditional knowledge holders get due recognition, respect and reward for their innovations. It also tries to ensure that such innovations diffuse widely through commercial and/or non-commercial channels, generating material or non-material incentives for them and others involved in the value chain.

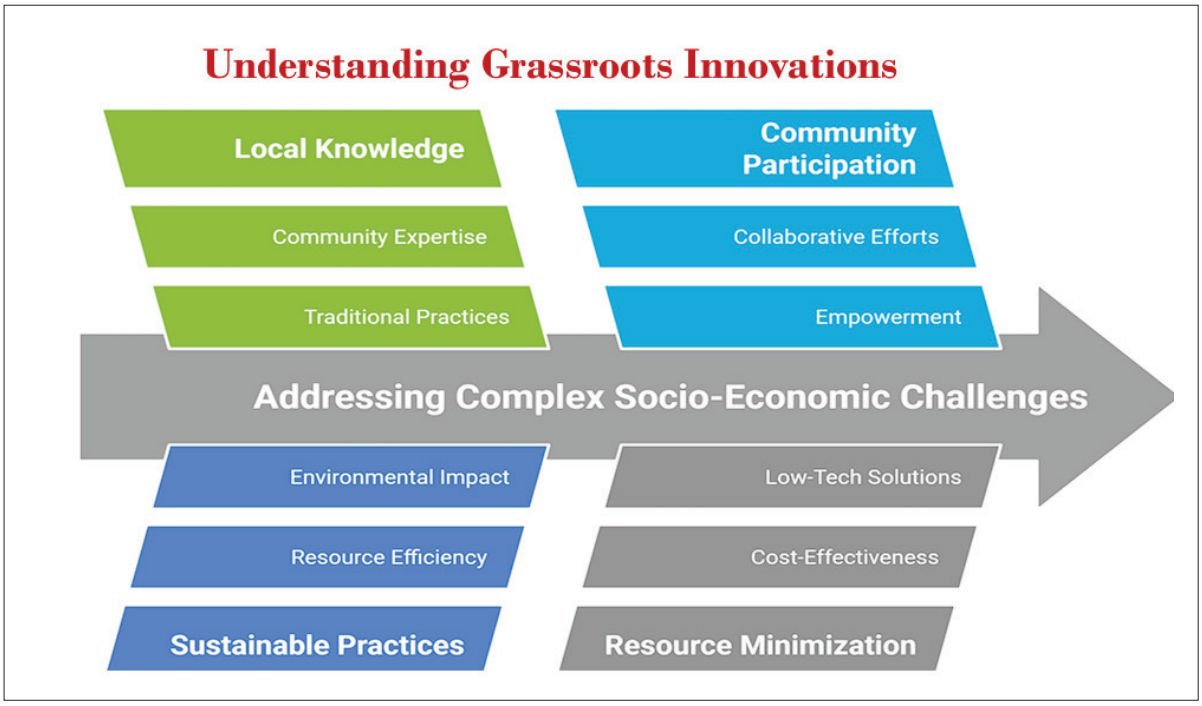

Figure 3.20: Major focus areas of NIF activities
(**Source**: NITI Workshop on Building Synergies in India Innovation Ecosystem, 2025, Presentation by Director, NIF)

NIF has pooled a database of over 225,000 technological ideas, innovations and traditional knowledge practices (not all unique, not all distinct) from over 585 districts of the country. NIF has till date recognised 816 grassroots innovators and school students at the national level in its various National Biennial Grassroots Innovation Award Functions and annual Dr A P J Abdul Kalam Ignite Children Award functions. NIF has also set up an augmented Fabrication Laboratory (Fab Lab) with the help of Massachusetts Institute of Technology (MIT), Boston, for product development and strengthening in-house research.

NIF is a good example of a Quadruple Helix - with participation of community and formal institutions for promoting societal and grassroots innovation.

NIF is also working towards revamping The INSPIRE - MANAK (Million Minds Augmenting National Aspiration and Knowledge) program in association with the Department of Science & Technology to align it with the action plan for "Start-up India" initiative launched by the Hon'ble Prime Minister of India.

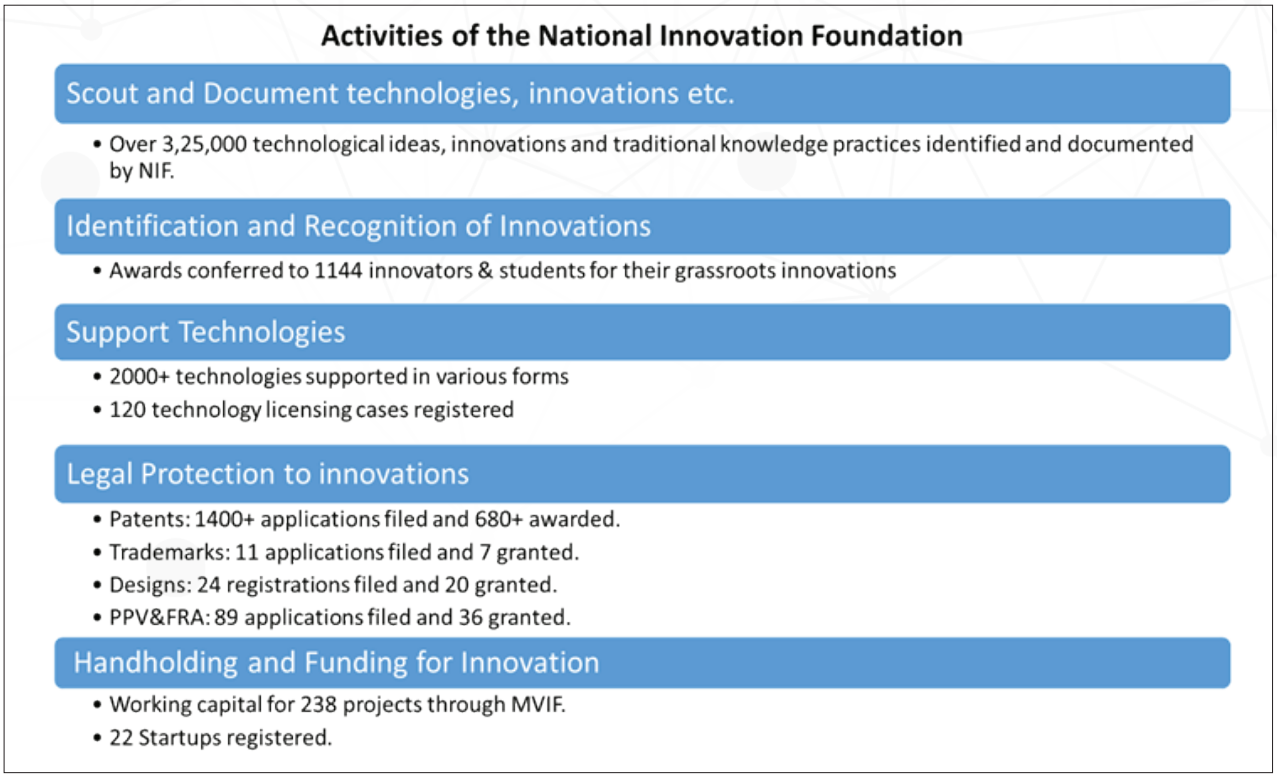

Figure 3.21: An indicative account of NIF activities and achievements
(**Source**: Compiled with information from the NIF Website)

3.1.4 Support for S&T Activities at Academic and Research Institutions

(i) **Innovation in Science Pursuit for Inspired Research (INSPIRE) program:** This program was conceptualized in 2008 to communicate to the youth of the country the excitements of creative pursuit of science, attract talent to the study of science at an early age and thus build the required critical human resource pool for strengthening and expanding the Science & Technology system and R & D base. INSPIRE has three components along with INSPIRE-MANAK:

- *Scheme for Early Attraction of Talent (SEATS)* to attract talented youth to study science by providing INSPIRE Award, and by arranging summer camps for students on an annual basis through INSPIRE Internship.
- *Scholarship for Higher Education (SHE)* to enhance rates of attachment of talented youth to undertake higher education in science intensive programmes, by providing scholarships and mentorship.
- *Assured Opportunity for Research Careers (AORC)* to attract, attach, retain and nourish talented young scientific Human Resource for strengthening the R&D foundation and base. It has two sub-components, first component i.e., INSPIRE Fellowship (age group of 22-27 years), for carrying out doctoral degree and the second component i.e., INSPIRE Faculty Scheme, for assured opportunity for post- doctoral researchers in the age group of 27-32 years.

The **INSPIRE - MANAK** (Million Minds Augmenting National Aspirations and Knowledge), is being executed by DST with National Innovation Foundation – India

(NIF), to motivate students in the age group of 10-15 years, studying in classes 6 to 10. To target one million original ideas/innovations rooted in science and societal applications to foster a culture of creativity and innovative thinking among school children. The considered top 60 ideas/innovations are supported by NIF for product/process development and their linkage with other schemes of NIF/DST and their display at the Annual Festival of Innovation & Entrepreneurship (FINE).

(ii) **IMPacting Research INnovation and Technology (IMPRINT):** Launched in November 2015, IMPRINT addresses engineering challenges across ten strategic domains including healthcare, energy, and manufacturing. Coordinated initially by IISc and 16 IITs with support from 25 government ministries. IMPRINT served dual functions namely, (a) developing engineering education policy and (b) creating roadmaps for addressing critical challenges. Consequently, the revised IMPRINT-II has expanded the program's scope to include Centrally Funded Technical Institutions, merging with the UAY scheme through a 50:50 funding model between the Ministry of Education and Department of Science and Technology.

(iii) **India Innovation Growth Programme (IIGP) 2.0:** The India Innovation Growth Programme (IIGP) 2.0, launched in 2018 by the Department of Science & Technology (DST) in collaboration with Lockheed Martin and Tata Trusts, serves as a strategic initiative to strengthen India's innovation pipeline across the stages of ideation, innovation, and acceleration. Building upon the foundation of the original IIGP (initiated in 2007), the programme provides comprehensive support for science and technology (S&T)-driven activities in academic and research institutions by fostering the development of technology-based solutions for both societal and industrial challenges. The initiative offers funding, mentorship, and incubation support through key implementation partners such as, the Federation of Indian Chambers of Commerce and Industry (FICCI), Indo-US Science and Technology Forum (IUSSTF), Centre for Innovation Incubation and Entrepreneurship (CIIE) at IIM Ahmedabad, IIT Bombay, and the Tata Center for Technology and Design at MIT. By engaging innovators and entrepreneurs nationwide, IIGP 2.0 promotes translational research and entrepreneurship in 13 focus areas under the University Challenge and across 21 categories (11 industrial and 10 social) under the Open Innovation Challenge, thereby reinforcing the innovation ecosystem within academic and research domains.[17]

(iv) **Tech Parks, Incubators, Innovation Hubs/Clusters, CoEs**

In addition to the support structures and dedicated programs described above, a large number of institutional structures have been created during the last several years. These include technology parks, incubation centres, S&T clusters, Centers of Excellence etc.

The **Software Technology Parks of India (STPI)**, under the Ministry of Electronics & IT, has established 67 centres nationwide (59 in Tier-II and Tier-III cities), providing infrastructure, export facilitation, and mentorship that have helped launch thousands of tech startups and generated substantial IT/ITeS exports.

[17] https://hbtu.ac.in/wp-content/uploads/2024/11/aboutIIGP.pdf

The Department of Science & Technology's (DST) flagship incubation programmes (including NIDHI-Technology Business Incubators (TBIs)), has contributed to the development of a network of more than 284 incubators across the country as per the last updated records of DST, among the DST-backed TBIs each unit typically has the capacity to incubate at least 30 ventures at a time, collectively supporting over 2,500 startups.

Leading academic institutions like IIT Madras, IIT Delhi (through FITT), IIT Bombay (via SINE), and IIT Kanpur have set up dedicated **Technology Incubation Centres** that, together, have nurtured more than 1,000 deep-tech startups and attracted upwards of ₹2,000 crore in venture funding to date. These incubation centers are involved in different stages of the translational journey of lab to market and facilitating industry partnerships through enabling government support. The incubation centre models are getting established across different universities creating a new space for institutionalisation of university-industry linkages with enabling government support and involvement. Thus, the transition towards hybrid Triple Helix linkages are taking shape.

Box 3.4: Select Examples of Universities that were Early Movers in Establishing Incubation centers/Cells

IIT Madras Incubation Cell (IITMIC) at IIT-Madras**.** Created India's first university-driven Research Park. Incubated startups in deep technologies as well as in rural and social sectors. Incubated more than 200 startups, filed 1300 patents, has created more than 70 R&D partnerships across 17 sectors

The Society for Innovation and Entrepreneurship (SINE) at IIT Bombay. It has incubated 32 companies so far. A novel feature is an entrepreneurship cell being run by students.

Foundation for Innovation and Technology Transfer (FITT) at IIT Delhi. Formulated 450 Development Projects, provided,1900 Industrial Consultancies, Over 100 Technologies transferred to Industries, 100+ Start-ups Incubated. Developed various programs for promoting entrepreneurship such as Faculty Innovation and Research-driven Entrepreneurship (FIRE), Platform for Harnessing Deep Technologies (PHD) Incubator.

Society for Innovation & Development (SID) at IISc. SID have undertaken R&D projects with various big companies including Unilever, Pratt & Whitney, BHEL, GAIL, Hindustan Petroleum, Infosys, Tata, FMC, Microsoft etc. SID has supported about 200 companies & 550 projects till now and have 10 research centers.

Depiction of the geographical distribution of Hubs in the country.

Source: https://dst.gov.in/25-technology-innovation-hubs-across-country-through-nm-icps-are-boosting-new-and-emerging

To foster a knowledge and Innovation Hub instituted by central ministries, departments, or public-private partnerships aiming to serve as a specialized institutional platform that fosters advanced research, technology development, capacity building, and industry collaboration in focused thematic areas, Centers of Excellence (CoEs) are established for advancing specialized domains within the innovation ecosystem. These dedicated entities concentrate expertise, resources, and infrastructure in strategic areas that align with national priorities and emerging technological frontiers. By creating these specialized hubs, governments and organizations can develop critical mass in targeted fields, foster interdisciplinary collaboration, and accelerate knowledge creation and application. These centers also serve as bridges between academic research and industrial application, facilitating technology transfer and commercialization of innovations. By establishing visible, high-performing institutions in priority sectors, Centers of Excellence enhance national competitiveness, attract international partnerships, and provide leadership in addressing complex societal and technological challenges that require sustained, focused effort and specialized expertise.

Several Centers of Excellence (CoEs) in India have established themselves as

significant contributors to the national innovation ecosystem. While comprehensive performance metrics are limited in the public domain, these centers have demonstrated impact through their research output, industry collaborations, and talent development.

These dedicated entities provide multiple systemic benefits to India's innovation ecosystem, including efficient resource utilization, talent retention, knowledge translation between academia and industry, specialized human resource development, and enhanced national competitiveness in priority sectors. India has established numerous successful CoEs across various domains that have demonstrated significant impact.

- In technology, C-DAC has pioneered indigenous supercomputing capabilities through its PARAM series,
- CEERI has advanced semiconductor research and microelectronics development essential for manufacturing capabilities.
- The CoE-IoT in Bengaluru supports IoT solution development and testing,
- while specialised centers at institutions like IIT Kanpur, IIT Kharagpur, and various regional innovation hubs focus on emerging technologies including flexible electronics, AI, blockchain, and data analytics.
- Industry-academia partnership models such as IIT Madras Research Park have achieved remarkable success, incubating over 200 startups and generating numerous patents.
- Sector-specific CoEs address challenges in automotive research, healthcare technology, and biotechnology, while regional innovation centers ensure geographic diversity in entrepreneurial support.

Despite these accomplishments, evaluating CoE performance remains challenging due to inconsistent metrics, limited public data on impact assessments, variable sustainability models, and gaps in commercialization pathways—issues that must be addressed to maximize these canter's contributions to India's development goals.

There are government funded incubators, corporate and academic-level incubators, few of them listed below:

Public Sector Incubators

1. 70+ Technology Business Incubators (TBIs) at academic institutions
2. 20+ Science and Technology Entrepreneurship Parks (STEPs)
3. 40+ Technology Incubation and Development of Entrepreneurs (TIDE) centers
4. 10+ Bio-incubators under BIRAC
5. 15+ Biotechnology Parks across India

Private and Corporate Incubators

1. T-Hub in Hyderabad (India's largest incubator)
2. Microsoft Accelerator Program
3. Cisco LaunchPad
4. Shell E4 Program (energy startups)
5. Invest India's Startup India Hub

Academic Institution Incubators

1. IIT Bombay's Society for Innovation and Entrepreneurship (SINE)
2. IIM Ahmedabad's Centre for Innovation Incubation and Entrepreneurship (CIIE)
3. IISc Bangalore's Society for Innovation and Development (SID)
4. IIT Delhi's Foundation for Innovation and Technology Transfer (FITT)
5. IIT Madras Research Park

Knowledge Clusters

Knowledge clusters are regionally concentrated ecosystems that bring together multiple stakeholders like government, academia, industry, R&D institutions, and civil society to collectively reflect a hybrid Triple helix linkages emerging in select sectors. They foster collaborative research, policy integration, and resource sharing across a region. Unlike Innovation hubs, these facilitate Macro-level networks spanning multiple sectors and institutions to address regional or national priorities.

One good example is the knowledge linkages in Life science clusters. Figure 3.17 highlights one of the interesting linkages that is bringing different partners together for creating an enabling ecosystem– university-industry and Government. The Bangalore Life Science Cluster (BLiSc) along with the ecosystem of an incubator C-CAMP, receives significant support from BIRAC in terms of setting up regional entrepreneurship centres (BREC). This partnership involves BIRAC providing funding and creating platforms for C-CAMP and the cluster's startups to access resources, mentorship, and grants for developing innovative bioscience technologies.

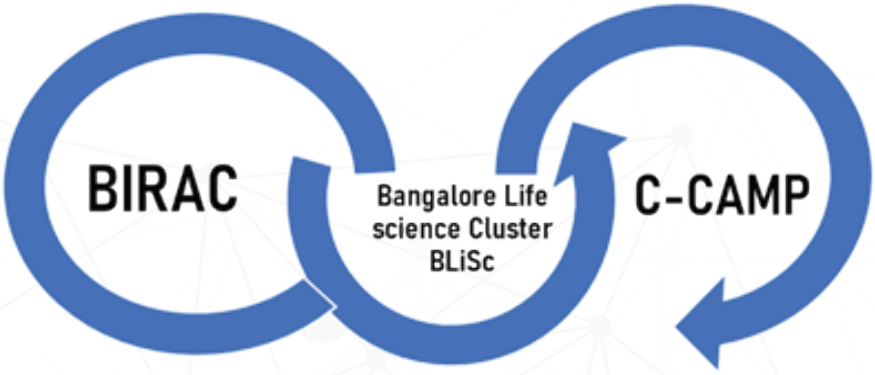

Figure 3.22: Collaboration of BIRAC with BLiSc and C-CAMP

Another good example of an Innovation cluster is Genome Valley, a Life Science cluster in Hyderabad developed through public-private partnership. It has various types of facilities such as wet laboratories, incubation facilities, testing facilities, clinical research management, etc. It has emerged as a hub for the vaccine and bulk drugs. The cluster has over 200 life sciences companies, including MNCs like Novartis, AMRI, Dupont, Aizant, and Daichi. Major vaccine manufacturers like Shanta Sanofi, Bharat Biotech International Limited, Indian Immunologicals Limited, Biological E. Limited, Globion, SAMI labs are in this Valley. It contributes over 65% of the domestic supplies in India and exports across the world and has further consolidated its position with COVID-19 vaccine production. The US pharmacopoeia has also set up a facility in Genome valley, one of the first facilities outside the US. Genome valley is well connected with other knowledge institutions, clusters within the city and outside

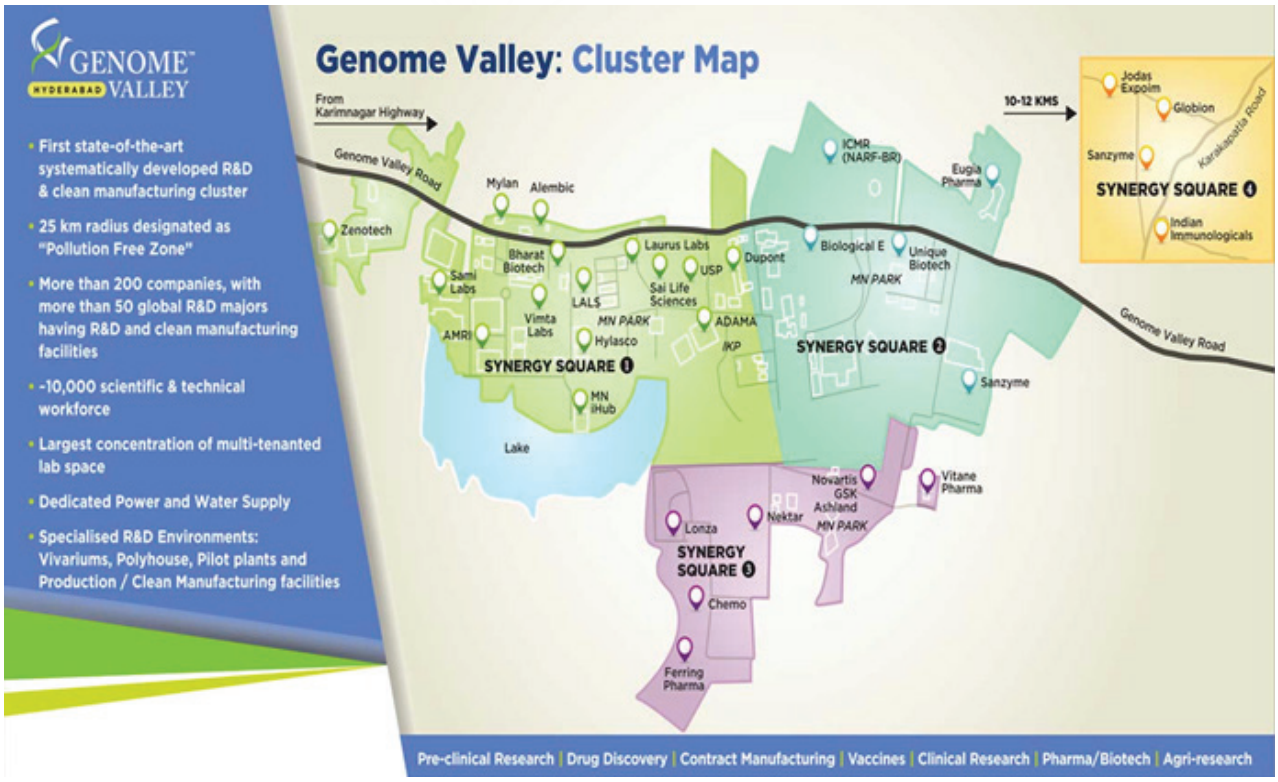

Figure 3.23: Geographical connections with Genome valley.
(**Source:** https://koncepo.com/news-detail/the-emerging-story-of-genome-valley-cluster)

There are eight operational clusters till date listed below in a map view along with their primary thematic domains:

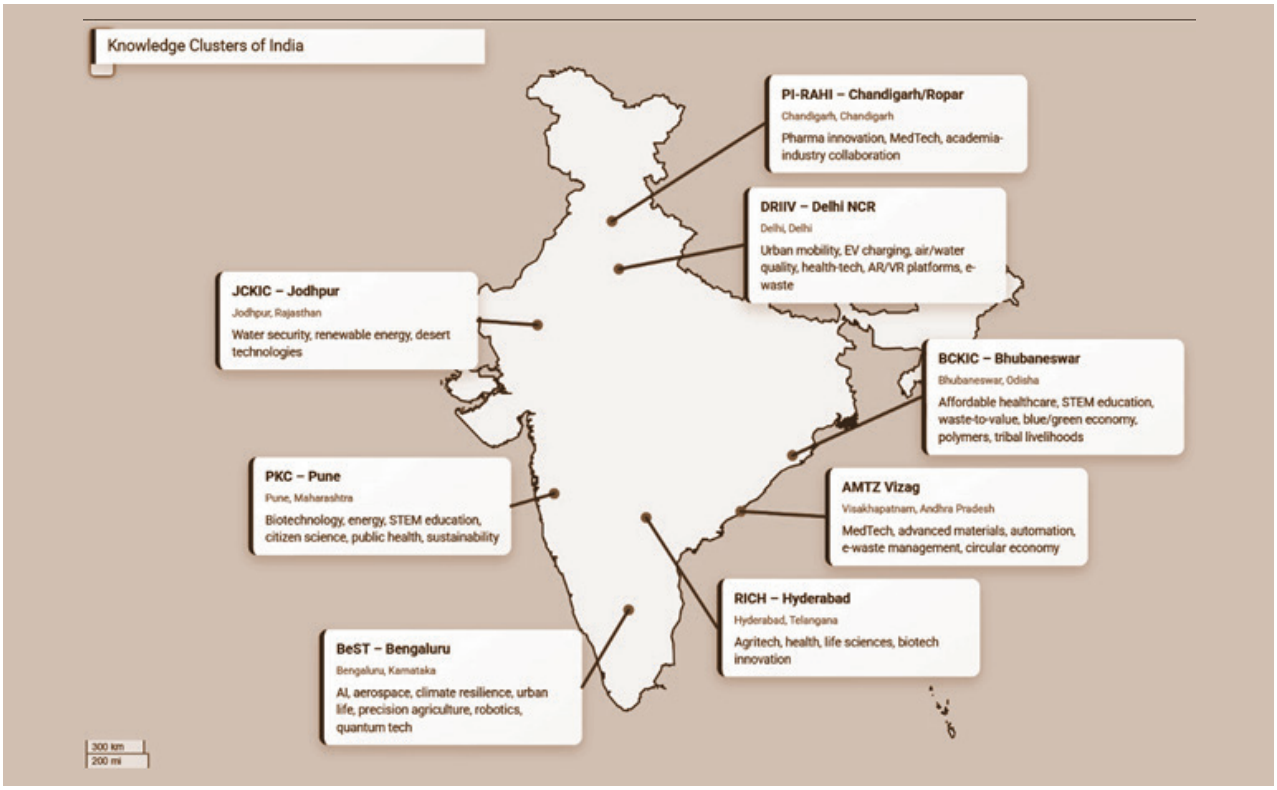

Figure 3.24: Existing Knowledge clusters in India
(**Source:** Compiled with information obtained from PSA website)

3.2 Initiatives at the State Level

In a large and diverse country like India, states play a key role in creating a strong national innovation ecosystem. Strong alignment of national missions and policies with regional development strategies is a catalyst for creating a strong innovation driven growth. The Government of India is dedicated to enhancing the nation's innovation performance and has recognized the necessity for a tailored framework to assess the innovation capacity and capabilities of its States and Union Territories (UTs). This realization inspired the development of the India Innovation Index framework, aimed at motivating States and UTs to evaluate and enhance their innovation ecosystems and performance, ultimately contributing to the overall innovation advancement in India.

Throughout India, nearly every state and union territory has implemented specific policies for science, technology, and innovation, aimed at enhancing their startup ecosystems, encouraging research and development, and advancing entrepreneurship in critical growth sectors. As of mid-2023, 31 out of 36 states/UT's have a dedicated startup policy, many formulated after the central Startup India initiative began in 2016. These state policies provide crucial funding, mentorship and market-access support for startups, and even incentives for incubators and universities. Together with central schemes, this has fuelled India's booming startup ecosystem: as of Dec 2023, there were 117,254 DPIIT-recognized startups creating over 12.4 lakh jobs across the country.

An overview of key state policies and their respective outcomes is presented below:

In the **southern part** of India being a pioneer in state-led startup support, **Andhra Pradesh's** Startup Policy 4.0 (2024–29) emphasizes on electronics, agritech, and IT-enabled services, with the goal of creating substantial employment opportunities. It introduced India's first Startup & Innovation Policy in 2014, long before most other states. The government positions AP as a "Leader in fostering innovation". Its latest Innovation & Startup Policy (4.0, 2024–29) sets very ambitious targets: 20,000 new startups and at least 100,000 jobs in five years. AP's policy emphasizes incubation parks (like Amravati's IT parks), grants for entrepreneurs, and industry-academia R&D tie-ups. It also makes it easier for startups to access state procurement and investment networks.[18]

Karnataka, home to Bengaluru, India's "Silicon Valley", launched its Startup Policy 2022–27 to strengthen its leadership in innovation. Rolled out by the Karnataka Innovation and Technology Society (KITS) in Dec 2022, the policy supports the entire startup lifecycle through funding, infrastructure, and industry linkages. Key initiatives include 50 NAIN centres to boost student entrepreneurship, a ₹100 crore VC fund for emerging tech, and Elevate Idea2PoC grants (up to ₹50 lakh).[19] It also backs women entrepreneurs (loans up to ₹10 lakh, 25% VC fund reserved) and promotes startups beyond Bengaluru via rural innovation hubs and regional incentives. **Karnataka** is at the forefront with its Startup Policy 2022–27 and K-Tech initiatives, which concentrate on IT, deep-tech, and emerging fields such as AI, robotics, and ESDM, bolstered by a robust network of incubators and Centers of Excellence.

Telangana's T-Hub and Innovation Policy prioritize areas like AI, life sciences, and agritech. T-Hub (Technology Hub), established in 2015, serves as a ground breaking public–private partnership that brings together the Government of Telangana, leading academic institutions (IIIT-Hyderabad, ISB, NALSAR), and the private sector. It functions based on the esteemed triple helix model—integrating government, academia, and industry to stimulate innovation. Through programs such as T-Fund, T-Hub implements Telangana's State Innovation Policy by providing organized financial assistance to nascent startups. The potential for scaling is highlighted with T-Hub 2.0, which is set to elevate Telangana into a worldwide center for innovation.

Tamil Nadu, through *StartupTN* and its Innovation Policy, focuses on sectors including manufacturing, electronics, and renewable energy, providing seed funding and connections to global markets. This aims to create 5,000 tech startups and position the state as a global innovation hub. It focused on infrastructure, regulatory ease, and academia-industry linkages, attracting nationwide entrepreneurs. Under the Startup TN brand, the state now hosts thousands of startups and a high density of incubators.[20] Post-2023, Tamil Nadu deepened funding, emphasized social inclusion, expanded regionally, and entered sectors like space and defence tech.

Kerala's Startup Mission (KSUM) promotes healthtech, edtech, and fintech, supported by a strong pipeline of student innovation. MIT and KSUM have collaborated to create the Kerala Startup Mission, a state-wide initiative that supports over 6,500 startups through

[18] https://apit.ap.gov.in/assets/files/2025ITC_36424_MS9_E.pdf
[19] https://eitbt.karnataka.gov.in/startup/public/policy/en
[20] https://skpc.edu.in/wp-content/uploads/2023/05/Tamil-Nadu-startup-Innovation-Policy.pdf

incubation, acceleration, and ecosystem-building. The mission fosters decentralization through 530 Innovation & Entrepreneurship Development Cells (IEDCs) and 60+ incubators, including FabLabs and Super Fab Lab in Kochi. The ecosystem includes LEAP Coworks, innovation grants, patent subsidies, and early-stage venture funding. Kerala's startup ecosystem is growing rapidly—expanding at an annual rate of **20%**, with around **3,500 ventures** currently active, indicating its dynamic evolution. **i4G 2024** is a government program inviting startups and innovators to pitch emerging technology-based solutions for public adoption, through pilot implementations assessed by mixed evaluation panels.[21]

In **western India**, **Gujarat's** Innovation Policy is built on a layered and forward-looking framework that harnesses academia, industry, and government to cultivate an innovation-driven growth model. Central to this ecosystem is the **Student Startup and Innovation Policy (SSIP 2.0)** (2022–2027), which aims to embed innovation directly within educational institutions—supporting up to 10,000 student-led prototypes, enabling 5,000 IP filings, and establishing pre-incubation infrastructure across 500 colleges and universities, while facilitating physical and virtual incubation of startups via i-Hub Gujarat.[22] While it may not have a standalone "State Innovation Policy" like Karnataka or Tamil Nadu, its ecosystem is policy-rich, structured, and deeply institutionalized. As of 2025, Gujarat hosts over 13,000 DPIIT-recognized startups across sectors like healthcare, IT, agri-tech, and e-mobility, with hubs in Ahmedabad, Surat, and Vadodara. Gujarat has consistently ranked as a "Best Performer" in India's State Startup Rankings, reflecting its leadership in inclusive and innovation-driven entrepreneurship. Complementing this, the **Scheme for Assistance for Startups and Innovation** (under the Industrial Policy 2020) offers targeted seed funding (up to ₹30 lakh), sustained allowances for early-stage ventures, and has disbursed over ₹60 crore to more than 400 startups as of April 2025. Additionally, the **Gujarat Global Capability Centre (GCC) Policy 2025–30** seeks to elevate the state's innovation capacity by attracting advanced research and development centres, promoting collaboration between multinationals and local innovators, and incentivizing both capital and operational investments, ultimately aiming to create 50,000 skilled jobs and draw ₹10,000 crore in investments. Together, these policies reflect a robust and comprehensive approach to innovation from grassroots educational engagement to global technological collaboration positioning Gujarat as a key innovation hub in India.

Maharashtra's Startup Policy (2018–23) aimed to create 10,000 startups and 5 lakh jobs, and exceeded expectations with over 13,500 DPIIT-recognized startups by 2023. Backed by ₹5,000 crore in funding, 15 incubators, and the Maharashtra State Innovation Society, the state built a strong innovation ecosystem (startupindia.gov.in). In 2024–25, it expanded efforts through virtual incubation, a unified digital facilitation system for faster approvals, and a ₹1,200 crore ITI upgrade to boost youth entrepreneurship. Policies like 10% direct procurement from startups, the ₹500 crore MahaAgri-AI initiative, and international MoUs further cemented Maharashtra's role as a hub for inclusive, tech-driven growth. **Maharashtra** backs AI, drones, and Industry 4.0 through the State Innovation Society and enhanced ITIs.

[21] https://kdisc.kerala.gov.in/en/
[22] https://www.ssipgujarat.in/index

Rajasthan's Innovation Policy, led by the iStart initiative, nurtures startups from ideation to commercialization through incubation, seed funding, and mentoring support. The state offers monthly allowances, grants up to ₹10 lakh, and institutional incentives to strengthen innovation infrastructure. With over 6,000 startups registered, ₹40+ crore disbursed, and 40,000 jobs created, the policy has significantly boosted the entrepreneurial landscape. Upcoming initiatives such as the Rajasthan AI Policy 2025 further reinforce its commitment to emerging technologies and inclusive innovation.[23]

Goa's Innovation Policy aims to create a technology-driven entrepreneurial ecosystem by providing incubation, research and development incentives, and intellectual property rights support through the Startup Goa initiative. The state is enhancing its innovation capabilities with the AI Mission 2027, which involves the establishment of AI excellence hubs and global capability centers to promote technology-driven growth. Furthermore, initiatives such as the Open Innovation Challenge motivate startups and students to collaboratively develop scalable solutions in sectors like tourism, waste management, and agriculture, thereby strengthening Goa's ambition to become a center for creative and sustainable innovation.[24]

In the **Northern states**, **Uttar Pradesh** operates the Startup UP and Startup Haryana initiatives, respectively, focusing on electronics, food processing, and agritech aimed at making UP among the Top 3 States in the "States' Startup Ranking" conducted by Startup India. Uttar Pradesh's Innovation Policy rooted in the broader Startup Policy 2020 (revised 2022) aims to cultivate a vibrant grassroots innovation ecosystem by promoting the transition from ideation to commercialization. With a well-defined institutional framework that features the Innovation Hub at AKTU, a Hub-and-Spoke incubation model, and the objective of establishing 100 incubators along with 1 million square feet of innovation space, the state has developed a strong support infrastructure for innovators. Startups benefit from financial incentives, including a ₹17,500/month sustenance allowance, prototype grants of up to ₹5 lakh, seed/marketing assistance reaching up to ₹7.5 lakh, and patent reimbursement (₹2 lakh for domestic filings and ₹10 lakh for international filings). The state is also swiftly progressing into deep-tech sectors with Global Capability Centres (GCCs), policies for semiconductor and electronics manufacturing, and extensive AI integration across various sectors through initiatives like AI Pragya, thereby reinforcing its dedication to pioneering innovation.[25,26]

Haryana launched **Startup Haryana** to formalize support for innovation.[27] The state's policy focuses on providing world-class incubator infrastructure and regulatory ease. For example, Haryana's policy commits to "create a world-class incubator facility" for entrepreneurs, and it bundles incentives for incubators, startups and investors. It also emphasizes sector-agnostic growth (from IT to agriculture to tourism) and promoting women's and student entrepreneurship. Key pillars include ***Infrastructure Augmentation*** (building new incubators), ***Fiscal Support*** (tax breaks and grants) and ***Regulatory Easing*** (simpler labour and environment) clearances.

[23] https://www.startupindia.gov.in/content/sih/en/state-startup-policies/Rajasthan-state-policy.html
[24] https://www.startup.goa.gov.in/index
[25] https://startinup.up.gov.in/startup-policy-2020-first-amendment-2022/
[26] https://invest.up.gov.in/
[27] https://startupharyana.gov.in/

Punjab fosters biotech, agri-processing, and industrial innovation through its Startup Punjab framework. Punjab's innovation drive is anchored in a robust ecosystem cultivated through initiatives like Mission Innovate Punjab, Startup Punjab, and the public–private Innovation Mission Punjab, designed to bridge academia, industry, and global investors in catalyzing startup growth and entrepreneurship. The state boasts over 1,000 DPIIT-recognized startups, more than 30 incubators, and a dedicated ₹100 crore Fund-of-Funds to support scale-up funding via venture capital partners. Its Mission Innovate Punjab, steered by the State Council for Science & Technology, aims to foster research-to-commercialization pipelines through networking among universities, research bodies, and industry, specifically targeting domains like biotech, agriculture, and applied sciences. These efforts have positioned Punjab as a leader among the larger Indian states in startup ecosystem maturity, particularly in institutional support and funding.[28]

Himachal Pradesh and Uttarakhand give priority to clean energy, tourism technology, and innovations based on local resources. Himachal Pradesh promotes innovation through its Chief Minister's Startup/Innovation Project, which aids entrepreneurs by providing incubation centers, monthly sustenance allowances of ₹25,000 for one year, and seed funding of up to ₹50 lakh under the HIMSUP Yojana. This initiative is further enhanced by subsidies for DPR preparation, preferential land rates, and patent reimbursements of up to ₹2 lakh for domestic applications and ₹10 lakh for foreign applications. Established at IIT Mandi, the Catalyst incubator and iHub & HCI Foundation support advanced technology ventures, including initiatives such as Drone Didi, which trains rural women to become agricultural drone operators. In parallel, Uttarakhand's Startup Policy 2023 fosters innovation by providing recognized startups with monthly allowances of ₹10,000, which can increase to ₹15,000 for SC/ST, women, and startups from Category-A regions. Additionally, it offers marketing support of up to ₹5 lakh (or ₹7.5 lakh for certain groups), reimbursement for patent costs (₹1 lakh for domestic and ₹5 lakh for international applications), as well as exemptions on stamp duty and SGST reimbursement. These focused frameworks demonstrate the commitment of both states to cultivate tech-driven and inclusive innovation ecosystems.[29]

In **central and eastern India**, **Madhya Pradesh** emphasizes social innovation and technology solutions linked to MSMEs, while **Chhattisgarh**'s 36Inc supports manufacturing, clean energy, and enterprises based on tribal resources. Madhya Pradesh has meticulously crafted its Startup Policy (2022–2027) to promote innovation throughout the state via a robust support framework. This policy provides sustenance allowances of ₹10,000 per month, margin money and interest subsidies, patent assistance up to ₹5 lakh, as well as concessions on lease rentals and electricity tariffs—all specifically designed to support early-stage startups, with additional advantages for women entrepreneurs and product-oriented businesses. Furthermore, the state encourages the establishment of incubators by offering capital and operational grants, funding for events, and complete reimbursement of stamp duty and registration fees. It also supports high-impact solutions through a competitive State Innovation Challenge that awards grants of up to ₹1 crore.

Chhattisgarh, through its Startup Policy 2019–24, enhances innovation by providing administrative support and streamlined funding avenues. A significant initiative is the

[28] https://pscst.punjab.gov.in/en/pscst-signs-mou-with-startup-punjab
[29] State & Central Startup Portals: startuphimachal.hp.gov.in, emerginghimachal.hp.gov.in, startupindia.gov.in

establishment of an i-Hub along with a transit campus for the National Forensic Sciences University (NFSU)—a strategic effort aimed at fostering innovation and entrepreneurship, especially in technology-driven and forensic science sectors.

Odisha's Startup Odisha encourages women entrepreneurship and rural technology. Odisha adopted a startup policy (2016) aiming to make the state a top innovation hub by 2020, with tax breaks and land for startups (startupodisha.gov.in). **Odisha's innovation agenda** is driven by a robust institutional framework (Startup Odisha), a clear ambition to support **5,000 startups by 2025**, plus substantial seed funding, incubation infrastructure such as O-Hub, and targeted sectoral initiatives spanning biotechnology, electronics, and AI. Recent flagship efforts include the **Odisha AI Policy-2025**—emphasizing infrastructure, skilling, ethical governance, and AI-led public innovation—and the launch of the **Marine Biotechnology Research & Innovation Corridor (OMBRIC)** to catalyse blue-economy startups from local coastal resources.

Jharkhand advocates for advancements in mining technology and agro-processing. **West Bengal'**s Startup Bengal fosters innovation in creative industries and MSMEs. Jharkhand, in contrast, is currently experiencing a period of significant growth, having introduced the Startup Policy-2023 with the objective of nurturing 1,000 new startup concepts by 2028 through the Atal Bihari Vajpayee Innovation Lab (ABVIL)—which includes financial assistance, idea assessment, incubation, and mentorship. Simultaneously, collaborations between universities and research institutions (such as CUJ with ICAR-IIAB), incubation support through alliances with organizations like IIM-Ranchi and XLRI, along with infrastructure development driven by industrial policy initiatives, indicate a maturing ecosystem. On the other hand, West Bengal is focusing on extensive technology infrastructure to drive innovation. The Bengal Silicon Valley Tech Hub in Kolkata is planned to serve as a significant convergence area for IT/ITeS, AI, research and development, data centers, and emerging technologies, with an anticipated creation of 100,000 direct jobs upon its completion in 2025. This hub exemplifies the state's approach to establishing global-scale technological infrastructure to promote innovation-driven industrial advancement.

The **North Eastern region** collectively focuses on inclusive innovation by merging traditional strengths with contemporary entrepreneurial ecosystems. Generally, the states implement a model that integrates incubation support, seed funding, mentoring, and skill development, while customizing sectoral priorities to align with local resources and cultural assets. This approach guarantees that innovation not only propels economic growth but also sustains livelihoods, especially in rural and semi-urban regions.

Assam has positioned itself as a leader in regional innovation through its flagship initiative, Assam Startup – The NEST, which serves as a platform for emerging entrepreneurs in agritech, handicrafts, and IT-enabled services. The state provides organized incubation, access to investors, and industry mentorship to enhance value chains in agriculture and indigenous crafts, while establishing Guwahati as a center for digital entrepreneurship. **Meghalaya,** via its PRIME (Promotion and Incubation of Market-driven Enterprises) initiative, employs a distinctly market-oriented strategy for entrepreneurship. PRIME emphasizes capacity building, incubation, and funding access while promoting ventures

in agriculture, tourism, and creative sectors. It is notable for its focus on youth-led enterprises, tackling both job creation and innovation concurrently. **Manipu**r capitalizes on its cultural and resource-based advantages by fostering startups in handloom, handicrafts, and horticulture. Its policies emphasize seed funding, incubation programs, and business connections that aid in transforming traditional crafts into scalable businesses. By connecting grassroots artisans with entrepreneurial ecosystems, Manipur nurtures innovation that is deeply embedded in its heritage. **Nagaland** emphasizes innovation based on resources, particularly in industries related to bamboo, handicrafts, and agro-processing. The state's initiatives offer incubation, seed funding, and market access, motivating local entrepreneurs to transform indigenous resources into value-added products. This strategy not only promotes economic diversification but also strengthens cultural identity.

Sikkim incorporates sustainability into its innovation framework, concentrating on organic agriculture, eco-tourism, and wellness sectors. By merging incubation assistance with specific funding, the state establishes itself as a frontrunner in green innovation, aligning entrepreneurial efforts with its global standing as India's pioneering organic state. **Tripura** focuses on food processing, bamboo products, and IT-enabled services, implementing policies that provide seed grants, mentorship, and incubation. This combined strategy fosters resource-driven industries while progressively enhancing capabilities in technology-oriented enterprises, ensuring a well-rounded innovation ecosystem. **Arunachal Pradesh** channels its innovation efforts towards horticulture, handicrafts, and tourism, backing community-driven enterprises with incubation resources and financial support. Its approach emphasizes grassroots entrepreneurship, ensuring that innovation reaches remote and rural regions where traditional industries can be modernized and expanded.

Union Territories like **Delhi and Jammu & Kashmir** have recently introduced startup policies, where Delhi is concentrating on procurement and seed funding for technology-driven enterprises, and J&K is encouraging entrepreneurship in handicrafts, tourism, and agritech.

Table 3.1: List of State/UT government initiatives with focus and outcome

State / UT	Initiatives	Domain areas	Key focus	Salient aspects
Andhra Pradesh	AP Innovation & Startup Policy 4.0 (2024–29); AP Innovation Society	Electronics, agritech, and IT-enabled services	Startup One single window, CoEs, Amravati's IT parks incubators	India's first Startup & Innovation Policy in 2014, Leader in fostering innovation, New policy targets 20,000 startups/1 lakh jobs in 5 yrs;
Arunachal Pradesh	Startup Arunachal (planning & industry)	Horticulture, handicrafts, and tourism,	Grants, youth entrepreneurship, grassroots entrepreneurship,	Targets 250 startups in five years, backed by a substantial ₹38.45 crore seed funding corpus
Assam	Assam Startup – The Nest	Agritech, handicrafts, and IT-enabled services	Incubation, seed grants, market linkage	600+ startups incubated; 8,000+ jobs; ₹100+ cr grants/ investments mobilised
Chhattisgarh	Startup Policy 2019–24, 36Inc (state-backed incubator)	Green & Renewable Technologies, Agri-Business & Food Processing, Biotech & Health Tech	Incubation support, i-Hub along with a transit campus for the National Forensic Sciences University (NFSU)	36Inc cohorts/ incubatees published
Delhi (UT)	Delhi Startup Policy (2022)		Seed support, procurement	Policy portal/news outline benefits & hubs
Goa (UT)	Startup Goa	Cutting-edge techn-ologies, renew-able energy, waste manage-ment, health-care, educ-ation, food and beve-rages and mining	Secure funding access, facilitate government–startup collaboration, empowering women entrepreneurs, Open Innovation Challenge	279 startups certified; ₹4 cr incentives; 33% women-founded ventures, 6 incubators

Gujarat	Student Startup & Innovation Policy (SSIP 2.0); iCreate	Healthcare, IT, agri-tech, and e-mobility; focus on elect-ronics, manufa-cturing	Student grants, prototyping, IP support	Best Performer" in India's State Startup Rankings; SSIP 2.0 supports up to 1,000 student startups/yr and 50 incubators; home to national initiatives like iCreate
Haryana	Startup Haryana (Policy 2022)	Digital Innovation & IT Infrast-ructure, Electric Vehicles (EVs) & E-Mobility	Seed grants, incubation, procurement support, Startup Warehouse in Gurugram; incentives for land, power, interest; sector-agnostic growth	1740 recognised startups by 2023; innovation spreading beyond NCR; active promotion of student and women entrepreneurs
Himachal Pradesh	HP Startup/ NAVTP initiatives	Rural infrast-ructure, crafts, arts, water & sanitation, renewable energy, healthcare	Seed grants, incubation	14 incubation centers; BIC-HPU (Biotechnology Incubation Centre, Himachal Pradesh University) has incubated 30 startups (by 2025)
Jammu & Kashmir	J&K Startup Policy (2024)	Disruptive & Deep Tech Emphasis	Seed support, incubation, angel mobilization; Grassroots Innovation	2000 new startups to be incubated within 5 years
Jharhand	Startup Jharkhand	Technology, manufa-cturing, agri-culture, and renew-able energy	Seed funding, incubators	1,000 startups by 2028 via the Atal Bihari Vajpayee Innovation Lab (ABVIL) framework

Karnataka	Karnataka Startup Policy (2022–27); K-Tech Startup Cell; KITVEN; Booster Kit	K-Tech initiatives, which concentrate on IT, deep-tech, and emerging fields such as AI, robotics, and ESDM,	SGST reimbursement, patent/quality reimbursements, CoEs in AI/ Robotics/ ESDM; excels in grassroots innovation (sanitation tech, green energy); global recognition	4,000+ startups, 45 unicorns, 144 incubators/ accelerators; ~50% of India's unicorn valuation centred in Bangalore; ranked best-performing state in 2022; 88 unicorns (2024); Top Performer in national rankings
Kerala	Kerala Startup Mission (KSUM)	Healthtech, edtech, and fintech	Statewide incubators, student innovation, grants	6,200–6,500+ registered startups; 60+ incubators; 1.0M+ sq ft incubation; ecosystem value ~$1.7B (2021–23) and 20% annual growth reported.
Madhya Pradesh	MP Startup Policy (2022); MP Startup Center	IT, ITES, and Digital Innovation, AgriTech	Incubation grants, market access, mentor network	Startup recognition grew 30% (to 5,230), including a 34% boost in women-led ventures. More than 54,000 jobs generated through startups and MSMEs.
Maharashtra	Maharashtra State Innovation Society (MSInS); Startup Maharashtra	AI, drones, and Industry 4.0	Seed/scale-up schemes; innovation challenges in AI/ drone/robotics	Rs 1,200 cr ITI upgrade plan; ~13,500 DPIIT startups by 2023; India's biggest startup base (Mumbai–Pune); vibrant innovation events & angel funding ecosystem
Manipur	Startup Manipur	handloom, handicrafts, and horticulture.	Seed funding, idea grants	1,300+ startups registered; ₹10+ cr grants disbursed

Meghalaya	PRIME (Promotion & Incubation of Market-driven Enterprises)	agriculture, tourism, and creative sectors	Entrepren-eurship training, grants, mentoring	PRIME reports 3,000+ entrepreneurs supported; 100+ startups incubated; 2,500+ jobs
Nagaland	Startup Nagaland	Industries related to bamboo, handicrafts, and agro-processing	Incubation, grants, mentor connects	Program portal with cohorts & schemes
Odisha	Startup Odisha (Policy 2016; revised)	Social and climate tech startups	Recognition, grants, incubators, women entrepreneurship	1,500+ startups facilitated; 25+ incubators; target 5,000 startups by 2025; Rising startup visibility in Tier 2/3 cities
Punjab	Startup Punjab	Deep tech & Emer-ging Techno-logies	Incubators, grants, market access	800+ registered startups, 30 incubators
Rajasthan	iStart Rajasthan (DoIT&C)	Water, sanitation, healthcare, renewable energy, crafts	Incubation (Techno Hub), seed funds, QRate, school programs	6,165 startups registered; ~40,000 jobs; ₹1,005 cr+ investments mobilised
Sikkim	Startup Sikkim		Recognition, facilitation, incentives	
Tamil Nadu	Tamil Nadu Startups & Innovation Policy; StartupTN (TANSIM)	manu-facturing, electro-nics, and renewable energy,	Grants, incubators (120+), market access, registry	4th in 2023 DPIIT rankings; major startup hubs in Chennai, Coimbatore; StartupTN ecosystem valued at ~$28B; Chennai hosts ~6,152 startups; state growing ~23% annually

Telangana	T-Hub (state-backed incubator); Innovation Policy	AI, life sciences, and agritech.	Anchored on T-Hub (Asia's largest incubator); startup-friendly tenders; co-investment T-Fund; T-Innovation Cell	3,000+ startups and 200+ corporates engaged by T-Hub; 550+ mentors; 60+ VCs partnered.
Tripura	Startup Tripura	food processing, bamboo products, and IT-enabled services	Seed capital, incubation	Policy/portal outlines benefits and cohorts
Uttar Pradesh	UP Startup Policy; Startup UP	Agritech, deep tech, fintech, health-tech, semi-conductor manu-facturing	Seed funds, incubator network, grants	13,300+ DPIIT-recognized startups, exceeding the 2025 target; 8 unicorns and 2 soonicorns; 100,000+ jobs created, with 49% of startups located in Tier-II/III cities.
Uttarakhand	Startup Uttarakhand	Travel & Tourism, Food Processing & Agriculture (including Horticulture)	Incubators, seed grants	Marketing support of up to ₹5 lakh (or ₹7.5 lakh for certain groups), reimbursement for patent costs (₹1 lakh for domestic and ₹5 lakh for international applications
West Bengal	Startup Bengal (WBIDC)	IT/ITeS, AI, data centres, e-comm-erce, IoT, and R&D hubs.	Facilitation, incubation, market access	Establishment of Entrepreneurship Development Centre Network (EDCN), IT exports surged from ₹4,500 crore in 2011 to ₹35,000 crore in 2025

State innovation policies have emerged as a cornerstone of India's innovation ecosystem, playing a crucial role in fostering regional entrepreneurship, strengthening R&D frameworks, and promoting inclusive economic growth. By supporting startups, establishing incubation centers, and fostering collaboration between academia, industry, and government, these policies enable states to harness local talent and address region-

specific challenges. Collectively, they contribute to national objectives such as job creation, digital transformation, and sustainable development, while also enhancing India's global competitiveness, attracting foreign investment, and positioning the country as a hub for innovation and technology leadership.

To assess the impact and efficiency of these initiatives, it is essential to evaluate how effectively states utilize their available resources to generate innovative solutions. **Figure 3.25** illustrates this by mapping each state's innovation efficiency, calculated by dividing its performance scores by its enablers scores. Comparing current rankings with previous ones provides insights into progress over time and creates a healthy competitive environment, motivating states to continuously improve their innovation performance.

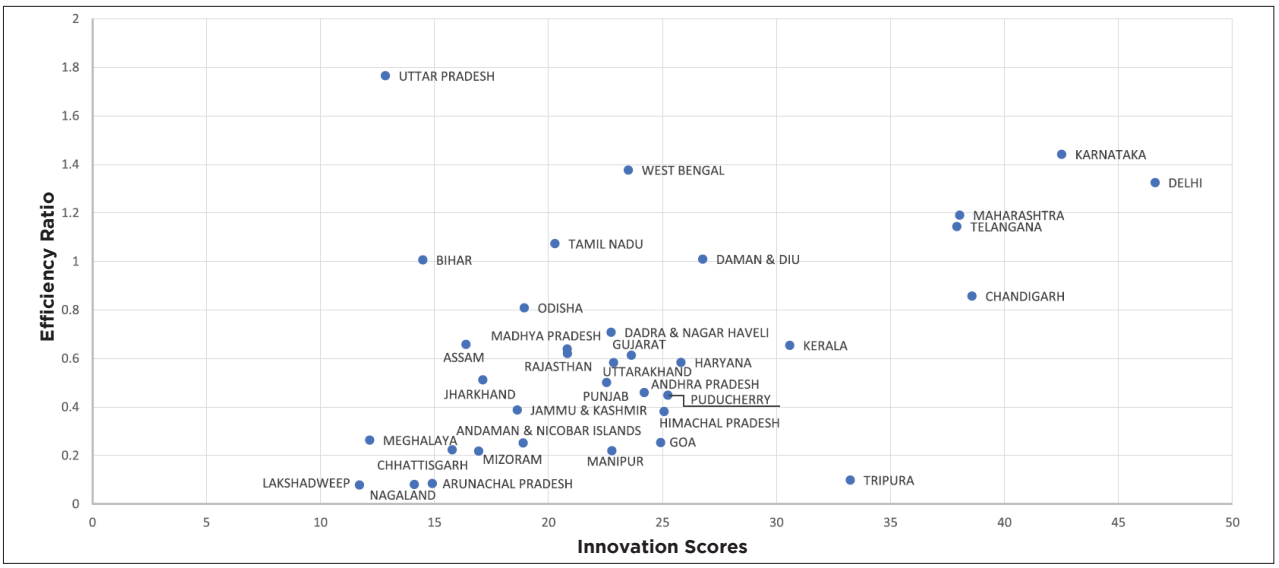

Figure 3.25: Efficiency in Innovation of Indian States.
(The states that score an efficiency of less than 1 are those which have not been able to attain a level of performance proportionate to the strength of their enabling factors.)
(**Source:** State R&D Ranking 2024 - www.niti.gov.in/sites/default/files/2021-01/IndiaInnovationReport2020Book.pdf)

In summary, these policies encompass a wide range of sectors including deep-tech, IT/ICT, manufacturing, agriculture, renewable energy, biotechnology, and creative industries, offering a combination of fiscal incentives, incubation networks, skill development, and international connections—thereby fostering a multi-sectoral approach to enhance the national science and technology innovation ecosystem.

Several Indian States and Union Territories (UTs) have launched these above-mentioned initiatives, policies, and institutional frameworks. These efforts are focused on enhancing innovation inputs (like education, infrastructure, R&D) and outputs (like patents, startups, and publications), and are designed to strengthen their local innovation ecosystems. This approach not only highlights each state's strengths and areas for improvement but also fosters competitive federalism, inspiring states to learn from each other and adopt best practices to drive economic growth and address societal challenges.

The **India Innovation Index** is an annual exercise conducted by NITI Aayog in collaboration with the Institute for Competitiveness, aimed at evaluating and benchmarking the

innovation performance of Indian states and union territories.[30]

This comprehensive framework assesses states across a range of parameters grouped into two major dimensions:

- **Enablers** (factors that drive innovation such as human capital, investment, knowledge workers, business environment, and safety/legal environment) and,
- **Performance** (actual results in terms of knowledge output and diffusion). It also aligns with India's broader vision of fostering innovation-led growth, in line with national missions such as Startup India, Digital India, and Atmanirbhar Bharat.

By tracking progress over time, the India Innovation Index plays a vital role in driving evidence-based policymaking and enhancing India's global innovation standing. The Index measures and ranks states and union territories based on their innovation capabilities and performance. This serves as a comprehensive tool for policymakers nationwide, enabling them to pinpoint challenges that need attention and strengths to capitalize on when formulating economic growth strategies for their respective regions.

States are increasingly adopting decentralized, community-driven approaches to address regional challenges while aligning with national innovation goals. The India Innovation Index has revealed that innovation in India is often concentrated in regions with a legacy of industrialization and economic growth. Southern states, in particular, have emerged as leaders, with Karnataka, Maharashtra, and Tamil Nadu consistently ranking at the top.

Image 3.5: Release of Third Edition of India Innovation Index
(**Source:** https://www.pib.gov.in/PressReleasePage.aspx?PRID=1842887)

The **States Startup Ranking Framework** was launched in 2018 under the Startup India Scheme as an annual exercise with the objective to augment the Startup ecosystem in the States and Union Territories across the country. Focus is on initiatives and policies undertaken in respective jurisdictions. The Framework has also introduced an effective

Feedback Collection Mechanism from beneficiary startups and incubators present across states and Union Territories to share their experience in handholding and support that they have received from respective governments. The Startup rankings intend to bring constructive competition among states to strengthen their startup enabling ecosystem. This has created a new synergy among the states, with each state coming up with their own startup policies and creating various institutional mechanisms to strengthen their Startup ecosystem. Startup ranking correlates strongly with effective policies and support systems that states have created.

Startup India has a strong focus on the engagement of stakeholders at the level of States and Union Territories.

Most of the states in the country, have in collaboration with the Department of Science and Technology (DST), GOI, established **State S&T Councils** to strengthen smooth partnerships between central and state governments in order to foster innovative capabilities in S&T. For instance: **Karnataka's** success is attributed to its robust knowledge ecosystem, strong business environment, and significant investment in research and development. **Maharashtra**, another top performer, excels in creating an enabling environment for innovation. The Maharashtra Agri-Business and Rural Transformation (SMART) Project (2018) initiative, promotes Agri-tech innovations like AI-driven farm management, drone-based crop monitoring, and climate-resilient practices. Innovation in Northeast India is also gaining momentum through technology-driven agricultural reforms, digital infrastructure, and agroecological initiatives. The North Eastern Region Agri-Commodity e-Connect (NE-RACE) Portal, launched on July 12, 2024, by Union Minister Jyotiraditya Scindia, a digital initiative which connects 50,000 farmers to 5,000 buyers, over five years via a digital Farm-to-Business platform, offering direct negotiations, real-time pricing, multilingual support, and logistics linkages.

Image 3.6: NITI organized a workshop on Building Synergies in Innovation Ecosystem held in Gujarat

The **Gujarat Council** has been actively involved in promoting S&T in Gujarat through various initiatives, including establishing regional science centers, supporting research and development, and fostering collaboration with other organizations. They are also focusing on science popularization and promoting emerging technologies like AI and Robotics. Gujarat also operates a Technology and Innovation Support Centre (TISC) to support technology developers and users. A recent workshop on building synergies in the Indian innovation ecosystem was organized by NITI Aayog with Gujarat State Science & Technology Council as a host. A few more of the examples that stand out are: **Kerala's Startup Mission**, **Telangana's T-Hub** and **Haryana government's Startup Haryana** run by HarTron.

3.3 Initiatives from Industry and Industry Associations

Industry-led initiatives that ensure innovative capabilities often take the form of strategic partnerships, research consortia, innovation hubs, and incubators, which are designed to foster a dynamic ecosystem of knowledge exchange and technological advancement. These initiatives frequently collaborate within the university- industry- government (U-I-G) framework, to accelerate innovation and bridge the gap between theoretical research and practical application. Industries drive these collaborations by identifying market needs and providing funding, infrastructure, and real-world problem statements. Universities contribute with cutting-edge research, academic expertise, and a skilled talent pool, while government agencies facilitate these interactions through policy support, grants, and regulatory frameworks. Together, they create synergistic environments that support the development of emerging technologies, commercialization of research, and economic growth. For example, innovation clusters like Silicon Valley or biotech hubs in Boston thrive on such collaborative efforts, where shared goals and co-investment in R&D lead to sustained innovation and competitiveness.

The **National Association of Software and Service Companies (NASSCOM) Innovation** Hub serves as a catalyst for technological advancement across India's economy. It aims to foster innovation, enable collaboration between stakeholders, accelerate startup growth, develop tech talent, drive digital transformation, promote research, attract investment, and advocate for favourable policies benefiting startups, established corporations, academic institutions, and government agencies through structured programs. These could include incubation services to startup, facilitating technology developments through funding CoEs, organizing networking events. Operating through a multi-stakeholder governance model, *NASSCOM Innovation Hubs* are strategically located across Tier 1 cities (Bangalore, Delhi NCR, Mumbai), Tier 2 cities (Kochi, Indore), and specialized domain hubs.

The **Confederation of Indian Industry (CII)** is another such industry body that provides incubation services, technology demonstrations, and support infrastructure (physical spaces, specialized laboratories, technical assistance, IP guidance, and business development support). *CII's innovation centers* operate nationwide through regional hubs in metropolitan cities, *state chapters* aligned with local industrial strengths, and sector-specific clusters, with funding through a combination of CII resources, member contributions, government partnerships, and program revenues. *CII's Startup Centre and Centre of Excellence for Innovation and Entrepreneurship* connect industry, startups,

academia, and government to drive economic growth through innovation.

The **Federation of Indian Chambers of Commerce and Industry (FICCI)** has been instrumental in fostering and advancing India's innovation landscape by serving as a crucial link among government, academia, and the private sector. As a prominent industry association, FICCI has launched and supported numerous initiatives designed to enhance innovation, entrepreneurship, and the commercialization of research. It has partnered with educational institutions and research entities to encourage research that is relevant to industry and to facilitate the transfer of technology. Through initiatives such as the FICCI Innovation and Technology Commercialization Centre, it has aimed to connect innovators with industry stakeholders, providing mentorship, access to funding, and market connections. FICCI has also played a significant role in advocating for policies that support innovation, actively participating in the development of favourable policies and reforms in collaboration with governmental agencies. By hosting innovation summits, startup expos, and forums for knowledge exchange, FICCI consistently fosters dialogue and collaboration among academia, industry, and government, thereby strengthening the foundation of a cooperative innovation ecosystem in India.

The **Tata Innovation Hub** and **InnoVerse** signify a notable transformation in the methodology of promoting innovation, distinguishing themselves from conventional industry organizations such as FICCI, CII, and NASSCOM. Unlike these entities, which mainly serve as advocates for policy, facilitators of collaboration between industry and academia, and organizers of innovation conferences, the Tata initiatives are intricately woven into the operational and strategic fabric of the Tata Group. The Innovation Hub is dedicated to enhancing internal innovation across group companies by utilizing advanced technologies, digital transformation, and synergies across various industries, whereas InnoVerse functions as an open innovation platform that gathers ideas from employees, startups, and external innovators to address genuine business challenges. These platforms prioritize outcome-driven innovation, agile experimentation, and swift prototyping, frequently integrating seamlessly with product development processes. Their distinct advantage lies in cultivating an innovation-centric culture within organizations and actively promoting co-creation, in contrast to the more generalized, policy-oriented facilitation role assumed by associations like FICCI, CII, and NASSCOM.

3.4 Social and Grassroots Innovation

Social and grassroots innovation represents a paradigm shift in how we understand technological development and diffusion. Unlike traditional top-down innovation systems centered around formal R&D institutions, these approaches emerge from communities addressing local challenges through creative problem-solving with limited resources. This innovation pathway democratizes the innovation process, creates solutions tailored to contextual needs, and often incorporates traditional knowledge systems that have evolved over generations. Grassroots innovations refer to creative ideas and solutions developed by ordinary people at the community level, especially in rural or resource-constrained settings, to solve local problems using locally available resources. These innovations are typically low-cost, sustainable, need-based, and inclusive, often born out of necessity rather than formal R&D.

Numerous organizations throughout India have initiated significant programs aimed at fostering social and grassroots innovation. The **Honey Bee Network** can be cited as one of the most influential models of grassroot innovation. Established in late 1980s by Prof Anil Gupta at the Indian Institute of Management, it is acting as a bridge for the formal and informal innovation systems. Over the years it has created synergetic linkages with individuals and communities to identify, document, and disseminate grassroot innovations and traditional knowledge. It laid the foundation for the establishment of the **National Innovation Foundation** (NIF), in 2000 under the Department of Science & Technology. NIF provides the formal support system for validating and scaling the grassroot innovations through multiple level support systems including technical, legal, and financial mechanisms. It diligently seeks out, supports, and amplifies indigenous grassroots inventions and traditional knowledge, local ownership of innovation, incubation, awards, and market-linkage assistance to innovators from rural areas. The strong linkages between Honey Bee network and NIF provides an interesting and valuable pathway for translation of grassroot innovation.

Image 3.7: Glimpses of event organized during FINE at Rashtrapati Bhavan
(**Source:** https://nif.org.in/upload/fine/FINE_2023_report.pdf)

Grassroots innovations are embedding inclusion and informal knowledge into the broader innovation ecosystem - a Quadruple Helix in action.

Traditional Knowledge Digital Library (TKDL) established by CSIR and coordinated by the CSIR and Ministry of AYUSH codifies India's rich traditional knowledge especially in Ayurveda, Unani, Siddha, and Yoga. It digitally documents this traditional medicinal knowledge in a searchable, patent-examiners accessible format. It contains over 300,000 formulations in these traditional knowledge systems translated into five international languages: English, French, German, Japanese, and Spanish, and assigns each of the formulations with a unique Traditional Knowledge Resource classifications (TKRC) system aligned with the International patent classification (IPC) system.. Agreements signed with the European Patent Office (EPO), United States Patent and Trademark Office (USPTO), Japan Patent Office (JPO), United Kingdom Intellectual Property office (UKIPO) gives access to their patent examiners to check the TKDL database for prior art searches. It has provided a formal mechanism for protection of biopiracy, knowledge commons, preventing the misappropriation of traditional knowledge by wrongful patent claims.

The Atal Innovation Mission (AIM) has established **Atal Community Innovation Centres (ACICs)** in underserved regions, providing essential infrastructure, mentorship, and rapid prototyping facilities to enable local problem-solvers to create and test solutions that are relevant to their contexts. The DST's Social Innovation Programme for Products: Affordable & Relevant to Societal Health (SPARSH) specifically funds and accelerates biotech innovations that tackle urgent healthcare issues in marginalized communities. At the state level, Telangana has introduced India's first dedicated Social Innovation Policy to foster a dynamic ecosystem, while the Maharashtra State Innovation Society actively identifies and supports socially-conscious startups through grants and capacity-building initiatives. Additionally, NGOs and academic institutions contribute to this collaborative environment, exemplified by the SRISTI Social Innovation Fund (SIF), which offers mentoring and fabrication resources for grassroots inventors, and IIM Kozhikode's Centre of Excellence for Social Innovation, which enhances the skills of leaders in CSR and social entrepreneurship.

India's unique innovative initiatives for promoting grassroot innovation, protecting traditional knowledge the Honey Bee Network, NIF, TKDL are being cited as model examples in different countries. They have influenced the development of institutions in similar directions in many countries.

3.5 Major Events pertaining to innovation

India organizes a series of flagship events and activities that catalyse innovation, foster entrepreneurship, and strengthen the national R&D ecosystem. Prominent among them are:

Startup Mahakumbh - A landmark event to create a unified platform for stakeholders across the innovation value chain: startups, incubators, investors, academia, government agencies, and global partners. Positioned as one of the largest congregations, the event plays a pivotal role in fostering cross-sectoral collaboration and celebrating entrepreneurial excellence in the country and catalyse innovation-led development and highlight India's growing global footprint in technology and entrepreneurship. Bringing together over 3,000 startups, 1,000 investors, 10,000 delegates, and 50,000 visitors from 50+ countries, the focus is to cover aspects of 12 thematic pavilions across key sectors such as DeepTech, HealthTech, AgriTech, and ClimateTech. It serves

as a major platform to showcase emerging talent, especially from Tier-2 and Tier-3 regions, and strengthen India's innovation ecosystem for a self-reliant economy.

Image 3.8: Dignitaries at Startup Mahakumbh 2025 along with G20 Sherpa Amitabh Kant
(**Source:** https://startupmahakumbh.org/img/photos/Inaugural%20panel.jpg)

India International Science Festival -The Department of Science and Technology (DST) organizes the India International Science Festival (IISF) receiving strong support from various departments like Space, Atomic Energy, CSIR, and different state government organizations with the National Innovation Foundation (NIF) as the coordinating and implementing organization. This festival unites students, researchers, policymakers, innovators, and the general public to honour science and promote innovation-driven growth throughout India and beyond. Initiated in 2015, IISF features several days filled with engaging activities such as science expos, themed exhibitions, workshops, lectures, hackathons, and interactive outreach programs like 'Students Science Village', 'Science Safari', and live-domain showcases.

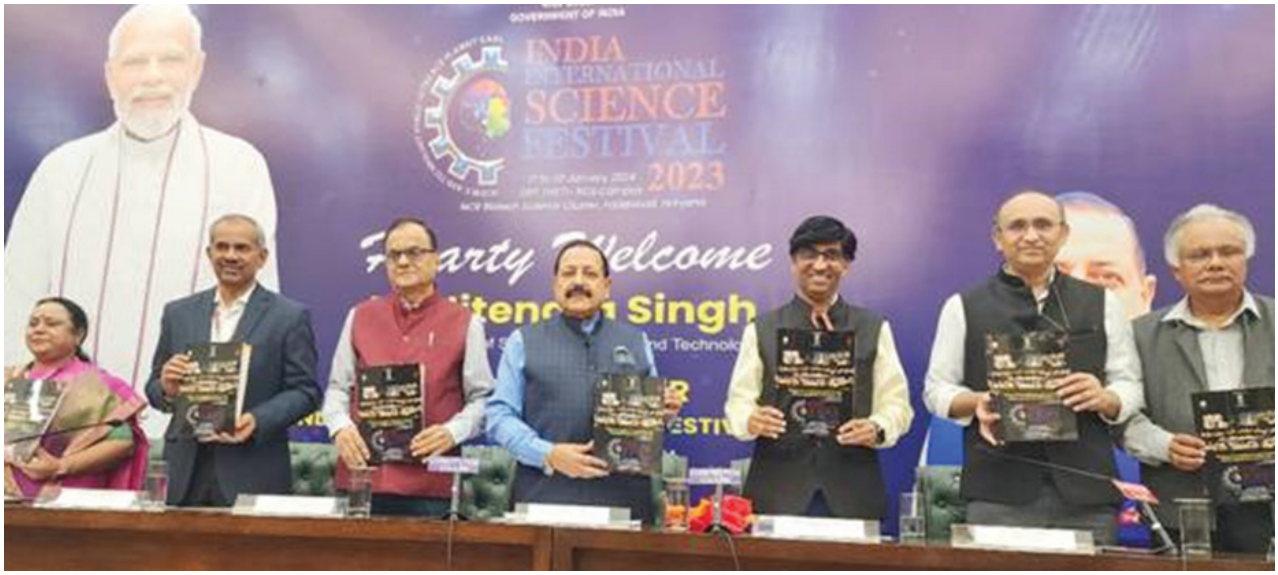

Image 3.9: Releasing the brochure of the ninth edition of India International Science Festival (IISF) 2023 by Dr. Jitendra Singh, Hon'ble Min. of State (S&T) at the centre, Ms. A. Dhanalakshmi (Joint Secretary, DST), Dr. M Ravichandran (Secretary MoES), Prof. Ajay Kumar Sood (PSA), Dr. Abhay Karadikar (Secretary DST), Dr. Rajesh S. Gokhale (Secretary DBT), and Prof. Sudhir Bhaduria.
(**Source:** https://dst.gov.in/sites/default/files/IISF-Ease%20of%20Living1.png)

Technology Summit - The DST-CII Technology Summit is a major yearly flagship event that is organized together by India's Department of Science & Technology (DST) and the Confederation of Indian Industry (CII). It plays a crucial role in promoting global partnerships in science, technology, and innovation. The summit brings together technology experts, policymakers, industry leaders, academic researchers, and startups from India and other partner countries like the Netherlands, Brazil, Canada, and Russia. They come together to discuss collaboration in various fields such as climate technologies, advanced manufacturing, healthcare, agriculture, mobility, water, and new materials.

Image 3.10: Glimpse of the Technology Summit 2021
(**Source**: https://www.pib.gov.in/PressReleaseIframePage.aspx?PRID=1800528)

Festival of Innovation and Entrepreneurship- An initiative to recognise, respect, showcase, reward innovations and to foster a supportive ecosystem for innovators, is being organised by Rashtrapati Bhavan in association with the Department of Science and Technology, Government of India and the National Innovation Foundation annually since 2018 highlighting grassroots innovations from across India, providing a platform for rural and traditional innovators to showcase problem-solving technologies.

Image 3.11: FINE inaugurated by the President of India
(**Source:** https://nif.org.in/upload/fine/FINE_2023_report.pdf)

Smart India Hackathon - A major nationwide program initiated by the Ministry of Education's Innovation Cell (MIC), the All-India Council for Technical Education (AICTE), and various partner ministries in line with the Prime Minister's vision to foster innovation, entrepreneurship, and a problem-solving mindset among students, contributing to the *Digital India* and *Atmanirbhar Bharat* initiatives. Started in 2017, it offers organizations a unique platform to access innovative and cost-effective solutions to real-world challenges while actively contributing to nation-building through innovation-led problem solving. It provides extensive national recognition and brand visibility across premier institutions in India, positioning companies as enablers of innovation. By engaging with talented youth from across the country, SIH facilitates the development of out-of-the-box solutions that address critical problems through fresh perspectives and cutting-edge approaches. As part of the world's largest open innovation movement, participating organizations gain the opportunity to collaborate with some of the brightest young minds, fostering partnerships that drive creativity, entrepreneurship, and future-ready technologies.

Image 3.12: PM Shri Narendra Modi Interaction with SIH Finalists at Grand Finale of SIH
(**Source:** https://www.pib.gov.in/PressReleasePage.aspx?PRID=1988472)

YUGM Innovation Conclave: Co-hosted by the Ministry of Education and the Wadhwani Foundation, YUGM 2025 convenes leaders from government, academia, and industry to advance India's innovation agenda. This landmark gathering of visionaries aims to accelerate the translation of research into real-world outcomes, shaping a future-ready India. In a recent conclave held in April 2025, it marked the launch of several high-impact initiatives, including Superhubs at IIT Kanpur (focusing on AI & intelligent systems) and IIT Bombay (dedicated to biosciences, biotechnology, and health), Wadhwani Innovation Network (WIN) Centers for research commercialization, and a ₹200 crore co-funding framework with the Anusandhan National Research Foundation to support late-stage translational research in domains like AI, quantum tech, and health-tech. Prime Minister Narendra Modi, addressing the conclave, articulated a bold vision: "Make AI in India; Make AI Work for India," reinforcing the need to compress the time from idea to prototype to product and positioning India as a rising global R&D powerhouse.

Image 3.13: Prime Minister Shri Narendra Modi and Dr. Jitendra Singh, Hon'ble Min. of State (S&T) along with Dr. Romesh Wadhwani, founder of the Wadhwani Foundation at the addressing of YUGM conclave 2025

(**Source:** https://www.pib.gov.in/PressReleasePage.aspx?PRID=2125248)

Semicon India: SEMICON India 2025 is a fair/event aimed at highlighting the emerging technologies and solutions shaping the future of electronics in India. It is conducted by SEMI IESA India and attended by Business and technology leaders, researchers, and industry analysts from across the microelectronics supply chain. This is an annual event and was held from September 2 to September 4, 2025 at the Yashobhoomi convention centre in Delhi to discover the next frontier for semiconductor innovation and growth.

Image 3.14: Inauguration ceremony in SEMICON 2023

(**Source:** https://www.pib.gov.in/PressReleseDetailm.aspx?PRID=1942448)

FICCI Bharat R&D Summit: A flagship annual convening of leaders from industry, academia, government, and startups, organized by the Federation of Indian Chambers of Commerce & Industry (FICCI). The summit focuses on strengthening industry–academia collaboration to drive research commercialization, foster innovation, and shape policy frameworks that bolster India's R&D ecosystem. Highlights include panel discussions, fireside chats, technology showcases, and the launch of a compendium of technologies

available for commercialization. With engaged participation from senior policymakers and thought leaders, the event is instrumental in translating academic innovation into market-ready solutions and aligning stakeholders around India's vision to strengthen its global innovation leadership.

Image 3.15: FICCI Bharat R&D Summit 2024
(**Source:** https://bharatrndsummit.ficci.in/img/3.JPG)

NASSCOM Technology & Leadership Forum: NASSCOM hosts a series of impactful innovation events that encompass the entire range of India's technology ecosystem. These events include the Digital Innovation Conclave, which delves into digital transformation across various sectors such as healthcare, fintech, and agriculture; the Future Forge & Tech Developer Confluence, which emphasizes deep tech strategy and its implementation; the Design & Engineering Summit, which promotes product research and development in semiconductors, telecommunications, and automotive industries; the GCC Summit & Awards, which showcases leadership in innovation within Global Capability Centers; and the People Summit, which fosters discussions on talent, leadership, and inclusion in a world increasingly influenced by AI. Through a variety of curated workshops, networking opportunities, and showcases, these events facilitate collaboration across sectors, enhance visibility for startups, and help shape strategic directions for innovation within the industry.

ASSOCHAM: The ASSOCHAM (Associated Chambers of Commerce & Industry of India) frequently organizes events focused on innovation that encourage technological progress and strategic discussions across various sectors. Among these, the Innovation Nexus: Conference on Security, Data Protection & AI stands out, as it is co-hosted with Telangana's IT department and industry collaborators to investigate emerging trends in generative AI, cybersecurity, and the ethical implementation of technology—uniting government policymakers, scholars, and industry specialists. Another important platform is the Symposium on Accelerating Adoption of Industry 4.0 Technologies, which takes place in Karnataka and tackles the challenges and strategies for MSMEs to embrace AI, IoT, and smart manufacturing solutions. These events illustrate ASSOCHAM's commitment to shaping the dialogue on innovation, encouraging the adoption of cutting-edge technologies, and enhancing collaboration among industry, academia, and the public sector.

In addition to all these major events, India observes several nationally significant days that celebrate and promote innovation, science, and technology, marked by thematic events, exhibitions, and outreach activities. For instance, **National Science Day** is celebrated with science exhibitions, innovation challenges, workshops, and public engagement programs aimed at promoting a scientific mindset. **National Technology Day** recognizes India's technological milestones, including the Pokhran-II nuclear tests; it includes technology showcases, startup exhibitions, innovation awards, and policy announcements that support research and development as well as emerging technologies. **National Mathematics Day** pays tribute to the legacy of Srinivasa Ramanujan; it features mathematics innovation fairs, problem-solving competitions, and awareness programs designed to boost the culture of mathematical research. Together, these days act as platforms to display homegrown innovations, encourage youth involvement, strengthen connections between industry and academia, and align innovation efforts with national goals. **National Space Day** is celebrated to commemorate the successful soft landing of Chandrayaan-3 on the Moon in 2023 and the event organizes activities including space innovation exhibitions, lectures by ISRO scientists, student competitions (model rocketry, satellite design, quizzes), and public outreach events showcasing achievements in satellite technology, planetary exploration, and emerging domains like space startups and private sector participation.

Several other activities that could make an impact in fostering innovation include BFSI Innovation & Technology Summit, BioTech Kisan, Pharma & Biotech Innovation Summits, Automotive Tech Innovation Challenges, University annual events and many more. Events like Hackathons, Startup Grand Challenges, and Innovation Bootcamps further create pathways for idea-to-market translation and scaling. Collectively, these activities enhance grassroots participation, promote cross-sectoral innovation, and build a robust pipeline of talent, technologies, and enterprises driving India's transformation into a global innovation hub.

CHAPTER 4
India in The Global Innovation Landscape

Global benchmarking of innovation ecosystems has emerged as a critical practice for policymakers, investors, and organizations seeking to understand relative performance and identify best practices across national and regional innovation systems. These comparative frameworks provide diagnostic insights into strengths and weaknesses while highlighting strategic opportunities for ecosystem development.

In the last decade or so, India is establishing itself as an innovation driven economy as evident from its performance reflected in various international benchmarking reports or indices. There are several globally recognized indices that benchmark and assess the strength, efficiency, and performance of innovation ecosystems across countries. These indices evaluate different dimensions such as policy environment, entrepreneurship, R&D, technology output, human capital, and infrastructure.

This chapter provides a comprehensive overview of India's innovation landscape through multiple global and national benchmarks. It begins with the Global Innovation Index (GII) 2025, where India has achieved the 38th position, reflecting its growing stature in the global innovation ecosystem (**Section 4.1**). Further, the report examines the European Innovation Scoreboard (**Section 4.2)**. Complementary perspectives are drawn from the OECD- Science, Technology and Innovation Scoreboard (**Section 4.3**), and the Bloomberg Innovation Index **(Section 4.4**), offering insights into India's relative performance across research, industry, and technology domains. India's start-up ecosystem growth is examined thereafter (**Section 4.5**). This is followed by a look into India's growing contribution to research publications and its rising strength in intellectual property generation including patents, trademarks, and geographical indications (**Section 4.6**), as well as the role of intangible assets and the creative economy (**Section 4.7**). Additionally, other key dimensions such as indicators from UNCTAD, the International Energy Agency (IEA), the UN Sustainable Development Goals (SDGs), and India's global leadership in generic medicines and vaccines **(Section 4.8**) are included to present a holistic picture of how innovation is shaping India's development and international positioning.

Box 4.1 India's Global Innovation Status

- 38th among 139 countries *(Global Innovation Index 2025)*.[1]
- Among the top 10 Knowledge Producers (on the basis of *Research Publications 2024*).[2]
- Globally 6th largest number of *patent applications*[3].
- Fastest ***annual growth of 6.6% in Intangible Investment*** among major economies.[4]
- **Four (04) Indian Science & Technology** clusters featured among world's top 100.[1]

- India boasts globally the **3rd largest startup ecosystem** with *more than 1.57 lakh DPIIT recognised startups*. These startups have *generated about 17.28 lakh jobs* until December 2024[5].

References:

[1] World Intellectual Property Organization (WIPO) (2024). Global Innovation Index 2025: Innovation at a Crossroads. Geneva: WIPO. DOI: 10.34667/tind.58864. https://www.wipo.int/web-publications/global-innovation-index-2025/assets/80937/global-innovation-index-2025-en.pdf

[2] Singh P, Singh VK, Arora P & Bhattacharya S. India's rank and global share in scientific research: How data sourced from different databases can produce varying outcomes? J Sci Ind Res. 2021; 80(4): 336-46. http://op.niscpr.res.in/index.php/JSIR/article/viewFile/38273/465479245

[3] https://www.pib.gov.in/PressReleaseIframePage.aspx?PRID=2073890.

[4] https://www.wipo.int/edocs/pubdocs/en/wipo-pub-rn2025-8-en-world-intangible-investment-highlights.pdf

[5] https://www.pib.gov.in/PressReleasePage.aspx?PRID=2098452

4.1 The Global Innovation Index (GII)

The Global Innovation Index (GII) is led by the World Intellectual Property Organization (WIPO) and supported by the Portulans Institute, who contribute to its research, data, and methodology. GII ranks the world's leading economies based on their innovation capabilities, assessed through two main sub-indices: **i) Innovation Inputs,** and **ii) Innovation Outputs**.

Inputs encompass majorly five pillars: Institutions, Human Capital and Research, Infrastructure, Market Sophistication and Business Sophistication, which reflect the environment and resources that support innovation. Outputs include Knowledge and Technology Outputs, and Creative Outputs, capturing results such as patents, technology exports, and creative products. Switzerland, Sweden, the United States, and Singapore regularly appear among leading nations, each exemplifying different approaches to innovation excellence.

In the **Global Innovation Index (GII) 2025,** India achieved the **38th position** among 139 global economies, marking a continued upward trajectory in its innovation capabilities from rank 81 in 2015. Further, India leads in the Central and Southern Asian region, and stands out as the top-performing in lower-middle-income economies**.** With notable strengths in science and engineering graduates, software exports, mobile app creation, and minority investor protection, India secures top 10 global rankings in several indicators. However, challenges persist in areas such as education and R&D expenditure, environmental sustainability, and university-industry collaboration. India also features in the global top 40 middle income economies along with China, Malaysia, Türkiye, and Bulgaria. Additionally, India continues to be recognized as a consistent innovation performer for the 15th consecutive year, reflecting sustained progress relative to its income group (Figure 4.1b).[31]

India

GII 2025 rank **38**

Output rank	Input rank	Income	Region	Population (mn)	GDP, PPP$ (bn)	GDP per capita, PPP$
32	52	Lower middle	CSA	1,450.9	16,020.0	11,112

		Score/ Value	Rank	
Institutions		**53.5**	**58**	◆
1.1	**Institutional environment**	**56.0**	**63**	◆
1.1.1	Operational stability for businesses*	57.3	79	
1.1.2	Government effectiveness*	54.7	47	◆
1.2	**Regulatory environment**	**50.2**	**65**	◆
1.2.1	Regulatory quality*	43.6	81	◆
1.2.2	Rule of law*	56.8	60	◆
1.3	**Business environment**	**54.2**	**53**	
1.3.1	Policy stability for doing business†	38.7	84	
1.3.2	Entrepreneurship policies and culture†	69.7	12	● ◆
Human capital and research		**34.7**	**54**	◆
2.1	**Education**	**45.9**	**85**	
2.1.1	Expenditure on education, % GDP	4.1	70	
2.1.2	Government funding/pupil, secondary, % GDP/cap	17.9	53	
2.1.3	School life expectancy, years	13.4	79	
2.1.4	PISA scales in reading, maths and science	n/a	n/a	
2.1.5	Pupil–teacher ratio, secondary	18.8	98	○
2.2	**Tertiary education**	**25.1**	**82**	
2.2.1	Tertiary enrolment, % gross	34.4	89	
2.2.2	Graduates in science and engineering, %	27.1	35	
2.2.3	Tertiary inbound mobility, %	0.1	113	○
2.3	**Research and development (R&D)**	**33.3**	**34**	◆
2.3.1	Researchers, FTE/mn pop.	259.3	80	○
2.3.2	Gross expenditure on R&D, % GDP	0.6	56	◆
2.3.3	Global corporate R&D investors, top 3, mn USD	68.1	16	● ◆
2.3.4	QS university ranking, top 3*	52.4	22	◆
Infrastructure		**45.2**	**61**	◆
3.1	**Information and communication technology (ICT)**	**78.8**	**60**	◆
3.1.1	ICT access*	84.0	72	◆
3.1.2	ICT use*	74.2	81	
3.1.3	Government online service*	78.2	44	◆
3.2	**General infrastructure**	**43.5**	**37**	◆
3.2.1	Electricity output, GWh/mn pop.	1,365.4	94	○
3.2.2	Logistics performance*	59.1	37	◆
3.2.3	Gross capital formation, % GDP	33.3	14	●
3.3	**Ecological sustainability**	**13.3**	**103**	○
3.3.1	GDP/unit of energy use	10.0	76	
3.3.2	Low-carbon energy use, %	10.4	92	
3.3.3	ISO 14001 environment/bn PPP$ GDP	0.9	72	
Market sophistication		**43.1**	**38**	◆
4.1	**Credit**	**34.5**	**50**	
4.1.1	Finance for startups and scaleups†	81.5	9	● ◆
4.1.2	Domestic credit to private sector, % GDP	50.1	64	
4.1.3	Loans from microfinance institutions, % GDP	0.4	48	○
4.2	**Investment**	**18.7**	**33**	◆
4.2.1	Market capitalization, % GDP	106.0	18	◆
4.2.2	Venture capital (VC) received, deal count/bn PPP$ GDP	0.1	45	◆
4.2.3	Late-stage VC deal count, % global VC	1.4	4	● ◆
4.2.4	VC investors, deal count/bn PPP$ GDP	0.1	63	
4.2.5	VC investor co-participation/bn PPP$ GDP	0.1	52	◆
4.3	**Trade, diversification and market scale**	**76.1**	**46**	◆
4.3.1	Applied tariff rate, weighted avg., %	7.6	116	○
4.3.2	Domestic industry diversification	95.3	19	◆
4.3.3	Domestic market scale, bn PPP$	16,020.0	3	● ◆

		Score/ Value	Rank	
Business sophistication		**29.2**	**64**	
5.1	**Knowledge workers**	**25.8**	**112**	○
5.1.1	Knowledge-intensive employment, %	11.6	95	○
5.1.2	Females employed w/advanced degrees, %	3.0	101	○
5.1.3	Youth demographic dividend, %	41.7	55	◇
5.1.4	GERD performed by business, % GDP	0.2	53	◆
5.1.5	GERD financed by business, %	40.6	42	
5.2	**Innovation linkages**	**26.7**	**63**	
5.2.1	Public research–industry co-publications, %	2.3	35	◆
5.2.2	University–industry R&D collaboration†	28.2	91	
5.2.3	University industry and international engagement, top 5*	35.9	49	◆
5.2.4	State of cluster development†	41.9	81	
5.2.5	Patent families/bn PPP$ GDP	0.2	45	◆
5.3	**Knowledge absorption**	**35.1**	**38**	◆
5.3.1	Intellectual property payments, % total trade	1.4	24	◆
5.3.2	High-tech imports, % total trade	11.8	25	
5.3.3	ICT services imports, % total trade	2.7	25	◆
5.3.4	FDI net inflows, % GDP	1.2	107	○
5.3.5	Research talent, % in businesses	30.7	47	
Knowledge and technology outputs		**37.8**	**22**	◆
6.1	**Knowledge creation**	**25.5**	**38**	◆
6.1.1	Patents by origin/bn PPP$ GDP	3.4	19	◆
6.1.2	PCT patents by inventor origin/bn PPP$ GDP	0.2	43	◆
6.1.3	Utility models by origin/bn PPP$ GDP	-	-	
6.1.4	Scientific and technical articles/bn PPP$ GDP	7.1	90	
6.1.5	Citable documents H-index	43.7	19	◆
6.2	**Knowledge impact**	**48.5**	**11**	● ◆
6.2.1	Labor productivity growth, %	1.7	39	
6.2.2	Unicorn valuation, % GDP	4.0	11	● ◆
6.2.3	Software spending, % GDP	0.3	44	◆
6.2.4	High-tech manufacturing, %	35.1	31	◆
6.3	**Knowledge diffusion**	**39.4**	**27**	◆
6.3.1	Intellectual property receipts, % total trade	0.2	50	◆
6.3.2	Production and export complexity	59.8	42	◆
6.3.3	High-tech exports, % total trade	5.1	41	
6.3.4	ICT services exports, % total trade	13.6	1	● ◆
6.3.5	ISO 9001 quality/bn PPP$ GDP	4.0	63	
Creative outputs		**32.7**	**42**	◆
7.1	**Intangible assets**	**41.8**	**28**	◆
7.1.1	Intangible asset intensity, top 15, %	80.7	8	● ◆
7.1.2	Trademarks by origin/bn PPP$ GDP	32.4	59	
7.1.3	Global brand value, top 5,000, % GDP	5.7	31	◆
7.1.4	Industrial designs by origin/bn PPP$ GDP	1.7	41	
7.2	**Creative goods and services**	**21.4**	**53**	◆
7.2.1	Cultural and creative services exports, % total trade	2.2	13	● ◆
7.2.2	National feature films/mn pop. 15–69	2.5	52	
7.2.3	Entertainment and media market/th pop. 15–69	1.1	61	○
7.2.4	Creative goods exports, % total trade	1.8	26	
7.3	**Online creativity**	**25.9**	**64**	◆
7.3.1	Top-level domains (TLDs)/th pop. 15–69	1.1	99	
7.3.2	GitHub commits/mn pop. 15–69	5.6	74	
7.3.3	Mobile app creation/bn PPP$ GDP	70.9	40	◆

NOTES: ● indicates a strength; ○ a weakness; ◆ an income group strength; ◇ an income group weakness; * an index; † a survey question. ⏲ indicates that the economy's data are older than the base year; Square brackets [ ] indicate that the data minimum coverage (DMC) requirements were not met at the sub-pillar or pillar level; n/a represents missing values; a dash - indicates an indicator which is not relevant to this economy and thus not considered for DMC thresholds.

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Figure 4.1a: Indicator-wise ranking and scoring of India in global innovation index.
Source: World Intellectual Property Organization (WIPO) (2025). https://www.wipo.int/web-publications/global-innovation-index-2025/assets/80937/global-innovation-index-2025-en.pdf

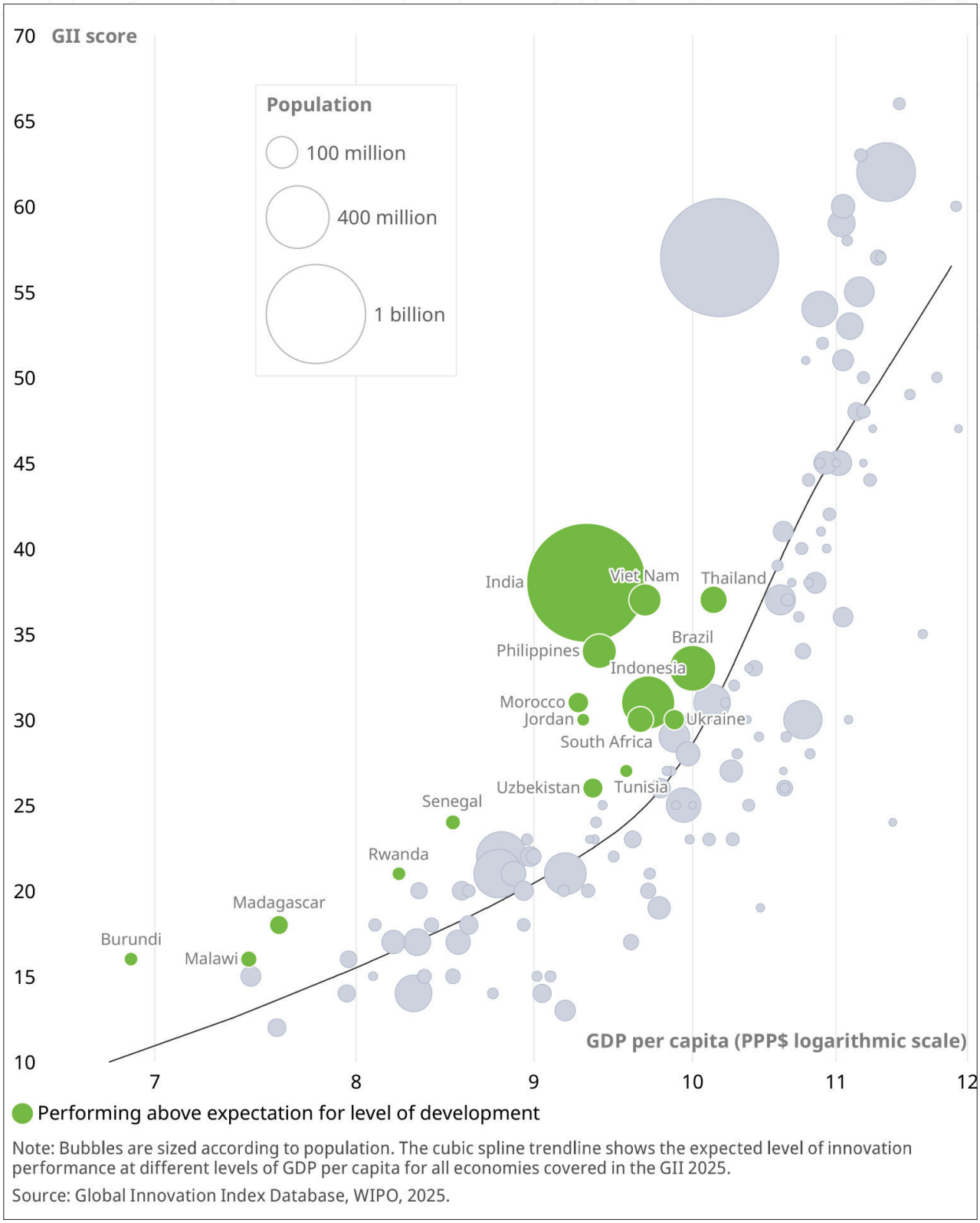
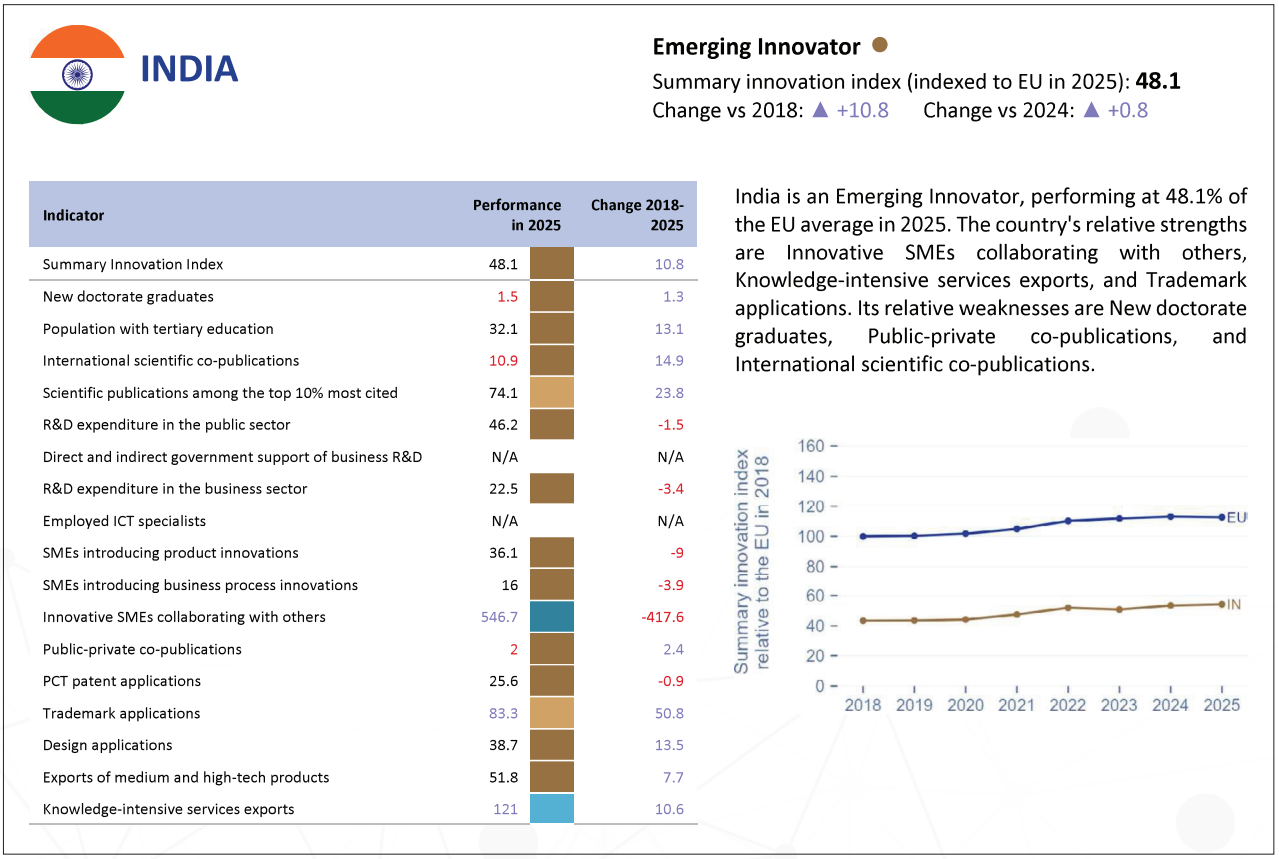


Figure 4.1b: India as the top Innovation overperformer, relative to economic development.
Source: World Intellectual Property Organization (WIPO) (2025).
https://www.wipo.int/web-publications/global-innovation-index-2025/assets/80937/global-innovation-index-2025-en.pdf

India is also steadily enhancing its global innovation footprint through several prominent science and technology (S&T) clusters, with four S&T clusters in top 100 globally. These four clusters namely, Bengaluru, Delhi, Chennai and Mumbai, are supported by robust academic and research infrastructures and a dynamic innovation environment. Additionally, cities such as Hyderabad, Chennai, and Pune are emerging rapidly as innovation hubs, gaining recognition for their increasing contributions to research and technology development. Collectively, these clusters reflect India's growing role as a key player in the global knowledge economy.

4.2 European Innovation Scoreboard

The European Innovation Scoreboard (EIS), published annually by the European Commission, evaluates and compares the innovation performance of EU Member States, neighbouring countries, and key global competitors using a comprehensive set of indicators across four areas: **Framework Conditions** (foundations such as education, research collaboration, digital skills, and internet access), **Investments** (public and private R&D funding, venture capital, and adoption of digital technologies), **Innovation Activities** (business efforts in product development, process improvements, collaboration, and intellectual property filings), and **Impacts** (outcomes like revenues from new products, job creation in innovative firms, high-tech exports, and resource efficiency).



Indicator	Performance in 2025	Change 2018-2025
Summary Innovation Index	48.1	10.8
New doctorate graduates	1.5	1.3
Population with tertiary education	32.1	13.1
International scientific co-publications	10.9	14.9
Scientific publications among the top 10% most cited	74.1	23.8
R&D expenditure in the public sector	46.2	-1.5
Direct and indirect government support of business R&D	N/A	N/A
R&D expenditure in the business sector	22.5	-3.4
Employed ICT specialists	N/A	N/A
SMEs introducing product innovations	36.1	-9
SMEs introducing business process innovations	16	-3.9
Innovative SMEs collaborating with others	546.7	-417.6
Public-private co-publications	2	2.4
PCT patent applications	25.6	-0.9
Trademark applications	83.3	50.8
Design applications	38.7	13.5
Exports of medium and high-tech products	51.8	7.7
Knowledge-intensive services exports	121	10.6

Figure 4.2: Innovation performance of India as emerging Innovator.
Source: European Commission, Directorate-General for Research and Innovation. European Innovation Scoreboard 2025. Luxembourg: Publications Office of the European Union; 2025. https://doi.org/10.2777/3239776

EIS 2025 identifies countries as "Innovation Leaders," "Strong Innovators," "Moderate Innovators," and "Emerging Innovators," while also highlighting regional hubs with outstanding performance. India is placed among the **"Emerging Innovators"**, reflecting that its innovation performance, at 48.1% of the EU average in 2025, is still developing (Figure 4.2). However, this marks a **notable improvement of 55 percentage points since 2018**, underscoring India's steady upward trajectory in innovation. While countries like China, South Korea, and the United States currently outperform the EU and remain ahead of India, the sustained progress signals that India is rapidly strengthening its innovation ecosystem and is well-positioned to narrow the gap with the world's leading innovation economies in the coming years.[32]

4.3 OECD - Science, Technology and Innovation Scoreboard

The OECD's *Science, Technology and Innovation Scoreboard*, which provides numerous indicators on research, innovation, patents, education, and the economy, includes a measure of "Product innovative firms, R&D-active (in-house and/or external), as a percentage of total firms," showing how active countries are in creating new ideas.

According to this indicator**, 65% of Indian firms are innovative or R&D-active** (Figure 4.3), putting India ahead of Japan and close to Korea. While some countries like Czech Republic, Greece, and Canada have nearly 100% participation, India's performance shows good progress and a strong base to build on, with plenty of room to further expand innovation and R&D among its firms.[33]

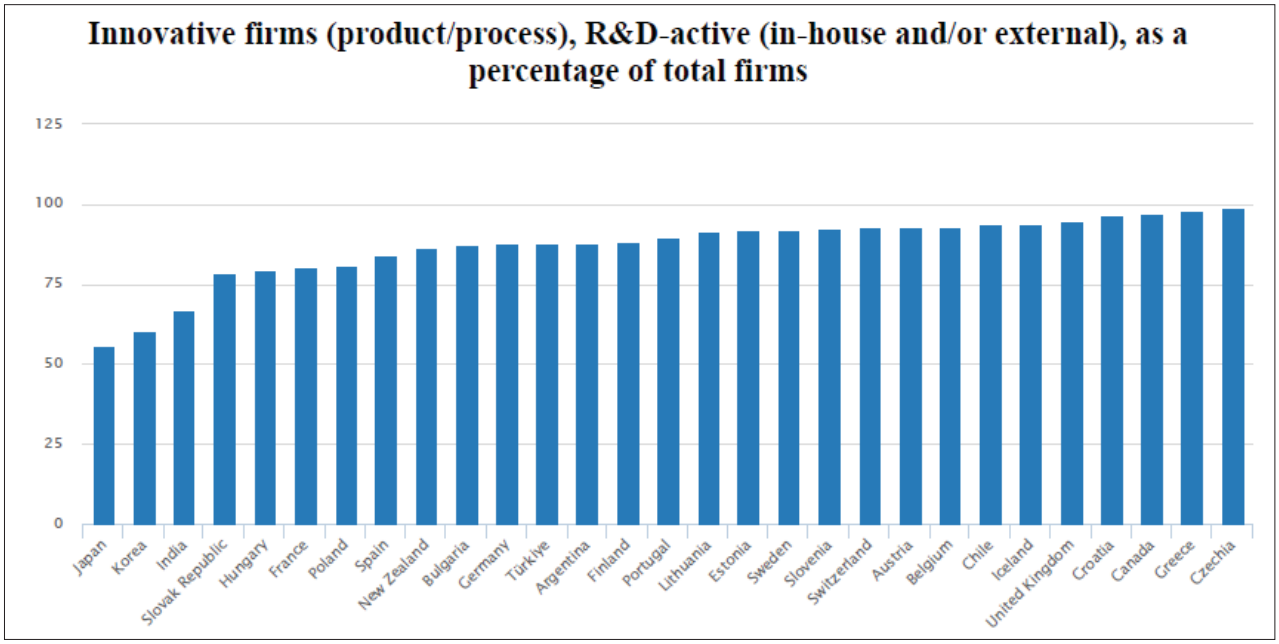


Figure 4.3: India's performance in OECD's Science, Technology and Innovation Scoreboard, Indicator: Product innovative, & R&D-active firms.
(**Source:** https://stip.oecd.org/stats/SB-StatTrends.html?i=G_XGDP&v=3&t=1998,2021&s=CHN,EU27_2021,JPN,KOR,OECD,USA,GBR)

4.4 Bloomberg Innovation Index

The Bloomberg Innovation Index evaluates countries based on several criteria, including research and development spending, manufacturing capability, and the concentration of high-tech public companies. India's inclusion in the Bloomberg Innovation Index and improvement in the rankings underscores its commitment to fostering an innovation-driven economy. This framework particularly highlights nations with strong manufacturing and industrial innovation capabilities, with South Korea, Germany, and Japan frequently ranking among top performers. In 2021, India secured the **50th position**, climbing four spots from 2019 (**54th** among 95 countries). Notably, it was the only South Asian country to feature in the top 50 that year.[34]

(*N.B. - Bloomberg Innovation Index - has been discontinued. The BII 2021 was the last assessment report*).

4.5 Startup ecosystem

India has emerged as the world's **third**-largest startup hub, with more than 1,57,000 startups registered under the Department for Promotion of Industry and Internal Trade (DPIIT) through the Startup India initiative, and over 100 unicorns as of 31 December 2024. These startups have collectively generated more than 17.28 lakh jobs, with 75,935 having at least one-woman director, highlighting the significant role of **women** in India's entrepreneurial ecosystem (Figure 4.5).[35]

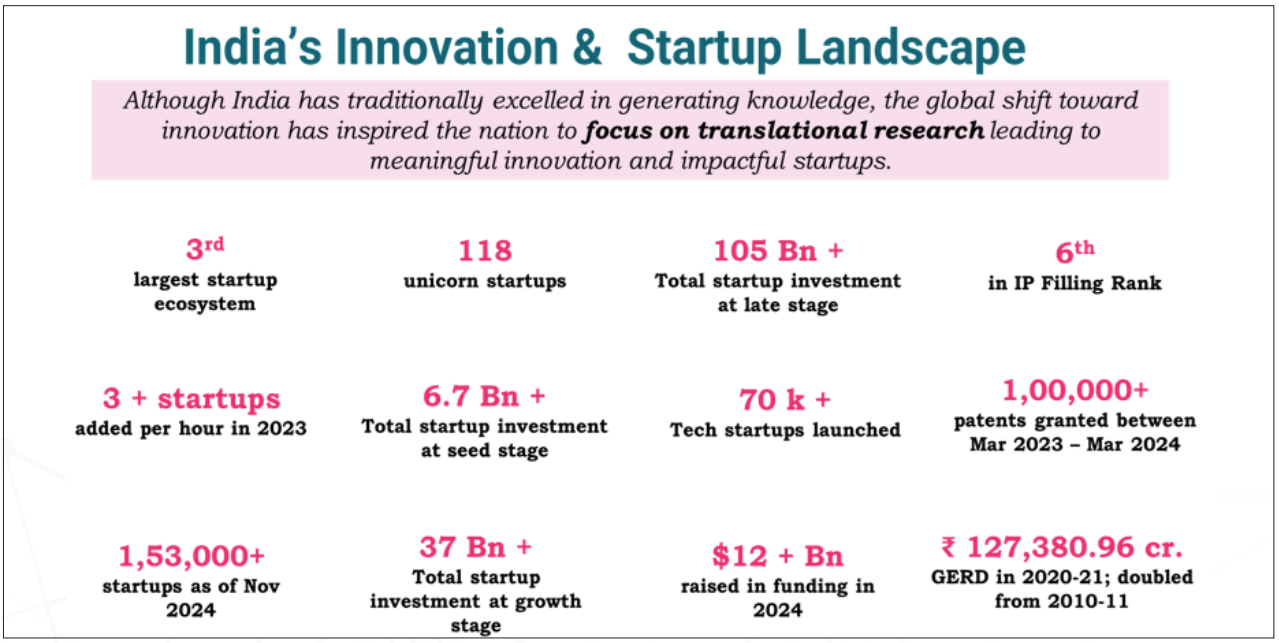


Figure 4.4: India's Innovation and startup landscape.
Source: NITI Workshop on Building Synergies in India Innovation Ecosystem, 2025

[34] https://www.bloomberg.com/news/articles/2021-02-03/south-korea-leads-world-in-innovation-u-s-drops-out-of-top-10
[35] https://www.pib.gov.in/PressReleasePage.aspx?PRID=2098452

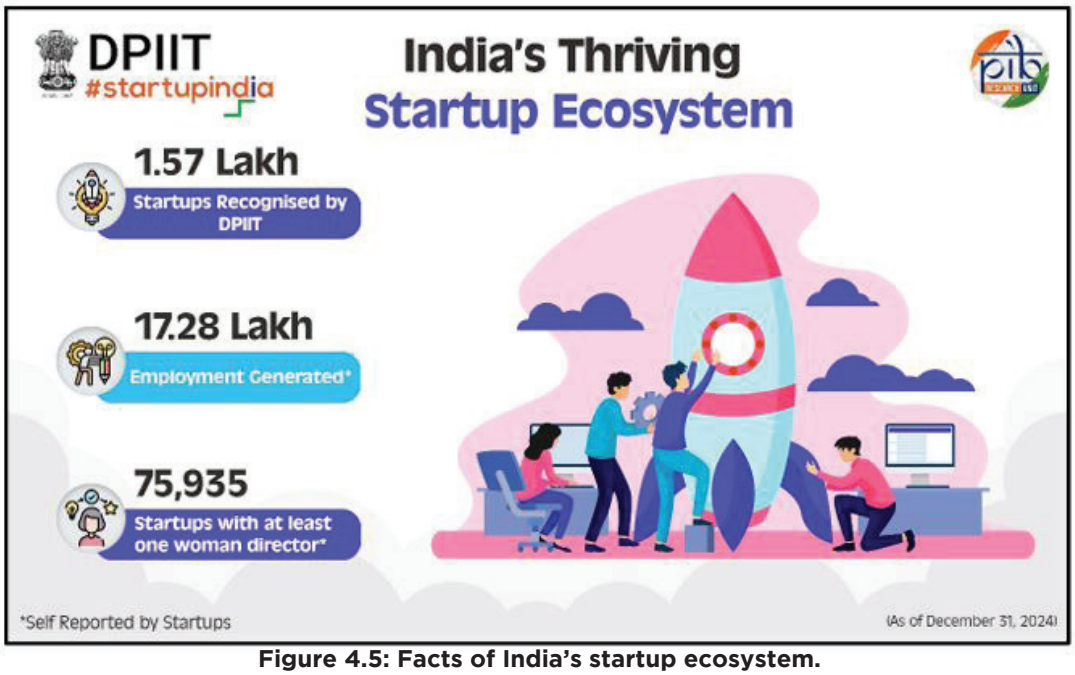


Figure 4.5: Facts of India's startup ecosystem.

(Source: https://www.pib.gov.in/PressReleasePage.aspx?PRID=2098452)

Startups in India have also been key drivers of employment generation across diverse sectors. The IT Services sector leads with 2.10 lakh jobs, followed by Healthcare and Lifesciences (1.51 lakh), while Professional and Commercial Services (96,474 jobs) and Education (92,694 jobs) have also made notable contributions. This demonstrates the central role of technology and healthcare in driving employment, supported by education and professional services.

At the global level, India's entrepreneurial strength is reflected in the Global Entrepreneurship Monitor (GEM) 2023/2024 Global Report, which is the world's leading study on entrepreneurship. GEM ranks countries based on the **National Entrepreneurship Context Index (NECI)**, which assesses 13 key framework conditions. In the 2024 NECI rankings, India is placed 5th globally with a score of 6.1, the highest among lower GDP per capita countries (Group C). This ranking shows that while India is not among the wealthiest nations, it offers one of the most supportive environments for entrepreneurship (Figure 4.6).[36]

Complementing GEM, two other global benchmarking studies reaffirm India's rising global startup prominence. The **Global Startup Ecosystem Report (GSER) 2025** by Startup Genome evaluates ecosystems on six dimensions: performance, funding, market reach, talent & experience, AI-native transition, and knowledge, where it places Bengaluru and Delhi among the Top 40 ecosystems worldwide, underscoring India's rapid advances in innovation, funding, and AI-led growth. Similarly, **Startup Blink's Global Startup Ecosystem Index 2025,** which maps over 1,400 cities and 110 countries, identifies India as one of only three countries, alongside the US and China, with multiple cities ranked in the global Top 20 startup hubs. At the regional level, India leads South Asia with a decentralized yet vibrant startup network, anchored by hubs such as Bengaluru, Delhi, and Mumbai.[37]

[36] Global Entrepreneurship Monitor 2024/2025 Global Report: Entrepreneurship Reality Check
[37] The Global Startup Ecosystem Report 2025_GSER 2025; Ver 2, Startup Genome LLC_startupgenome.com https://www.startupblink.com/startupecosystemreport?mc_cid=9bf1ecf1bb&mc_eid=435ade751d

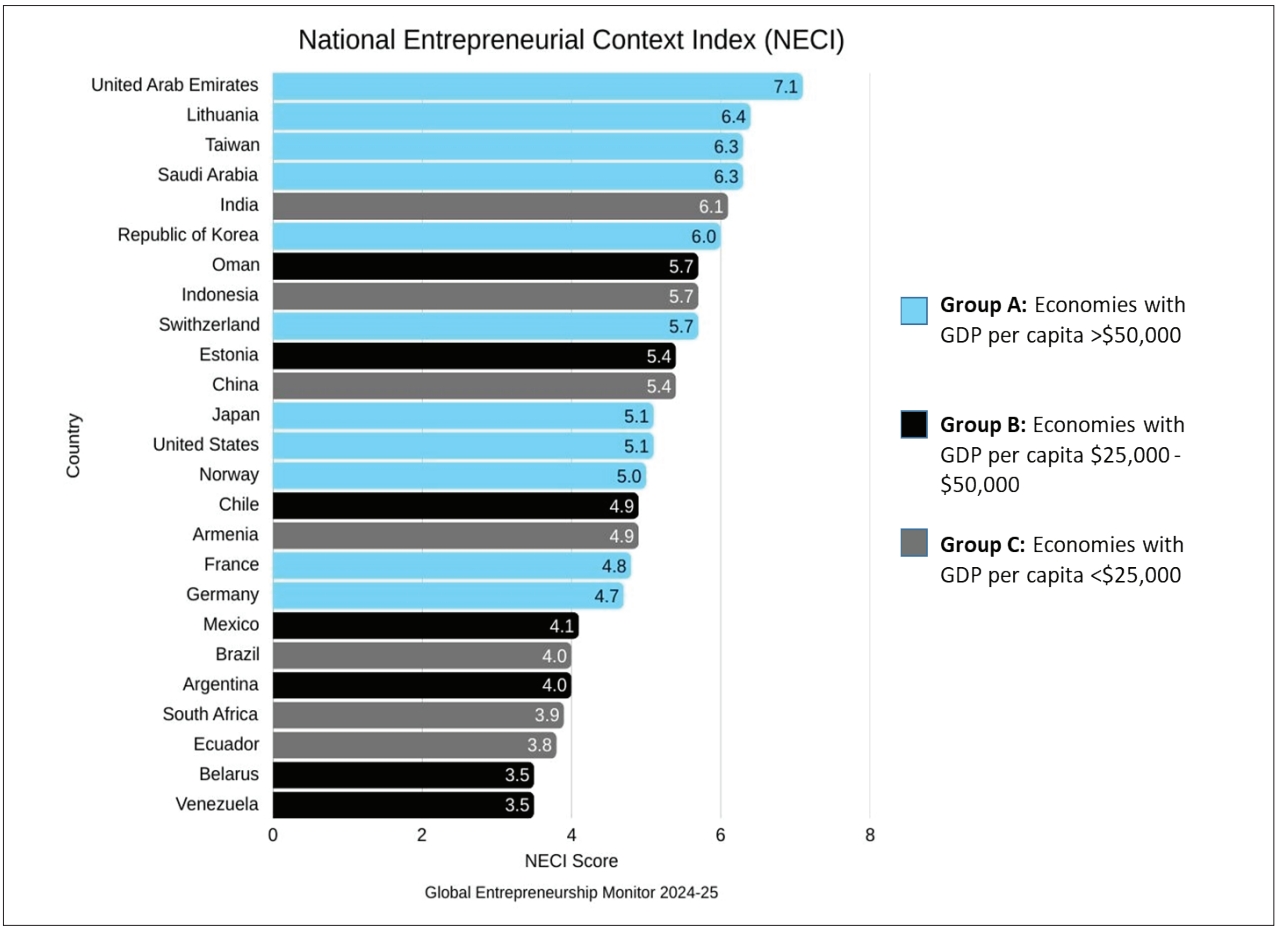


Figure 4.6: India ranks 5th in the world and 1st among the countries with Gross Domestic Product (GDP) per capita less than US $ 25,000 in the NECI 2024 rankings with a NECI score of 6.1.

(**Source:** Adapted from *Global Entrepreneurship Monitor 2024/2025 Global Report: Entrepreneurship Reality Check* https://gemconsortium.org/reports/latest-global-report)

4.6 Publications, Patents, Trademarks, and Geographical Indications

India has become a major global knowledge producer, consistently ranking among the **world's top 10**. Its research output and share of global publications have been rising steadily over the past two decades. However, studies and reports often place India at very different ranks, between 3rd and 9th globally, depending on the data source. Variations in India's global research ranking arise primarily from differences in database coverage and classification. While India's exact rank may differ across reports, the consistent trend is clear - ***India's research output and global share are growing steadily,*** establishing the country as a major knowledge producer worldwide.[38]

[38] Prashasti Singh, Vivek Kumar Singh, Parveen Arora and Sujit Bhattacharya, "India's Rank and Global Share in Scientific Research: How Data Sourced from Different Databases Can Produce Varying Outcomes?", Journal of Scientific and Industrial Research, Vol. 80, No. 04, pp. 336-346.

It has produced a total of about 3,341,068 **research publications**, of which 3,010,235 are citable. These have attracted **44.9 million citations**, including 15.8 million self-citations, yielding an average of **13.44 citations per paper**. With an **h-index of 925**, India's research footprint is expanding steadily, though there remains scope to further strengthen global visibility and impact.[39]

In Patents, Trademarks, and Industrial designs, India has secured a position among the **top 10 countries globally** reflecting its rising prominence in the international intellectual property (IP) landscape.[40]

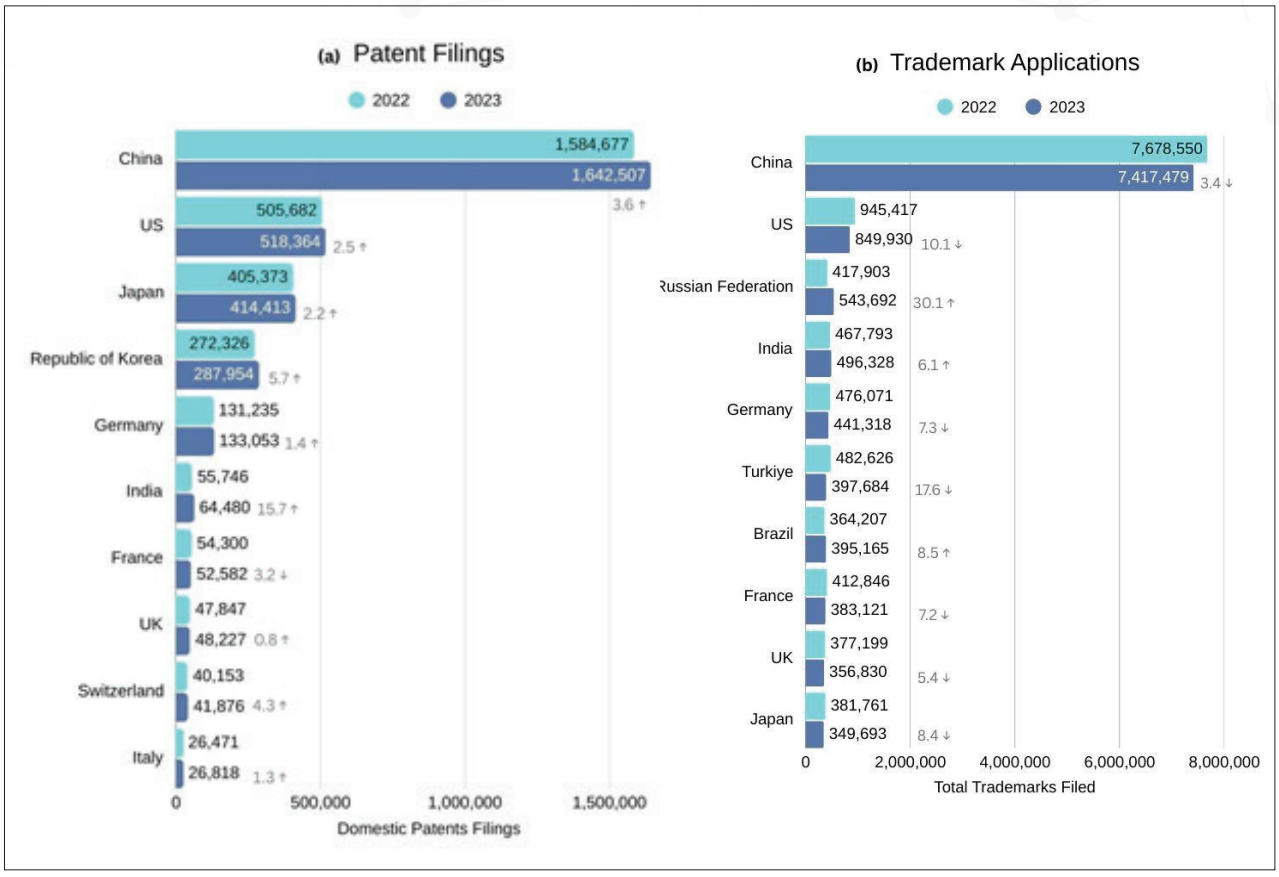


Figure 4.7: a) India ranks 6th in Resident patent applications for the top 10 origins, 2023. b) India ranks fourth in global trademark filing, 2023.
(**Source:** https://www.wipo.int/edocs/pubdocs/en/wipo-pub-941-2024-en-world-intellectual-property-indicators-2024.pdf)

Overall IP filings in India grew by 44% over the past five years, increasing from 4,77,533 in 2020-21 to 6,89,991 in 2024-25. The fastest growth was observed in Geographical Indications (380%), followed by Designs (266%), Patents (180%), Copyrights (83%), Trademarks (28%), and Semiconductor Integrated Circuits Layout-Designs (20%).[41]

In 2023, India became the **6th largest filer of patent applications worldwide** with **64,480 filings**, recording a **15.7% increase over 2022**, one of the highest growth rates among the top 20 origins globally (Figure 4.7a). *Origin data/Origins - Applications filed by applicants at a national or regional office (resident applications) or at a foreign office (applications abroad).

[39] https://www.scimagojr.com/countryrank.php
[40] https://www.pib.gov.in/PressReleasePage.aspx?PRID=2072706
[41] https://www.pib.gov.in/PressReleasePage.aspx?PRID=2146928

For the first time, **resident filings** (by domestic companies, universities, and researchers) accounted for 55.2% of total applications, signalling growing indigenous innovation capacity. Patents granted also increased sharply by 149.4%, while India's Patent: GDP ratio more than doubled, from 144 in 2013 to 381 in 2023, highlighting the strongerintegration of innovation into the economy.[42]

In **PCT international filing,** India ranks **9th** globally, reflecting strong innovation growth. With greater global reach and wider participation, India can further strengthen its position in national phase entries (Current - 19th rank) and per capita filings (current - 50th rank).[43]

India's performance in **trademarks** has been equally impressive. With 496,328 trademark applications in 2023, the country ranked fourth globally, recording a 6.1% increase over 2022 (Figure 4.7b).[44] Meanwhile, in **Geographical Indications (GIs)**, India has registered a total of 697 products spanning agriculture, handicrafts, manufactured goods, food items, and natural products, reflecting the growing recognition of cultural and economic heritage in IP protection.[45]

4.7 Intangible Assets and Creative Economy

Alongside the rise in IP activity, India has also shown remarkable progress in intangible asset investment, a critical driver of modern, knowledge-based economies. Intangible assets include IP rights, R&D, software, data, branding, organizational capabilities, and skilled human capital, all of which fuel innovation, productivity, and competitiveness.[46]

India recorded the **fastest growth** in intangible investment among major economies, **with an annual growth rate of 6.6%,** between 2014 and 2024, outpacing advanced innovation driven nations such as the United States, France, and Sweden (Figure 4.8). As per the latest WIPO-LBS World Intangible Investment Highlights 2025, India's intangible investment by 2022 had reached nearly USD 70 billion, about 10% of GDP, marking significant progress toward a knowledge-driven economy.[47]

[42] https://www.pib.gov.in/PressReleaseIframePage.aspx?PRID=2073890
[43] WIPO Statistics Database, March 2025
[44] https://www.pib.gov.in/PressReleaseIframePage.aspx?PRID=2073890
[45] https://www.pib.gov.in/PressReleasePage.aspx?PRID=2146928
[46] WIPO and Luiss Business School (2025). World Intangible Investment Highlights 2025. Geneva and Rome: World Intellectual Property Organization and Luiss Business School. www.wipo.int/en/web/intangible-assets/measuring-investments
[47] WIPO-LBS World Intangible Investment Highlights 2025- https://www.wipo.int/web-publications/world-intangible-investment-highlights-2025/en/world-intangible-investment-highlights-2025.html

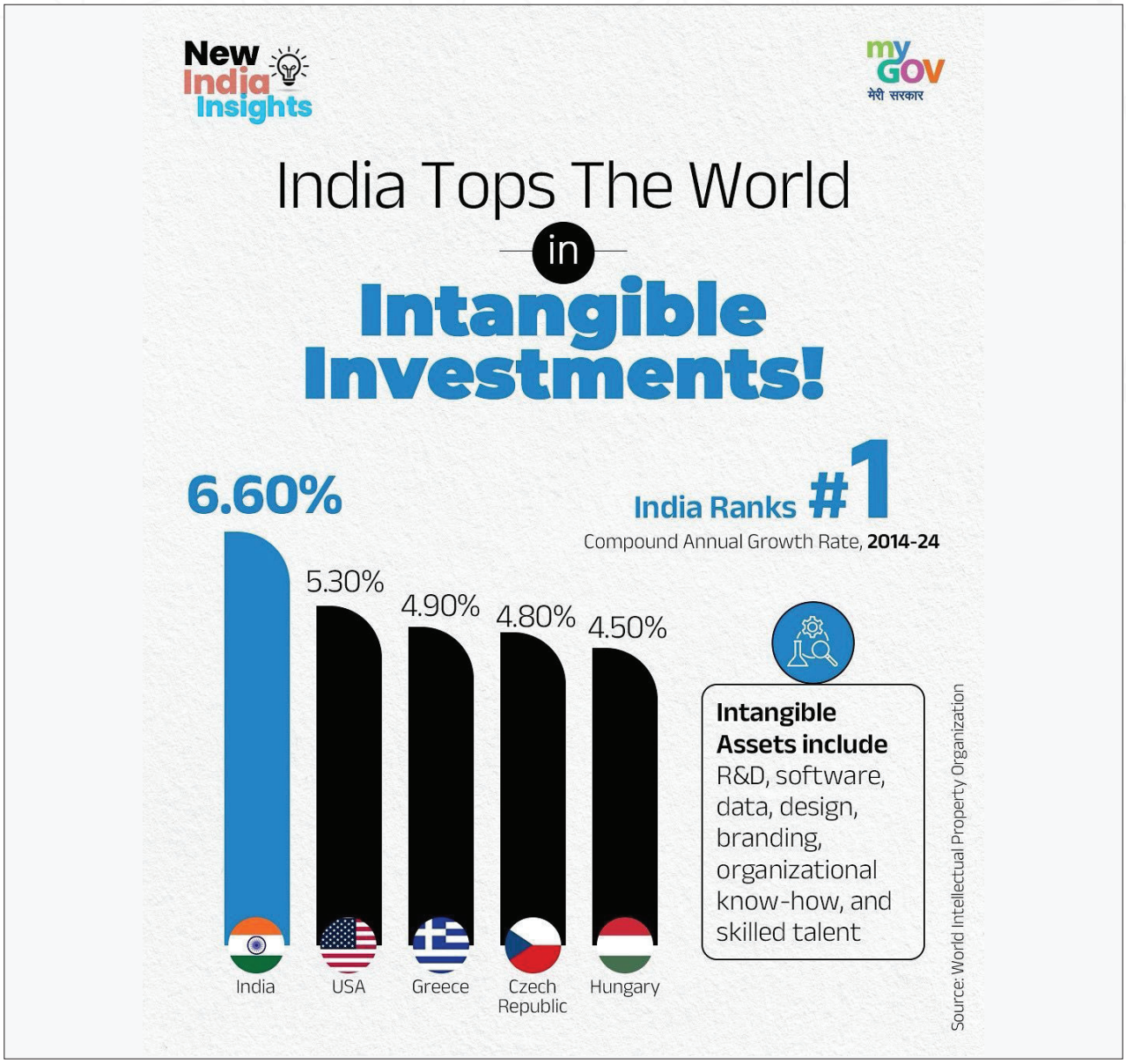


Figure 4.8: Annual growth rate of different economies in intangible investment.
Source: WIPO-LBS World Intangible Investment Highlights 2025

The composition of India's intangible investment highlights its digital strengths, with software and databases accounting for 50% of the total. Organizational capital contributes 23%, while R&D makes up around 5% **(Figure 4.9)**. Between 2014 and 2024, India along with Brazil, achieved intangible investment levels comparable to several advanced EU economies, reflecting a strong catch-up process from a lower base. This rapid expansion underscores India's growing capacity to harness digital infrastructure, innovation, and organizational capabilities as key drivers of long-term economic resilience.

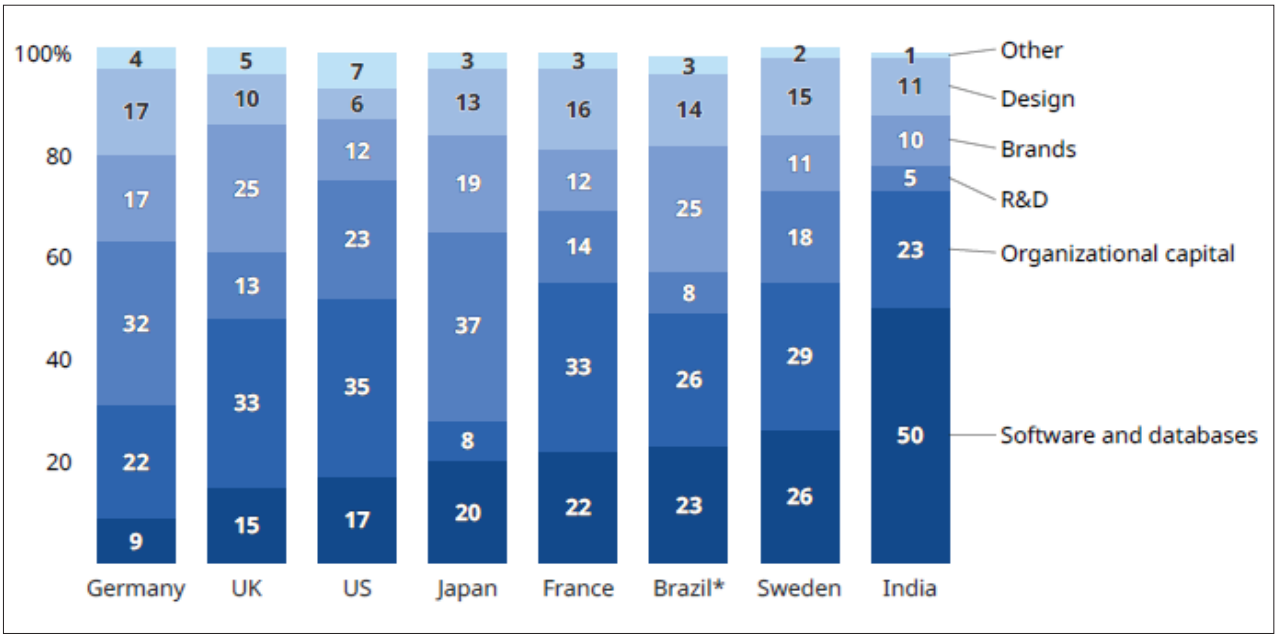


Figure 4.9: Analysis of asset types reveals varying investment across economies.
Source: World Intangible Investment Highlights 2025.

Closely linked to intangible assets is the **creative economy**, which includes industries such as painting, sculpture, performing arts, media, software, architecture, advertising, social media, fashion, design, publishing, and other creative products and services

India's creative economy is valued at USD 30 billion and employs nearly 8% of the workforce. Creative services exports touched USD 11 billion in 2024, growing at around 20% annually, led by IT and design, with contributions from arts, crafts, publishing, and grassroots innovations. With rising youth interest and supportive initiatives such as the All-India Initiative on Creative Economy (AIICE) launched in 2024, the sector is emerging as both a cultural asset and a driver of innovation and economic growth.[48,49]

4.8 India's Global Positioning: Some Other Salient Achievements

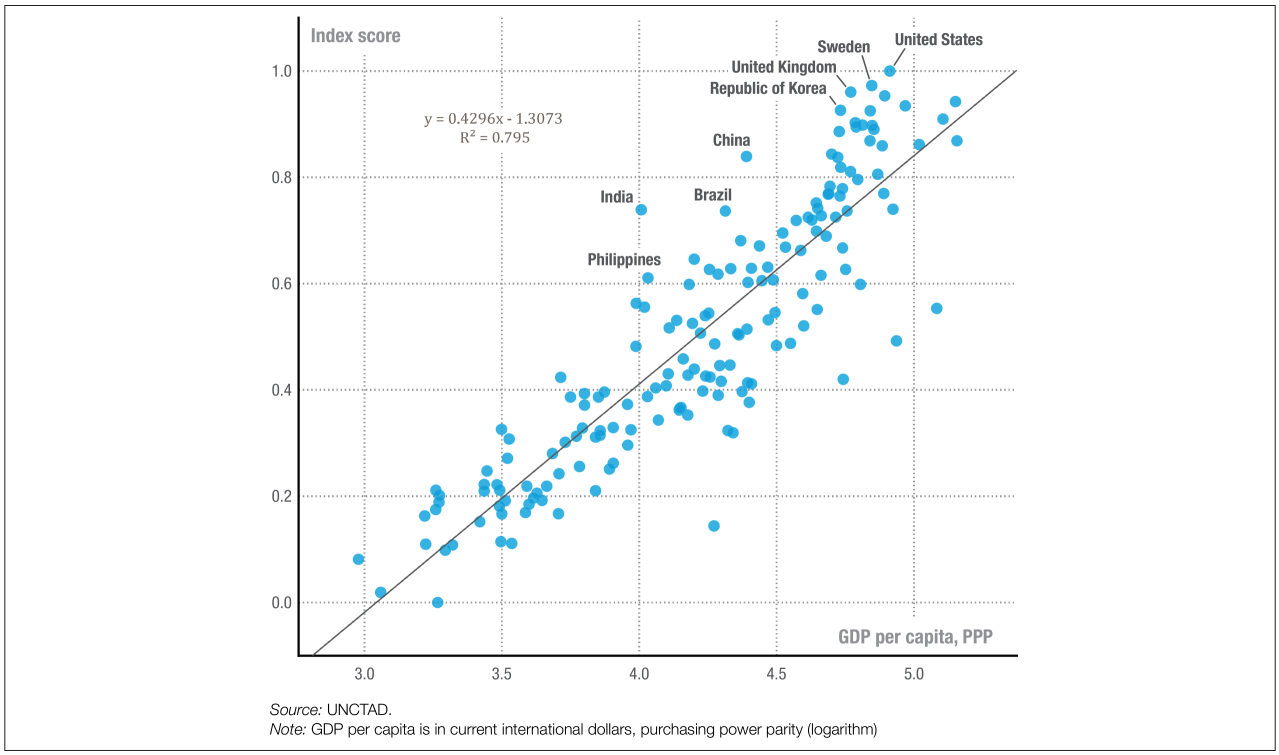
India's rising position as a global hub for innovation and technology is reflected in international assessments highlighting its progress in both digital and clean energy domains. According to **UN Conference on Trade and Development** (UNCTAD) data 2000 - 2023, India ranks among the global leaders in the *Internet of Things (IoT) and nanotechnology, with growing strengths in artificial intelligence (AI), green hydrogen, and concentrated solar power* **(Figure 4.10)**.

[48] Creative Economy Outlook 2024: https://unctad.org/publication/creative-economy-outlook-2024
49 PIB AIICE Press Release: https://pib.gov.in/PressReleasePage.aspx?PRID=2048272

		Patents					
		USA	China	Germany	India	Korea	Japan
Industry 4.0 frontier technologies	AI	1.2	0.8	1.3	1.7	1.1	1.4
	IoT	0.6	1.3	0.2	2.3	1.4	0.3
	Big data	0.1	1.7	0.0	0.4	0.9	0.1
	Blockchain	1.2	1.0	0.4	0.8	1.0	0.6
	5G	0.4	1.0	0.1	0.2	4.4	0.2
	3D printing	0.8	1.2	1.5	0.2	0.5	0.2
	Robotics	2.5	0.5	0.9	0.9	0.3	1.0
	Drone	1.0	1.0	0.8	0.7	1.6	0.7
Green frontier technologies	Solar PV	0.2	1.6	0.0	0.8	0.5	0.4
	Concentrated solar power	2.8	0.1	1.5	1.7	0.2	1.8
	Biofuels	2.1	0.3	0.8	0.9	0.5	0.7
	Biogas and biomass	1.0	0.9	1.2	0.6	0.3	0.9
	Wind energy	0.3	1.2	4.3	0.5	0.2	0.2
	Green hydrogen	0.7	1.1	1.0	1.5	0.8	0.4
	Electric vehicles	0.7	1.0	1.3	0.4	1.5	3.0
Other frontier technologies	Nanotechnology	1.3	0.5	0.9	3.0	0.4	0.3
	Gene editing	2.9	0.6	0.6	0.0	0.3	0.6

Figure 4.10: Revealed technology specialization of selected countries based on patent filings, 2000–2023. Figure of 1 = country's share in a technology equals its share in all frontier technologies; a figure above 1 indicates a specialization and a figure below 1 indicates "no specialization".
Source: Technology and Innovation Report 2025.

India is also performing above expectations in ***technology readiness relative to its income level***, supported by strong digital infrastructure, forward-looking policies, and a skilled workforce (Figure 4.11), indicating India's efforts to improve the country's innovation ecosystem, helping it lead in some frontier technologies.[50]



Source: UNCTAD.
Note: GDP per capita is in current international dollars, purchasing power parity (logarithm)

Figure 4.11: India in Technology Readiness vs GDP per capita. Correlation between Index Score and GDP per capita.
Source: UNCTAD, Technology and Innovation Report 2025.

[50] Technology and Innovation Report 2025 – Inclusive Artificial Intelligence for Development: https://unctad.org/system/files/official-document/tir2025_en.pdf

This trajectory is reinforced by India's advances in the clean energy transition, as recognized by the **International Energy Agency (IEA)**. The IEA *World Energy Investment 2025* report notes that renewable energy investment in India reached USD 33 billion in 2024, a 17% year-on-year increase, and is projected to grow by a further 12% in 2025. India is also on course to meet its goal of 50% non-fossil power capacity well before 2030, with increasing investments in Solar Photovoltaic (Figure 4.12).[51] Progress is evident in solar manufacturing, battery storage, electric vehicles, small modular reactors, and bioenergy, along with more than 12 billion sq. ft. of certified green building space achieved in 2024. With supportive policies, cost-effective innovation, and a strong talent base, India is steadily positioning itself as a global leader in clean energy innovation, contributing both to its domestic growth and to global sustainability efforts.

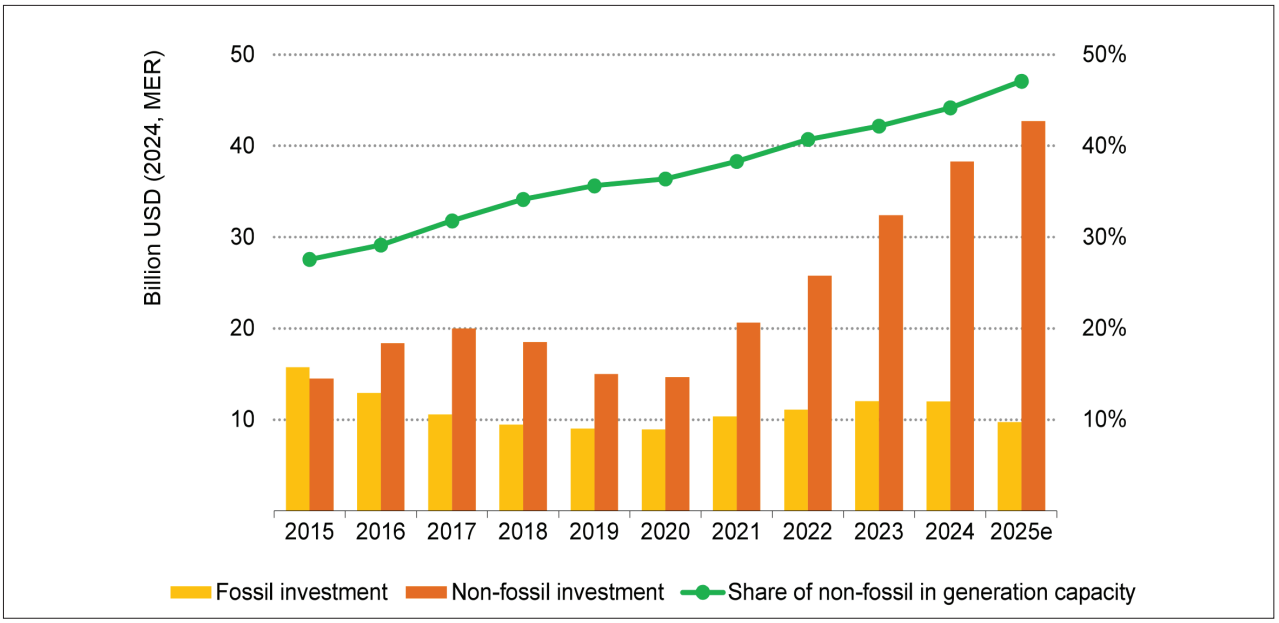


Figure 4.12: Strong investments are propelling India's shift to non-fossil power, achieving its 2030 goal early. MER- market exchange rates; 2025e - Estimated values for 2025.
Source: World Energy Investment 2025, 10th Edition, IEA.

Science and Technology Innovation in India is increasingly driving the nation's efforts to achieve the **United Nations Sustainable Development Goals (SDGs)** particularly, Affordable and Clean energy **(SDG 7),** Industry, Innovation and Infrastructure **(SDG 9),** Good Health and Well-being **(SDG 3)** through healthcare Research, Zero Hunger **(SDG 2)** through Agriculture advancements, and Responsible consumption and production **(SDG 12)**. According to Clarivate's 2025 G20 Scorecard, India prominently focuses on Affordable & Clean Energy (SDG 7), and Responsible Consumption & Production (SDG 12), amongst the various SDGs. Figure 4.13 highlights India's steady progress in advancing the United Nations SDGs. With an overall country score of 67.0, India has improved by 7.6 points since 2015, underscoring consistent progress in sustainable development. India's SDG trajectory demonstrates that science, technology, and innovation are central to its development pathway, with notable global leadership in clean energy and sustainability (SDG 7 & 12), as also reaffirmed by Clarivate's 2025 G20 Scorecard.[52] Industry and Infrastructure (SDG 9) remain priority areas, where India needs to accelerate progress.

[51] World Energy Investment 2025, 10th Edition, IEA
[52] https://clarivate.com/academia-government/wp-content/uploads/sites/3/dlm_uploads/2025/07/G20-Research-and-Innovation-Scorecard-2025-Executive-Summary.pdf

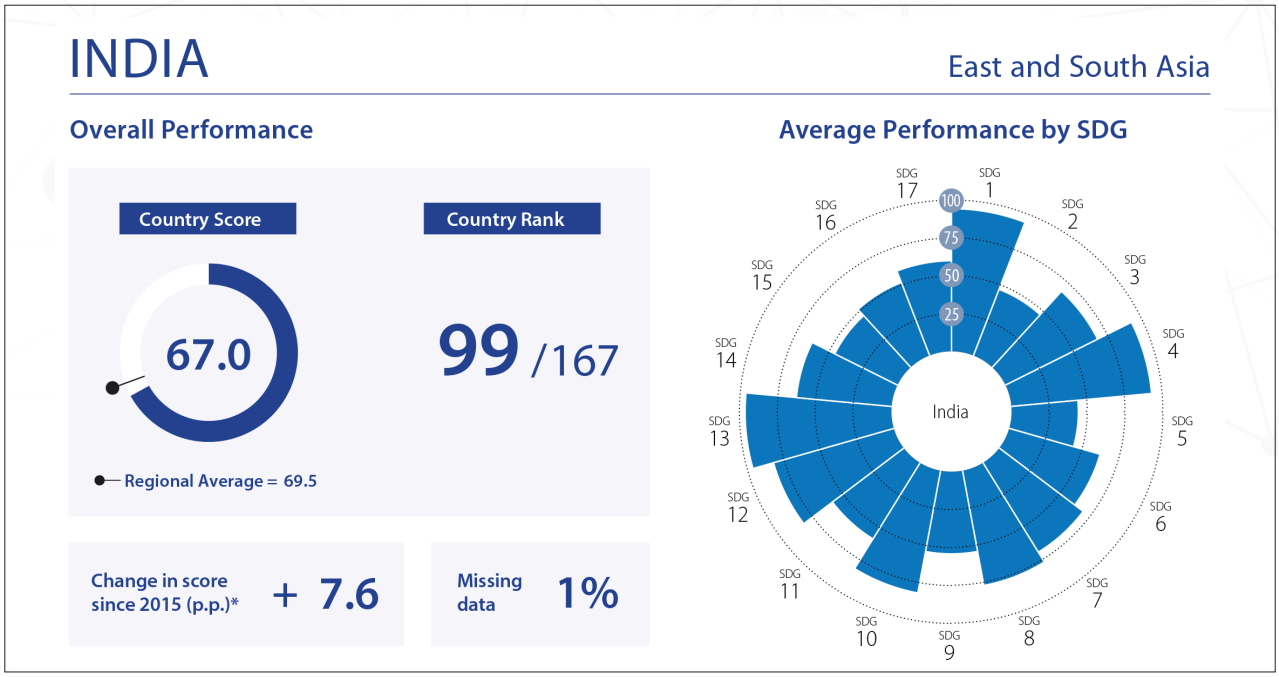


Figure 4.13: India's SDG Performance at a Glance.

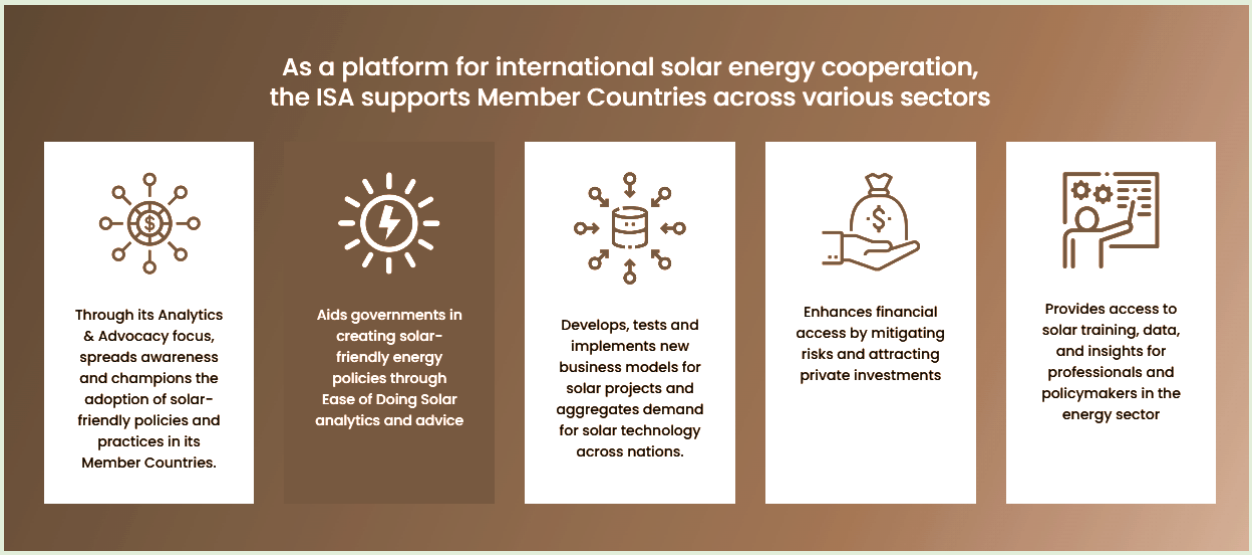
(**Source:** Sachs, J.D., Lafortune, G., Fuller, G., Iablonovski, G. (2025). Financing Sustainable Development to 2030 and Mid-Century. Sustainable Development Report 2025. Paris: SDSN, Dublin: Dublin University Press. DOI: https://doi.org/10.25546/111909)

Box 4.2 International Solar Alliance (ISA)

The International Solar Alliance (ISA), founded in 2018, is a group of more than 120 UN member nations, mainly situated between the Tropics of Cancer and Capricorn. Based at the National Institute of Solar Energy in Gurugram, India, ISA's goal is to promote the global use of solar energy.

ISA leads efforts in policy and regulatory advocacy, releasing yearly reports on technology, investment, and market trends within the solar industry. Through its main initiative, the Solar Technology and Application Resource Centres (STAR-C), it provides capacity-building programs, solar training, and standard-setting to enhance solar ecosystems, especially in developing countries.

In terms of programming, ISA is dedicated to supporting sustainable solar projects in areas vulnerable to climate change, such as Least Developed Countries (LDCs) and Small Island Developing States (SIDS). It does this by aggregating demand, scaling up innovative solutions, and helping to secure access to risk-mitigated financing. Notable initiatives include Scaling Solar for Agriculture, Rooftops, Mini Grids, Solar Parks, E-Mobility & Storage, Solar PV Waste Management, Heating & Cooling Systems, and Green Hydrogen.



Source: International Solar Alliance Website, https://isa.int/about_uss

India has emerged as the world's largest provider of generic medicines, contributing 14% of total generics imported by the United States. Similarly, India's role in vaccine production is significant, where it supplies nearly 70% of the World Health Organization's total requirements. Together, these achievements firmly establish India as a global hub for affordable, quality healthcare, ensuring wider access to essential medicines and vaccines across the world.[53]

Box 4.3 India: A Global Player in Generic Medicine, Vaccine Manufacturing, and Supplying Affordable Medicines to the world

India stands as the world's third largest producer of pharmaceuticals by volume[1] and 11th by value[2], with a diversified product base spanning generic medicine, active pharmaceutical ingredients, bulk drugs, drug intermediates, over the counter products, vaccines, biosimilars, and biologics. Its exports reach more than 200 countries including highly regulated markets such as the United States, United Kingdom, European Union, and Canada. India accounts for 60% of the global vaccine production, which makes it the largest vaccine producer in the world (https://www.pib.gov.in/PressReleasePage.aspx?PRID=19319180. India was among the few countries in the world that successfully developed its own indigenous COVID-19 vaccine, 'COVAXIN'. India **Vaccine Maitri (Vaccine Friendship)** launched during Covid-19 pandemic created a global impact and support system to combat the pandemic. Through this initiative, India supplied millions of doses of vaccines, including COVAXIN and the Oxford–AstraZeneca vaccine manufactured locally as Covishield to more than 100 countries during Covid pandemic (https://www.pib.gov.in/PressReleasePage.aspx?PRID=1931918)

[53] https://www.pib.gov.in/PressReleasePage.aspx?PRID=2136620

Indian firms have emerged as global frontrunners in generic drug production. It is the largest provider of generic medicines globally, occupying a 20% share in global supply by volume (https://www.pib.gov.in/PressReleasePage.aspx?PRID=1931918) and account for 14% of the total generics imported by the United States. One of the indicators of technological capability is the capacity of the country to file Abbreviated New Drug Application (ANDA) in the United States. Immediately after patent expiry, generic drug manufacturers can enter the US market through this mechanism. If their application of ANDA is approved i.e. granted, the firm enjoys 180-day exclusivity (awarded to the first successful filer), a temporary monopoly before other generic competitors can enter. India dominates ANDA approvals; in 2022 for example there were 355 ANDA approvals accounting for 48% of the total approvals (https://www.expresspharma.in/top-of-anda-approvals-list-low-on-ip-index/?utm_source=chatgpt.com) The Production Linked Incentive (PLI) Scheme for Pharmaceuticals and other government initiatives are further driving innovation, encouraging the development of complex generics, biologics, and high-technology products. With these achievements, India is establishing itself as a trusted hub for affordable, high-quality healthcare solutions. Its continued progress ensures greater global access to essential medicines and vaccines, cementing India's respect as a partner in advancing public health worldwide.

References:

[1]Annual report 2024-25, Department of Pharmaceuticals, https://pharma-dept.gov.in/annual-report
[2]Press Release: Ministry of Chemicals and Fertilizers, https://www.pib.gov.in/PressReleasePage.aspx?PRID=2110209

CHAPTER 5

Characterizing The Indian Innovation Ecosystem

Building on the framework of the STI ecosystem outlined in Chapter 2, the following chapters examine how India has framed policies and implementation mechanisms to create an enabling environment that can create directionality and support systems for innovation-driven growth. The key actors and institutions in the system, the role of intermediary bodies, and the successful outcomes have been highlighted along with implementations, roles and interactions of key actors, the institutional architecture, and the policy landscape. This chapter brings an analytical assessment of the key directions in which India's innovation is shaping, how it is addressing structural limitations, and the gaps that call for further attention. In other words, to assess how the country has progressed in its innovation odyssey. This will provide us with directionality to strengthen many of the successful initiatives and also design new interventions that can help India to position itself in frontier technologies, build deep technology startups and synergise the industry towards knowledge intensive product development. Make India progress towards the vision and mandates of the Viksit Bharat 2047.

5.1 Key Dimensions for Characterisation

Based upon the overview of the STI ecosystem, the policies and the various interventions, 8 key dimensions were framed to examine the characterisation of the country's enabling innovation ecosystem. This framework allows us to identify the specific areas where India's ecosystem offers strong support for innovation, where systemic gaps still persist, and how policy and institutional design can be optimised to create a more resilient, inclusive, and globally competitive innovation system. This analytical lens thus helps us to assess how the country has progressed in its innovation odyssey. The key dimensions in which we examine are:

- **Policy Direction** – strategic prioritisation through national missions and targeted programmes,
- **Intermediary Institutions** – bridging mechanisms that connect research, startups, and industry for lab-to-market translation,
- **Knowledge & Human Capacity** – talent development, IPR literacy, and entrepreneurship culture,
- **Financial & Infrastructural Support** – mechanisms to bridge the "valley of death" through capital access and facilities,
- **Startup & Entrepreneurial Ecosystem** – fostering inclusive entrepreneurship through accelerators and incubation networks,
- **Societal & Grassroots Innovation** – leveraging frugal and community-based innovations for socio-economic development,
- **Global Positioning & International Cooperation** – enhancing India's standing in global innovation indices and partnerships,
- **S&T Cluster and Regional Strategies** – reducing regional disparities and building thematic excellence.

The dimensions are inter-related and progress across each dimension influences the positive outcomes in the other dimensions. By structuring the analysis around these dimensions, the chapter links conceptual understanding of the enabling ecosystem with concrete policy programmes, institutional actors, and initiatives. **Table 5.1** provides us with a broad overview of positioning along these dimensions.

Table 5.1: India's Strategic Positioning in the Key Dimensions

Dimension	Vision & Objective	Key Programmes/ Initiatives	Key Institutional Actors
POLICY DIRECTION	Creating Strategic prioritisation for enabling innovation driven growth. Promoting entrepreneurship and inclusivity. [Development of Infrastructure, Institutions, Capability, and Directionality]	National Missions, Technology Missions, Dedicated Ministry/Dept. Innovation Programs. **Startup India, Atal Innovation Mission, Make in India; National Quantum Mission, Semiconductor Mission, etc.**	NITI Aayog, MeitY, DPIIT, DBT, DST
INTERMEDIARY INSTITUTIONS	Acting as a bridging institution for facilitating collaboration between academia, startups, industry, and government. [Promote lab to market translation, technology transfer, incubation, commercialisation]	Key Intermediary organisations and related programs. e.g., **BIRAC, TDB, NIF, BioNEST, MSME Innovation Scheme**	DBT, DST, MSME Ministry, National Labs, CoEs
KNOWLEDGE & HUMAN CAPACITY	Build innovation culture and IPR literacy; promote student entrepreneurship. [Talent development, IP awareness, student entrepreneurship, and research excellence]	Programs to develop trained skilled practitioners and their support mechanisms. e.g., **INSPIRE, NIDHI, Innovation Cells (MoE), Design Innovation Centres, KAPILA**	MoE, AICTE, DST, HEIs
FINANCIAL & INFRA-STRUCTURAL SUPPORT	Bridge "valley of death"; ensure access to capital and facilities. [Promote Access to seed funding, VC, incubators, testing facilities Support system]	**Fund of Funds, SIDBI, TIDE 2.0, SAMRIDH, SISFS, CGSS, ATMP**	SIDBI, MeitY, DPIIT, State Incubators
STARTUP & ENTREPRENEURIAL ECOSYSTEM	Promote innovation and inclusive entrepreneurship	**Startup India, GENESIS, Atal Incubation Centres (AICs), ACICs**	DPIIT, NITI Aayog, State Govts, Private Accelerators
SOCIETAL & GRASSROOTS INNOVATION	Leverage community innovation for socio-economic development [Promote Frugal innovation, traditional knowledge systems, rural innovation]	**Programme support: NIF, SUNIL Programme, Biotech-KISAN, SIIP**	DST, DBT, NGOs, SHGs, Farmer Groups
GLOBAL POSITIONING AND INTERNATIONAL COOPERATION	Position India as a global innovation leader. Developing strong partnership on STI. [Creating mechanisms for improving ranking in different global benchmarking/ ranking index such as GII ranking]	**Global Innovation Index coordination, State Innovation Index**	NITI Aayog, MeitY, DPIIT, MFA
S&T CLUSTER AND REGIONAL STRATEGIES	Build region-specific STI capabilities, reduce regional disparities [Create mechanisms for Decentralized innovation, thematic excellence, regional development]	**NEST (NER), BioNEST, CoEs, STPI, Design Innovation Hub**	PSA Office, DBT, DST, State Innovation Councils

The subsequent sections of this chapter examine India's progress in three inter-related areas: *a) Startups, b) University-Industry-Government linkages (Triple Helix partnership), and c) Inclusive innovation (Quadrupole partnership)*. Startups drive inclusive economic growth and societal innovation and can provide an early mover advantage in deep technologies. The U-I-G partnerships further augment this advantage by developing intrinsic innovation capacity. Innovation intermediaries play a key role in shaping the outcomes of these activities and in bridging any systematic gaps to facilitate entrepreneurs, researchers and other stakeholders. The progress in these three areas, thus, will be instrumental in strategising India's approach towards promoting innovation and technology commercialisation.

The examination is undertaken based on the above 8 dimensions to provide an analytical and evidence-based assessment of the progress and future pathways that can be adopted to further strengthen our STI ecosystem. The enabling innovation ecosystem highlights many other aspects that create pathways towards an inclusive innovation-driven pathway for inclusive growth and a knowledge and innovation hub. Examination within the three areas through the 8 dimensions of the successful edifice of an enabling ecosystem is addressed to a large extent.

5.2. India's Startup Ecosystem

India has given a strong push for creating an enabling environment for startups. This has resulted in various positive outcomes. It has the third largest number of startups in the world after the USA and China. There are 1.57 lakh recognised startups and more than 100 Unicorns (i.e., startups with a valuation of US $1 billion and above).[54] It is estimated that they have helped to create 17.28 lakhs jobs in the past 7-8 years.[55] DPIIT recognised startups have a dominant presence in three key areas namely IT services accounting for 13% of startups, healthcare & life sciences accounting for 9% of startups, and education which accounts for 7% of the startups. Together they account for 29% of the DPIIT recognised startups.[56] The orientation of startups in India has largely been in the service sector primarily in areas such as e-commerce, novel business models for aggregation, supply chain management, etc. There are some concerns as many startups do not have profitable growth and do not perform as per their valuation. This has resulted in funding slowdown and unallocated capital as investors are now concentrating more on startups that exhibit profitable growth. A skewed statewise distribution in startups can be seen as about 40% of the startups are from three states namely Maharashtra, Karnataka, and Delhi.[57]

Deep tech startups constitute only 10,298 of the total DPIIT recognised startups.[58] Majority of these startups are leveraging 4IR technologies to make themselves competitive, strengthening supply chains and improving their valuation. The deep technology enabling is thus an important shift observed in the Indian startup ecosystem. *Inspite of these positive developments, there are only a few deep technology startups that are creating new technologies, i.e., are "inventive," and even fewer are developing technologies that can be characterized as technologies that are new to the world*. The

54 https://www.pib.gov.in/PressReleasePage.aspx?PRID=2098452
55 https://www.pib.gov.in/PressReleasePage.aspx?PRID=209845
56 https://kpmg.com/in/en/insights/2024/12/exploring-indias-dynamic-start-up-ecosystem.html
57 https://www.pib.gov.in/PressReleasePage.aspx?PRID=2037579
58 https://www.fortuneindia.com/long-reads/indias-deep-tech-disruptors/116967

central government, with different major stakeholders and some state governments, industry associations, entrepreneurial universities, research institutions, and financial institutions have been focusing on the country as a global hub for deep technology startups. One recent initiative by the office of the Principal Scientific Advisor was the articulation of a Draft National Deep Tech Startup Policy (NDTSP). The draft underscores that deep technology startups can become the key driver of India's innovation-led growth, helping address challenges in different sectors. It can transform India from a technology adopter to a global creator of frontier technologies.

Two major programmes that have created a key role in synergising the Indian startup ecosystem are the 'Startup India' and the 'Atal Innovation Mission (AIM)'. They have an overarching role in creating a culture of entrepreneurship, and facilitating the translation of ideas into practice. Both programmes, launched in 2016, are complementing each other. A key component of AIM is its focus on learning by doing and providing support to schools for creativity and translation of ideas and developing incubation capacity. Startup India is creating various enabling structures for startup growth and market entry. It has also started an annual exercise, the States' Startup Ranking with the objective to augment the Startup ecosystem in the States and Union Territories across the country. Focus is on initiatives and policies undertaken in respective jurisdictions. It has also established a feedback collection mechanism from beneficiary startups and incubators present across states and union territories to share their experience in handholding and support that they have received from respective governments. Various other programmes have been initiated by different Ministries that are also trying to embed innovation and entrepreneurship within their various programmes. Sectoral mapping provides more insights into the progress and constraints for startups therein. Some useful insights can be obtained by closely examining each of the eight dimensions **(Table 5.2)**.

Policy Direction and Intermediary Institutions

Both the Startup India and the AIM are providing policy directionality, positioning entrepreneurship and innovation as national imperatives. Under the AIM, *intermediary organisations* such as Atal Incubation Centres (AICs), Atal Community Innovation Centres (ACICs), and Atal Tinkering Labs (ATLs) have been developed. These organisations are envisaged as the *platforms to bring together the innovations and promote efforts at the different levels* namely schools, universities, research institutions, and startups. Similarly, under the Startup India mission, components focused on providing support to startups are included. Besides establishing Incubation centres, the MAARG (Mentorship, Advisory, Assistance, Resilience, and Growth) portal and the Startup India portals are envisaged as *platforms for supporting research to market translation of new innovations*.

Table 5.2: India's startup progress using the 8 dimensional analytical lens

Dimension	Programmes	Key Institutional Actors
POLICY DIRECTION	*Sector Agnostic* Startup India Mission, Atal Innovation Mission, *Sector-Specific* National Deep Tech Startup Policy, National Biotechnology Mission. Research, Development, and Innovation (RDI) Scheme, National Innovation and Startup Policy 2019	DST, MoE, DPIIT
INTERMEDIARY INSTITUTIONS	BIRAC, NASSCOM, FICCI, CII, MoE-AICTE Investor Network, MeitY Start-up Hub' (MSH)	DBT, MeitY, MoE
KNOWLEDGE & HUMAN CAPACITY	AIM, Startup Shala, KAPILA, IDEA Bank	
FINANCIAL & INFRA-STRUCTURAL SUPPORT	**Missions such as** - India AI Mission - India Semiconductor Mission - National Mission on Interdisciplinary Cyber-Physical Systems - National Quantum Mission (NQM) - MeitY TIDE 2.0	
STARTUP & ENTREPRENEURIAL ECOSYSTEM	NASSCOM's Deep Tech Club (DTC) 2.0, BIRAC- life sciences, DPIIT-industrial R&D, MoE-academic research, DST-GDC I-NCUBATE Program, MeitY-TIDE 2.0, Agrinnovate India Limited (AgIn) etc.	DBT clusters, DPIIT, DST, MeitY, MoAFW etc.
SOCIETAL & GRASSROOTS INNOVATION	DST SUNIL, MSME and STINER support grassroots innovations for local socio-economic development, etc.	NIF
GLOBAL POSITIONING AND INTERNATIONAL COOPERATION	The Startup20 Engagement Group to facilitate harmonisation and cross collaboration amongst the largest global economies IndiaAI Startups Global Acceleration (IndiaAI Mission) Startup India — "International Bridges INDUS-X (India–U.S. Defense Acceleration Ecosystem) T-Hub (Hyderabad) – T-Bridge Program	India's G20 Presidency DPIIT - Startup Policy Forum (SPF) Collaboration, TiE Global Summit
S&T CLUSTER AND REGIONAL STRATEGIES	Atal New India Challenge, MoE-AICTE Investor Network, North East Science & Technology (NEST) Cluster, Space Technology Cells (STCs); Regional Academic Centres for Space (RAC-S); and Space Technology Incubation Centres (S-TICs)	AICTE, NEST, STCs, RAC-S, S-TICs

Besides these two missions, the growth of startups in India is also a result of *sectoral programs* (DST-NIDHI, Smart India Hackathon, National Biotechnology Mission. Research, Development, and Innovation (RDI) Scheme, National Innovation and Startup Policy 2019 etc.), are some initiatives to improve the interest of market investors, entrepreneurs and individual innovators in pursuing commercialisation of grassroot innovations. The key S&T ministries DST, DSIR, DBT, DPIIT, MoE etc. have developed various programs and intermediary institutions. However, in spite of the overarching role of the two missions, which are sector agnostic, and aim to support all startups; the mechanisms for fostering strong sector-specific linkages, particularly with mission-mode programs in key sectors,

remain weak even though numerous such initiatives exist. Most of them are of recent origin and are yet to take full effect.

Knowledge & Human Capacity

AIM is supporting early-stage creativity by embedding innovation pedagogy in schools. However, the programme does not have a selective mechanism to promote promising prototypes developed at the school level further. Startup India is promoting IPR literacy and facilitates patent filing support (through DPIIT interventions and training such as StartupShala and MoE's KAPILA scheme). The IDEA Bank is a step towards the sharing of a curated collection of problem statements and sector challenges for innovators and startups. Support for intellectual property typically concludes with the submission of patents, with insufficient emphasis on converting them into marketable products or aligning them with industry standards.

The success of startups depends not only on technological innovation but also on their capacity to secure funding, build markets, and forge strategic linkages. Therefore, a key area that can still be improved is the knowledge and training of other important aspects essential to startups, namely financial, business development, and networking, which is an essential element in scaling up the startups.

Financial & Infrastructural Support

The Fund of Funds for Startups (FFS) and the Startup India Seed Fund Scheme (SISFS) are the two most important support mechanisms for financial support to startups. The two funds aim to bridge the funding gaps that are especially critical at the "valley of death" stage. Another important scheme is the Research Development and Innovation Fund (RDIF) Scheme, which aims to address significant funding deficiencies and support projects with high Technology Readiness Levels (TRL). Another initiative, MeitY's SAMRIDH (Startup Accelerator for MeitY's Product Innovation, Development and Growth), is focused on promoting software startups and supporting them in developing linkages with customers, investors, and international market opportunities.

Inspite of these initiatives, there are still funding gaps for supporting proof-of-concept, prototype development, and making the prototype attractive for getting support from industry.

DST Technology Development Board, NRDC, BIRAC etc. are positioning themselves at different stages of the financial and infrastructure support. Such infrastructural and financial support systems also have been developed under various startup incubation centres at various IITs, IISc, and other institutions through support from different departments. A sector such as Biotechnology, which has developed a strong enabling institutional mechanism through BIRAC is able to provide various types of financial and infrastructure support.

However, startups in many other sectors are struggling to get the funds and also face challenges in finding the appropriate funding body for support. Another major concern is lack of funding support to non-technology dimensions that are critical for startups to enter the commercialisation stage.

Startup & Entrepreneurial Ecosystem

Some key knowledge hubs are visible that are creating an enabling ecosystem for startups; startup clusters such as in Bangalore, Pune, Delhi NCR, Chennai and Hyderabad. They are providing a conducive environment for creation of new and growth of existing startups. The organisational and infrastructural support extended through institutions TDB, Bio-NEST, Technology Parks, Technology Business Incubators, Innovation Hubs/ Clusters, CoEs etc. has contributed towards the establishment of various startup hubs.

There is, however, a large part of the S&T system that can contribute to this ecosystem and provide valuable knowledge creation, sharing, and facilitative support for the startups. These are the several research and innovation institutional clusters, such as the CSIR (Council for Scientific and Industrial Research), ICAR (Indian Council of Agricultural Research), ICMR (Indian Council of Medical Research) etc. having nationwide presence through their regional centers/institutions. They have a large pool of skilled technical and scientific experts, and well-established institutional mechanisms. They can become crucial actors for promoting innovation and commercialisation. *Largely their innovation is centered within their organisation i.e. laboratories under them. The open innovation model is largely missing in these institutions, bringing knowledge, ideas, or technologies from external sources (inbound), and sharing their own knowledge and solutions with others (outbound).*

Societal & Grassroots Innovations

Social financial schemes such as PMMY (Mudra) and Stand-Up India provide collateral-free financing to different stakeholders, including micro, small, and women/SC/ST entrepreneurs through relevant banking/non-banking organisations. MSME's CGTMSE (Credit Guarantee Fund Trust for Micro and Small Enterprises) has expanded access to funding and mentorship for scaling startups. The Atal Innovation Mission, with its nationwide incubation and tinkering network, along with ASPIRE and Chunauti, promotes rural, agro-industrial, and tech-based entrepreneurship. Additionally, the Credit Guarantee Scheme for Startups (CGSS) provides risk-mitigation for lenders, improving access to working capital, venture debt, and growth loans.

Linkages with the National Innovation Foundation and civil society can help to broaden their reach and bring more inclusivity.

Global Positioning and International Cooperation

Largely the startups have positioned themselves in the Indian market. Positioning themselves in the global value chain and linking with global knowledge-intensive firms are rare exceptions. *Programmes that have been created need to be revisited to make them more effective. Provisions need to be created that allows entrepreneurs from foreign countries to open startups in India.*

S&T Cluster and Regional Strategies

Several approaches to promote development of specialised regions as hubs of innovation and technology development are being implemented. Some of the well-known include Tech Parks, Incubators, Innovation Hubs/Clusters, CoEs, State S&T councils, and Startup missions (Kerala's Startup Mission, Telangana's T-Hub and Haryana's Startup Haryana run), Special Economic

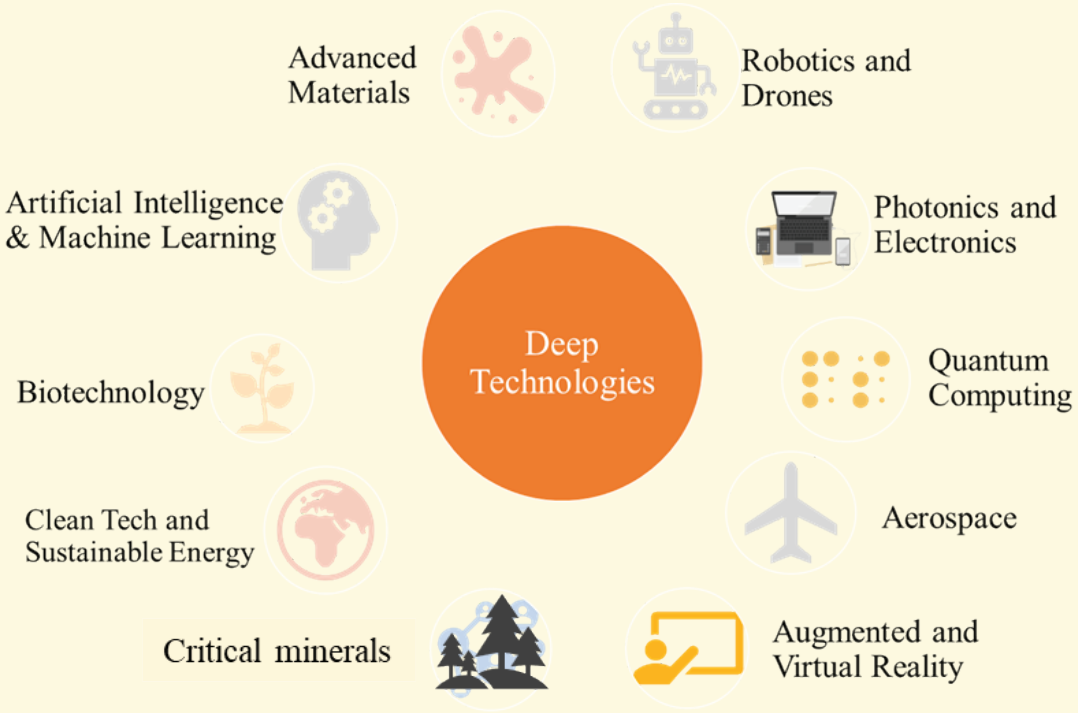
Zones etc. The exercise of ranking states' startup ecosystems is also being undertaken.[59] A recent initiative "BHASKAR" has set up an online platform to promote interaction between entrepreneurs, investors, mentors, policymakers, and other startup ecosystem players.

5.2.1 India's Deep Technology Startup

As highlighted, *in spite of this positive development, the technology driven startups in frontier technology areas/deep technologies are only a few.* It calls for a strategic focus to create a deep technology startup ecosystem.

Box 5.1: Deep Technologies and Implications for India

Selected technologies that are built on disruptive innovations resulting in non-conventional scientific and industrial breakthroughs are categorized as deep technologies. These have a profound impact on the status quo in their related sectors and can push the technological capabilities through previously determined limits. However, development of such innovative technologies involves high risk R&D efforts with substantial capital investment and long gestation periods. Some sectors which are currently of global relevance in Deep Tech are Artificial Intelligence, Biotechnology, Photonics, Robotics etc.



[59] https://www.startupindia.gov.in/srf/

In India, the role of deep tech. has been underlined at several instances now. The recent achievements of ISRO demonstrated the capability of the Indian R&D sector in taking significant leaps through the development of solutions to complex scientific challenges. The National Deep Tech start up policy has been proposed to set up the policy priorities in the areas and drive related activities. ANRF funding support has been laid out in the 2025 Union Budget, and sector-specific schemes and thematic missions such as ADITI (defense), AIRAWAT, AI Mission, Blockchain strategy, Quantum mission, Cyber-Physical systems, Green Hydrogen mission, Deep Ocean mission etc.are being rolled out to develop a comprehensive ecosystem.

Mission mode programs have been framed in some of the key deep technology domains for creating capacity and capability for engaging successfully with technology frontiers. IndiaAI Mission, National Quantum Mission (NQM), India Semiconductor missions (ISM) provide new directionality and enablers in deep technology. It is important to have an overarching framework that provides policy directionality for building a deep technology ecosystem. Initiative has been taken in this direction. A preliminary draft of the National Deep Tech Startup Policy (NDTSP), has been circulated by the Office of the Principal Scientific Advisor for stakeholder engagement. *The challenge is to bring different stakeholders together that can create the pathways for creating an enabling framework for the deep technology ecosystem. The policy directionality calls for creating specialised intermediary organisations that can support the deep technology startups that face higher risk environments than normal startups and a more challenging pathway for crossing the valley of death.*

Huge entry barriers are there for deep technology startups. Deep tech fields demand highly specialized, and interdisciplinary expertise. India produces a large pool of STEM graduates, but very few have advanced research or commercialization-ready skills in frontier technologies. Regular upskilling and reskilling of employees is required due to the complexity of engaging with the deep technologies. Reskilling is more challenging especially as it involves learning something entirely new to the existing knowledge.[60] Deep technologies are highly protected by patents and standards. Thus, it calls for adopting new strategies and developing novel pathways.

Deep tech startups are capital-intensive with long gestational periods, requiring significant financial and infrastructural support and domain expertise. Venture funding is not easy and calls for strong state co-investment or incentives. This could limit the scalability of deep technology startups and slow down lab-to-market technology transfer mechanisms. Deep tech products often need early adopters in defence, healthcare, or energy sectors. Procurement challenges or lack of government-as-first-buyer programs reduce innovation pull. It is also crucial to ensure innovation inclusivity in emerging sectors like deep tech, as this is often concentrated in metro and select states, northeast and Tier-2/3 clusters lack deep tech R&D infrastructure.

[60] https://isid.org.in/wp-content/uploads/2024/01/PB2307.pdf

5.3 University Industry Government (UIG) Collaboration

A stylised representation of India's UIG ecosystem using the analytical lens of the 8 dimensions are highlighted in **table 5.3.**

Table 5.3: India's position in UIG partnership using the 8 dimensional analytical lens

Dimension	Programmes	Key Institutional Actors
POLICY DIRECTION	*Sector Agnostic* -STIP 2013, -Atal Tinkering Labs, -National Innovation Foundation, -DST-SEED -DST-WISE-KIRAN Scheme *Sector Specific* DBT-BIRAC Grand challenges India, DST-TARA, Institutional mechanisms created in institutions such as in IITs, TISS, BARC, AIIMS, Tata Trusts, Azim Premji foundations, BHU, Anna University, Amrita University for developing affordable technologies in critical domains of healthcare, water, climate risks etc.	DPIIT, DST, MoE, DBT, Industry players such as, Tata, Power corporations, space research, pharma and biotech firms.
INTERMEDIARY INSTITUTIONS	NASSCOM, FICCI, CII, MoE-AICTE Investor Network, Ministry of Education's Innovation Cell (MIC)	DBT, MeitY, MoE, etc.
KNOWLEDGE & HUMAN CAPACITY	Frontier Technology Labs (AI, AR/VR, IoT) in partnership with Meta	Private industries, etc.
FINANCIAL & INFRA-STRUCTURAL SUPPORT	DST-NIDHI Program, MeitY Start-up Hub (MSH), Women Involvement in Science and Engineering Research (WISER)	
STARTUP & ENTREPRENEURIAL ECOSYSTEM	Atal Tinkering Labs (ATLs), Atal Incubation Centres (AICs), and partnerships with corporates. Agrinnovate India Limited (AgIn), Institutional Innovation Councils (IICs) IITs- Dedicated centers for affordable technologies TISS- Community based innovation Tata Trusts- support for frugal innovations BARC- Technologies for Societal applications, AIIMS- Translational Research Centers	
SOCIETAL & GRASSROOTS INNOVATION	Primarily led by individual startups, alumni and organisations	
GLOBAL POSITIONING AND INTERNATIONAL COOPERATION	DST-DAAD, DBT-CEFIPRA, DBT-BMGF, DBT-Crest Award, BEST, BIRAC-Wellcome Trust Partnership etc.	DST, DBT, TDB, DSIR and foreign agencies.
S&T CLUSTER AND REGIONAL STRATEGIES	Atal New India Challenge, MoE-AICTE Investor Network, North East Science & Technology (NEST) Cluster.	

Policy Direction

The Science, Technology, and Innovation Policy (STIP) 2013 made a strong assertion of the need for university collaboration in promoting innovation. It called for the government to be an active partner to promote this relationship, an understanding

drawn from the Triple Helix model. Most of the missions and initiatives consist of a significant component stressing on promoting UIG collaborations. Besides this, industry and government departments (DST, DBT, MOE and DPIIT) have a significant component of their schemes facilitating UIG linkages. However, the university-industry collaborations are highly skewed with only a few reputed institutions having developed strong industry partnerships.

A new pathway that can create a stronger institutional mechanism for university-industry collaborations is articulated by the ANRF. It plans to bring industry stakeholders into the research ecosystem with schemes such as Advanced Research Grant and PAIR etc.

Intermediary Institutions

Industry bodies NASSCOM, FICCI, CII have played an important role in promoting university-industry collaborations. Ministerial programmes focused on facilitating technology transfer, startup incubation, leveraging academic expertise or providing industrial exposure to academic experts such as MoE-AICTE Investor Network, Ministry of Education's Innovation Cell (MIC), TBIs at different IITs, research institutions etc. also provide a significant portion of support for facilitating UIG collaborations. *Effectiveness of intermediary institutions role is seen mainly in reputed institutions that have created strong interfaces with industry.*

Knowledge & Human Capacity

A major aspect of UIG collaboration is to facilitate the exchange of knowledge between these three spheres. Often such exchanges are hindered by challenges of intellectual property rights, data privacy, trade secrets, national interests etc. Thus, strong mechanisms to build trust among the stakeholders are necessary in sensitive areas. Other sectors have existing exchanges for developing human capacity such as the frontier technology labs (AI, AR/VR, IoT) in partnership with Meta.

Financial & Infrastructural Support through development of S&T Cluster and Regional Strategies

Provisions to support university-industry collaboration exist in most government programs to support startups. Programmes such as DST - NIDHI Program, MeitY Start-up Hub (MSH) are driving the creation of infrastructure through directed infrastructure development. This is creating an impact but mostly in universities that have established enabling institutions for creating various types of partnerships with industry and have a vibrant ecosystem that supports startup and entrepreneurship. Thus, there is a need to have within these programs, support for creation of the enabling institutions across different universities.

Startup & Entrepreneurial Ecosystem

Many universities have played a key role in creating an environment for translation of research from laboratory to technology product creation through startups. Many startups have deep roots in university. However, this is skewed in terms of inclusion and diversity. In other words, startup activity has largely been concentrated in a few universities, primarily those located in tier-1 cities.

Societal & Grassroots Innovation

Social entrepreneurship is getting institutionalized in many universities. University-industry partnerships are also getting created. Strong support is needed at different levels, in the central programs and at the state level, to support these initiatives.

Global Positioning and International Cooperation

Bilateral Research Exchange Programmes are being coordinated by several agencies including, DST, DBT, TDB, DSIR and foreign agencies such as DAAD, BMGF, British Council etc. The major programmes include DST-DAAD, DBT-CEFIPRA, DST's 1+1 and 2+2 schemes, BIRAC-Wellcome Trust Partnership, DBT-BMGF (Bill & Melinda Gates Foundation), DBT-Crest Award, Biotechnology Entrepreneurship Student Teams (BEST) etc. *Involvement of different line ministries particularly Ministry of External Affairs, Science councilors etc. can be very important to create new pathways for international collaboration.*

S&T Cluster and Regional Strategies

Major institutions such as IITs, Tata institutes, BARC, AIIMS, IIITs and some other technical universities have sector-specific collaborations. Other programs that have some potential opportunities to contribute towards the development of this sector are Atal New India Challenge, MoE-AICTE Investor Network, and North East Science & Technology (NEST) Cluster. Technology Business Incubators, Innovation and Technology parks such as IIT Madras, IIT Bombay, IISc, Hyderabad T-Hub etc. are some facilities that have developed as regional S&T clusters in the recent past.

There is, however, a need to promote a more systematic and decentralised effort so as to further diffuse such S&T research and commercialisation facilities. The administrative processes involved in availing these facilities are cumbersome and tedious. As a result, innovators invest most of their energy in fulfilling the procedural pre-requisites instead of actually availing the facilities, which further prolongs the process and increases the likelihood of failure.

5.4 Inclusive Innovation

Evaluating innovation's inclusiveness helps characterize the direction, depth, and fairness of the innovation journey. It further ensures that the innovation benefits not just a select few but serves the larger economy and society to maintain a Quadruple Helix Structure of innovation. A number of initiatives have been undertaken to address this requirement and provide an enabling environment for promoting innovations which are socially relevant and aimed at the betterment of the masses. encourages diverse participation (from stakeholders such as, startups, grassroots innovators, women, rural entrepreneurs). These initiatives have been driven by the motive in terms of reducing inequalities in access (to resources, infrastructure, and markets), and align technological advances with broader societal goals, rather than only commercial gains of the stakeholders.

Table 5.4: India's focus for promoting Inclusive Innovation in its ecosystem using the 8 dimensional analytical lens.

Dimension	Programmes	Key Institutional Actors
POLICY DIRECTION	***Sector Agnostic*** Inclusive Innovation based growth model, Atal Innovation Mission, ***Sector Specific*** Strengthening, Upscaling & Nurturing Local Innovations for Livelihood (SUNIL) Programme, STARS (Scheme for Transformational and Advanced Research in Sciences)	DPIIT, DST, MoE National Innovation Foundation, DBT etc.
INTERMEDIARY INSTITUTIONS	Atal Community Innovation Centres (ACICs), National Innovation Foundation (NIF), Women Technology Parks (WTPs)	DBT, MoE etc.
KNOWLEDGE & HUMAN CAPACITY	BioTech Kisan, Capacity Building of Community-based organizations (CBOs), NGOs, Knowledge Institutions (KI) & Social Start-ups	DST, DBT etc.
FINANCIAL & INFRA-STRUCTURAL SUPPORT	India Inclusive Innovation Fund (IIIF), Biogas Power Generation (Off-Grid) and Thermal energy application Programme (BPGTP), Social Innovation Programme For Products: Affordable & Relevant to Societal Health (SPARSH)	MoMSME, MNRE etc.
STARTUP & ENTREPRENEURIAL ECOSYSTEM	Agrinnovate India Limited (AgIn), Coordination with States and Aspirational Districts	DBT clusters, DST etc.
SOCIETAL & GRASSROOTS INNOVATION	MSME and STINER support grassroots innovations for local socio-economic development, Biotechnology Programme for Societal Development (DBT), Community Resilience Resource Centre (CRRC),Social Innovation Immersion Program (SIIP),	
GLOBAL POSITIONING AND INTERNATIONAL COOPERATION	Development of Solar Parks and Ultra Mega Solar Power Projects	
S&T CLUSTER AND REGIONAL STRATEGIES	National Innovation Foundation (NIF), Community led innovations etc.	

Policy Direction

India has articulated an inclusive innovation-based growth model in its development planning. This has driven different programmes such as the Atal Innovation Mission, Make In India, National Solar Mission, Semiconductor mission etc. to focus on developing an ecosystem which allows for small firms as well as large companies to participate and innovate. Besides the national missions, the sectoral programmes to support small innovators and in nurturing local innovations are present to some extent. However, shaping the innovation ecosystem that adopts an inclusive approach needs systematic structural shifts that calls for institutional changes at different levels.

Intermediary Institutions

Various intermediary organisations have been established for promoting inclusive innovation. Some key intermediary organisations are the Atal Community Innovation

Centres (ACICs), National Innovation Foundation (NIF), Women Technology Parks (WTPs). *At state and district levels, intermediary institutions need to be created to make a significant structural shift towards inclusive innovation pathways.*

Knowledge & Human Capacity

In order to build the capacity for innovative activities, development of a basic understanding of science and technology is a crucial precondition. The initiatives such as the BioTech Kisan, Capacity Building of Community-based organizations (CBOs), NGOs, Knowledge Institutions (KI) & Social Start-ups etc. are directed towards promoting knowledge and human capacity building. *Developing diverse skills and capacities across levels, and awareness building is critical for inclusive innovation.*

Financial & Infrastructural Support

The Digital India mission, PMMY (Mudra) and Stand-Up India, Biotech-KISAN and Atal Community Innovation Centres (ACICs) have been established to ensure that innovators in aspirational districts and remote areas receive the necessary funding, mentorship, and policy support to scale their ideas. Additionally, multiple programs include schemes for women entrepreneurs, SC/ST innovators, and rural artisans, ensuring that innovation benefits reach all segments of society. The India Inclusive Innovation Fund (IIIF), Biogas Power Generation (Off-Grid) and Thermal Energy Application Programme (BPGTP), Social Innovation Programme for Products: Affordable & Relevant to Societal Health (SPARSH), STARS (Scheme for Transformational and Advanced Research in Sciences) are some other supporting programs. Corporate Social Responsibility (CSR) funds have also supported rural entrepreneurship. *However, the large developmental challenges call for development of a more inclusive innovation model with strong partnership between Central Ministries and States.*

Inclusivity in State-level innovation policies can be ensured by empowering grassroots innovators, MSMEs, and Tier-2/Tier-3 regions through accessible funding, targeted capacity building, and participatory policy-making. Strengthening regional infrastructure, fostering center–state collaboration, and streamlining IP and market access can ensure equitable opportunities. This approach will transform fragmented innovation efforts into a cohesive, impactful ecosystem.

Startup & Entrepreneurial Ecosystem

The Ministry of MSME, MDoNER, and the Ministry of Rural Development have been promoting rural entrepreneurs, small-scale industries, and artisans. Programs such as MSME's ASPIRE and MDoNER's regional startup hubs support rural industrialization by integrating technology into agriculture, handicrafts, and small-scale manufacturing. Other programmes such as Agrinnovate India Limited (AgIn), C*oordination with States and Aspirational Districts further augment these initiatives in different sectors and build a capacity at district levels. This has to be further strengthened.*

Societal & Grassroots Innovation

Some important initiatives have been taken by the MSME and STINER to support grassroots innovations for local socio-economic development, like the Biotechnology

Programme for Societal Development (DBT), the Community Resilience Resource Centre (CRRC), and the Social Innovation Immersion Program (SIIP), etc. A new initiative of civil society engagement was undertaken under India's G20 Presidency. The Civil 20 (C20) engagement group was created with Mata Amritanandamayi, Chancellor of Amrita University, as the Chair of the engagement group. Amrita university coordinated the C20 Grassroots Survey, engaging over 8,000 respondents across 64 countries was coordinated by Amrita university to collect community level insights on issues like health, infrastructure, environment, and inequality. *It is important to have these types of initiatives that provide evidence based support for framing and directing programs and policies.*

Global Positioning and International Cooperation

A 2019 survey of countries in Asia reported India to be a model case for inclusive innovation with a naturally inclusive innovation ecosystem owing to its institutional structures and an inherently high absorptive capability for innovation.[61] This shows the high potential of India's firms and startups that are creating social entrepreneurship to expand their models to other countries.

S&T Cluster and Regional Strategies

Despite notable policy initiatives, inclusive innovation in India continues to exhibit structural limitations. Many programs/initiatives remain concentrated in metropolitan and Tier-1 cities, resulting in uneven access to innovation infrastructure for rural and remote regions. For example, a significant share of incubators and technology parks are located in urban clusters, leaving grassroots innovators with limited support systems. Funding mechanisms often prioritize ventures with higher commercial returns, while inclusive innovations, such as affordable medical devices or low-cost agricultural technologies, struggle to attract sustained, risk-tolerant capital. Awareness of intellectual property facilitation and incubation opportunities among marginalized groups is also relatively low, as seen in the limited patenting activity emerging from rural technology projects supported by initiatives like NIF. Moreover, market linkages for socially driven innovations remain weak; many affordable healthcare or education solutions fail to scale due to insufficient connections with mainstream industry supply chains or public procurement mechanisms. These gaps collectively indicate that, while inclusive innovation is recognized in principle, its operational ecosystem lacks the depth and regional outreach necessary to enable equitable participation and impact.

The characterisation of India's policies and programs, and the way they have been implemented provides an analytical assessment of India's innovation journey and its outcome. It also gives us more informed insights into the broad gaps that need to be critically examined in depth. Chapter 6 thus builds up on this by examining the key challenges that impede our innovation journey. The final chapter, Chapter 7, draws from the insights of the different chapters to frame a roadmap that can help to create a strong enabling STI ecosystem that can help India to become Viksit Bharat in 2047 with innovation as the key driver to achieve this vision.

[61] https://www.bertelsmann-stiftung.de/en/publications/publication/did/inclusive-innovation-atlas-1

CHAPTER 6

Identifying Challenges And Gaps In The Indian Innovation Ecosystem

India's policy shift towards innovation and entrepreneurship is influencing the STI ecosystem in various ways. India, through various combinations of policies, is trying to develop a knowledge economy; putting into place a growth model primarily driven by the production, distribution and use of knowledge and information. Various encouraging trends, as highlighted, show how India is building capacity on intellectual capital, innovation and skills. Continuous improvement of India's GII ranking from 81st position in 2014 to 38th position in 2025, is an outcome of improvement across various STI indicators. India's four (04) S&T clusters also figured in the global top 100. Significant strides have been made in fostering a vibrant startup ecosystem; a reflection of this is the fact that India now has the third largest number of startups globally. Several other indicators also measure India's impressive progress in knowledge translation and product development.

However, despite considerable investments and numerous initiatives, India's innovation ecosystem continues to grapple with several interconnected challenges, and persistent gaps. Addressing these limitations is crucial to unlock the nation's full innovative capacity, drive sustainable economic growth, and address societal needs effectively. This comprehensive analysis delves into the key challenges hindering India's innovation ecosystem, providing specific examples and highlighting the need for strategic interventions to foster a more cohesive, efficient, and impactful innovation landscape.

6.1 Fragmentation and Lack of Coordination

A significant impediment to India's innovation prowess is the fragmented nature of innovation efforts, leading to duplication, inefficiencies, and a lack of synergistic outcomes. While there is no dearth of investment or talent, these resources are often dispersed across isolated entities with limited cross-communication and collaboration.

- **Siloed Government Initiatives:** Innovation initiatives are scattered across numerous ministries and departments, including the Department for Promotion of Industry and Internal Trade (DPIIT), Department of Science & Technology (DST), Department of Biotechnology (DBT), Ministry of Micro, Small & Medium Enterprises (MSME), and the Ministry of Education (MoE). These entities often operate independently, resulting in overlapping schemes, inefficient resource allocation, and a lack of a unified national innovation strategy. For instance, multiple ministries might be funding similar projects due to the lack of a central mechanism for information sharing and coordination.
- **Disjointed Ecosystem Players:** Innovation ecosystems, grassroots innovators, and various support initiatives frequently function in parallel or isolation. This lack of synergy and connections across actors hinders the flow of knowledge, resources, and opportunities between different stakeholders. For example, a promising grassroots innovation might lack the necessary connection to established incubators or funding avenues.
- **Need for Integrated Platforms:** The absence of robust institutional mechanisms and integrated platforms that seamlessly connect research institutions, government bodies, private players (including startups and established industries), and grassroots innovators is a critical gap. This lack of connectivity prevents the

efficient translation of research into viable products and services and limits the potential for cross-sectoral collaboration.

6.2 Inadequate and Skewed Funding Models

While India's startup ecosystem has witnessed substantial growth, access to early-stage seed funding and patient capital remains a significant bottleneck, particularly for deep-tech innovations and startups located outside major metropolitan cities. Similarly, in R&D projects the funding opportunities remain limited and sub-par with GERD at 0.65% of GDP. This has led to a 'sub-critical diffused funding' environment where the quality of R&D output suffers greatly, and the knowledge created and technologies developed fail to get converted into commercial products.

- **Limited Seed and Early-Stage Funding:** Despite the increasing number of startups emerging beyond the top 5 cities (now accounting for over 50%), these ventures often struggle to secure crucial seed funding and mentorship during their formative stages. Investors often exhibit a preference for established business models and locations, leaving innovative but riskier ventures in Tier II/III cities underserved.
- **Misalignment with R&D-Heavy Innovation:** Existing funding mechanisms often do not adequately cater to the long gestation periods and high capital expenditure associated with research and development(R&D)-intensive innovations, such as those in biotechnology, advanced materials, or sustainable energy. The focus on short-term returns can deter investment in projects with significant long-term potential.
- **Lack of sustained investment:** Unlike conventional venture capital, which prioritizes rapid scaling and quick exits, sectors such as deep-tech demand sustained investment, higher tolerance for delayed returns and emphasizes long-term support for businesses, startups, and innovations with extended timelines to profitability. However, the limited availability of investors interested in long-term investment creates a critical funding gap, constraining the development, maturation, and commercialization of deep-tech and socially impactful innovations that inherently require prolonged gestation periods.
- **Sub-critical diffused R&D Funding:** The different R&D institutions play an important role towards knowledge creation and development of technology. Their technology development is however mostly limited to TRL4, and most of the technologies struggle to reach successful commercialisation, as funding support is usually not available for all aspects from knowledge creation to translation. Therefore, the dispersion of R&D grants results in sub-critical funding, which is not enough for end product development.

6.3 Weak University, Industry and Government (UIG) Connects

A persistent challenge is the low level of collaboration between research institutions and industry, which significantly limits the commercialization of academic research and the industry's access to cutting-edge knowledge and talent.

- **Research in Silos:** Research institutions often prioritize academic excellence and publications, sometimes operating in isolation from the immediate needs and demands of the industry. This can lead to the development of technologies with limited real-world applicability or commercial viability.
- **Underutilized Research and Limited Technology Transfer:** Without strong industry feedback and demand linkages, valuable research findings and technologies developed in academic institutions remain underutilized. The lack of effective technology transfer offices (TTOs) with the expertise and resources to bridge this gap further exacerbates the issue.
- **Weak Translational Research Frameworks:** The absence of robust translational research frameworks hinders the process of converting basic scientific discoveries into practical applications and marketable products. This is often due to poor linkages between research labs, academia, and the private sector, limiting the flow of knowledge and resources necessary for successful commercialization.

6.4 Regulatory and Bureaucratic Challenges

Cumbersome regulatory processes and bureaucratic complexities continue to stifle innovation and create unnecessary obstacles for startups and established businesses alike.

- **Control-Oriented Systems:** Existing systems are often optimized for control and compliance rather than agility and facilitation, creating a challenging environment for innovators, who require flexibility and speed. Lengthy approval processes, complex documentation requirements, and lack of transparency can significantly delay innovation cycles.
- **Need for Enabling Governance:** A fundamental shift towards an "enabling governance" approach is required, where regulations are designed to support and accelerate innovation rather than impede it. This includes simplifying compliance procedures, streamlining approval processes, and fostering a more innovation-friendly regulatory landscape.

6.5 Weak Collaboration and Institutional Partnerships

A lack of effective collaboration and knowledge sharing between different levels of governance and institutions hinders the scaling and replication of successful innovation initiatives.

- **Isolation Between State and Central Institutions:** State and central government institutions often operate in isolation, limiting the exchange of best practices and the potential for coordinated policy implementation. Successful pilot projects and innovative solutions developed in one region may not be effectively shared or replicated across the country.
- **Absence of Centralized Knowledge Exchange Platforms:** The lack of a centralized innovation knowledge exchange platform for seamless information sharing

between central and state-level actors, academia, and industry is a significant limiting factor. Such a platform could facilitate the dissemination of research findings, successful innovation models, funding opportunities, and policy insights.

- **Limited Long-Term Inter-Institutional Partnerships:** The absence of sustained, long-term partnerships between research institutions, industry players, and government agencies restricts the development of collaborative research projects, joint training programs, and the co-creation of innovative solutions.

6.6 Talent and Skills Gaps

Despite India's large pool of STEM graduates, a significant mismatch exists between the skills possessed by graduates and the requirements of the industry, particularly in emerging technology sectors.

- **Lack of Industry-Relevant Skills:** Graduates often lack the practical, industry-relevant skills required for new-age sectors such as Artificial Intelligence (AI), biotechnology, advanced manufacturing, and data science. This skills gap hinders innovation and limits the employability of graduates in these high-growth areas.
- **Overemphasis on Theoretical Knowledge:** The traditional education system often emphasizes rote learning over critical thinking, problem-solving, and innovation. This pedagogical approach does not adequately prepare students for the dynamic and complex challenges of the modern innovation landscape.
- **Need for Curriculum Reform and Industry Integration:** Bridging this gap necessitates comprehensive curriculum reforms that emphasize experiential learning, critical thinking, and problem-solving skills. Stronger academia-industry integration through internships, joint research projects, and industry-led training programs is also crucial.
- **Importance of Reskilling and Upskilling:** Widespread reskilling and upskilling programs, particularly in Tier II and III cities, are essential to equip the existing workforce with the skills needed for the evolving demands of the innovation economy.

6.7 Infrastructure Limitations in Non-Metro Areas

Innovation remains largely concentrated in major metropolitan cities due to limited infrastructure support in Tier II and III cities and rural areas.

- **Urban Concentration of Innovation Infrastructure:** Innovation districts, incubation centers, and maker labs, which provide crucial resources and networking opportunities for startups and innovators, are predominantly located in urban centers, limiting access for those in smaller towns and rural regions.
- **Digital Connectivity and Physical Infrastructure Deficiencies:** Limited broadband connectivity, inadequate laboratory facilities, and poor logistics in non-metro areas further hinder the diffusion of innovation and the growth of startups in these regions. Democratizing access to essential infrastructure is critical for fostering inclusive innovation.

6.8 Weak IP Protection and Commercialization

While India has made progress in strengthening its intellectual property (IP) regime, awareness and enforcement remain low, particularly among grassroots and academic innovators. Furthermore, the mechanisms for commercializing IP, especially from publicly funded research, are often weak.

- **Low IP Awareness and Enforcement:** Many innovators, particularly those at the grassroots level and in academic institutions, lack awareness about the importance of IP protection and the processes involved. Weak enforcement mechanisms further discourage IP creation and commercialization.
- **Limited Patent Literacy and Support:** There is a shortage of trained patent agents and legal support available to small innovators and startups, making it difficult for them to navigate the complexities of the IP system.
- **Barriers to Commercialisation of Publicly Funded R&D:** The commercialization of innovations arising from publicly funded R&D is often limited due to unclear pathways, bureaucratic hurdles, and a lack of incentives for researchers and institutions to pursue commercialization actively. Policies that promote an entrepreneurial mindset among researchers and streamline technology transfer processes are needed.
- **Technology Upscaling and Productisation:** India faces persistent challenges in transforming prototypes into market-ready products, largely due to weak IP protection and inadequate commercialization mechanisms. For instance-many innovations from CSIR laboratories, including bio-based chemicals and advanced materials, remain underutilized because of restrictive licensing, bureaucratic hurdles, and limited industry linkages. Similarly, deep-tech startups often lack structured technology transfer offices, patent advisory, and scaling infrastructure, leaving high-potential solutions stalled at early stages. Strengthening technology transfer systems, enhancing patent literacy, and introducing targeted commercialization incentives are critical to bridging this gap and unlocking the full potential of public research and startup-driven innovation.

6.9 Limited Global Integration

India's innovation ecosystem is relatively isolated from global R&D and technology transfer networks. International collaboration is a vital driver of innovation, and India needs to become a more active participant in these global flows.

- **Need for Enhanced International Collaborations:** Scaling up international collaborations, particularly with leading global universities, research institutions, and innovation clusters, is crucial for accessing global knowledge, technologies, and markets.
- **Attracting Foreign R&D Investment:** Efforts to attract foreign R&D investment and facilitate the establishment of global innovation centers in India need to be intensified.

- **Promoting Cross-Border Knowledge Exchange:** Initiatives that promote cross-border knowledge exchange, joint research projects, and the mobility of researchers and entrepreneurs are essential for integrating India's innovation ecosystem with the global landscape.

6.10 Systemic Gaps in State-Level Innovation Policies

State specific Innovation policies have largely remained a loose defined policy document and not converted into effective actionable steps and hence implementation has not been very effective.

- **Disconnect between policy formulation and on-ground execution:** Despite the widespread adoption of innovation policies at the state level throughout India, many of these policies tend to be more declarative than transformative, often existing primarily in written form rather than being effectively implemented. A key gap lies with inadequate institutional capacity, fragmented governance, and lack of continuous monitoring mechanisms.
- **Low inclusivity of innovation:** State-specific potential rural/grassroots innovators, MSMEs, and Tier II/Tier III cities often remain outside the formal innovation network. Without robust implementation and measurable outcomes, these policies struggle to translate intent into impact, creating fragmented progress instead of an integrated, inclusive and holistic innovation ecosystem.
- **Weak inter-state and center-state coordination:** States pursue isolated agendas without alignment to national priorities. This lack of synergy results in duplication of efforts, inefficient allocation of resources, and missed opportunities for cross-regional collaboration.

6.11 Lack of Innovation in Deep Tech

India's economic growth over the past few decades has been largely driven by the services sector, particularly IT and business process outsourcing. While this has created employment and global recognition, it has also led to an overemphasis on incremental service-based innovation rather than foundational, disruptive technological advancements. This skewed focus has limited India's footprint in the deep tech space

- **Lack of long-term capital investment:** Deep tech requires sustained investment, long development cycles, and robust R&D infrastructure elements that are still underdeveloped in India. The risk-averse nature of domestic investors, coupled with limited collaboration between academia and industry, has further hampered the growth of deep tech startups.
- **Low technology transfer mechanisms and productization:** Deep-tech startups frequently do not have organized technology transfer offices, patent advisory services, and adequate scaling infrastructure, which results in high-potential solutions being hindered at initial stages. As a result, India continues to lag in global patent filings and breakthrough innovations in core technologies.

- **Low inclusivity in innovation:** Talent is similarly skewed toward premier institutes, with limited penetration into Tier II and Tier III cities or state universities, while market orientation often prioritizes high-value international segments over domestic developmental needs. Intellectual property is frequently controlled by private or global corporations, restricting affordable licensing and shared benefits

It is essential to fortify technology transfer systems, improve patent literacy, and implement specific commercialization incentives to address this gap and fully realize the potential of public research and innovation driven by startups. To shift from a services-led model to an innovation-driven economy, India must nurture its deep tech ecosystem through mission-driven funding, dedicated infrastructure, strong IP frameworks, and global research partnerships. Prioritizing deep tech is not just about technological self-reliance; it's a key to securing long-term economic resilience and strategic global competitiveness.

Addressing the multifaceted challenges and bridging the existing gaps in India's innovation ecosystem requires a concerted and collaborative effort from all stakeholders – government, academia, industry, and civil society. Fostering synergy through enhanced coordination, strategic funding, stronger academia-industry linkages, streamlined regulations, robust institutional collaborations, targeted skill development, improved infrastructure, effective IP protection, and greater global integration are crucial steps towards realizing India's potential as a leading global innovation hub. By implementing comprehensive and well-coordinated policies and initiatives, India can unlock its vast innovative capacity, drive sustainable economic growth, and create impactful solutions for both domestic and global challenges.

CHAPTER 7
The Road Ahead

The key insights gained from the preceding chapters provides us with evidence of progress in India's journey in building an STI ecosystem that can effectively link with the production ecosystem. A positive structural shift in India's STI ecosystem is observed driven by innovative policy framing and implementation. This is reflected in new institutional arrangements, governance mechanisms, incentive systems, and expanding stakeholders' engagements. Creation and repurposing of existing organisations, framing and implementation of target centric mission mode programmes, and creation and strengthening of STI intermediary bodies show new institutional arrangements for bridging critical gaps between knowledge production, innovation, commercialisation, and societal applications. Some instances of strong university-industry linkages, and societal engagements are emerging with enabling roles played by the government. This is a promising demonstration of interactive, co-evolving models that are underscored by the Triple Helix, Quadruple Helix frameworks. Rise of startups, incubators, venture funds, grassroots innovators are signalling deepening and diversification of innovation actors. The study also draws attention to the gaps that need to be addressed that are impeding progress.

The road ahead in innovation requires integrating four elements—synergy, entrepreneurial commercialization, upscaling capabilities, and strategic reach—into a cohesive approach. Organizations that excel in orchestrating these dimensions will navigate the complex innovation landscape more effectively than those pursuing isolated excellence in any single area.

These understandings have led us to present a policy roadmap aimed at advancing the vision of Viksit Bharat 2047.

7.1 Scale Successful Models

A crucial area for improvement is the scaling of successful models nationwide for a truly inclusive innovation ecosystem. Programs, such as Atal Innovation Mission's Tinkering Labs, Atal Incubation Centres (AICs), and DPIIT's Startup India hubs, have proven highly effective in fostering early-stage innovation. However, their reach remains concentrated in major cities and academic institutions. The programs also need to link up with global innovation ecosystems; this can help to expose startups to diverse technical expertise, create opportunities for global market access, and lead to new synergy and dynamism.

Suggested Actions:

- **Strengthening and Creating Regional Innovation Clusters:** The existing programs should incorporate as their key action point to co-locate multiple Atal Centres, incubators, and Startup India hubs in existing regional clusters. They should also provide enabling support for creating regional innovation clusters wherein their successful institutions are embedded. This can create new synergy to the translational efforts nationwide by leveraging local capabilities, direct attention to create innovative solutions to regional development challenges, create more efficient sharing of resources, and more opportunities to connect to the national and global innovation ecosystem.

- **Diversify stakeholders' engagement:** Regional partners such as academic institutions and central sector R&D labs located in tier 2 and tier 3 cities, civil society including NGOs working at regional levels, institutions promoting grassroot innovations need to be part of the major successful programs. This will make the programs more inclusive and help to promote regional innovation and translation.
- **Create intermediary institutions:** Strengthen through intermediary institutions collaborations of regional startups with national and international innovation ecosystems such as global startup networks, international venture capital funds, and establish R&D partnerships in complex technologies.
- **Adequate and Focused funding:** Many programs and schemes suffer from insufficient financial support due to the prevailing practice of "sub-critical diffused funding," which disperses resources thinly across numerous initiatives. This fragmented approach leads to inefficiencies in funding mechanisms, ultimately undermining the intended impact of innovation-driven programs. To address this, there is a need for more strategic allocation of resources, with higher and more targeted investments in R&D, which in-turn requires a significant increase in our Gross Expenditure on Research and Development (GERD).

7.2 Diversify the Role of Technology Business Incubators

Technology Business Incubators (TBIs) should be actively engaged across the entire innovation-to-commercialisation value chain. Typically, they confine their support to the technical scaling of innovations alone. Startups need critical support also for developing business model design, regulatory navigation, market entry strategies, financial planning, and community engagement. Many startups in spite of strong technical foundations fail due to lack of non-technological support.

Suggested Actions:

- **Expand Mentoring Scope within TBIs:** Include expertise in finance, legal/ regulatory, marketing, and social innovation alongside technical mentoring.
- **Cross-disciplinary Mentorship:** Build mentor pools that combine technologists, policy experts, business strategists, and social entrepreneurs.
- **Sector-Focused Incubation:** TIs need to be created in deep technology sectors that are provided with/have access to specialized resources, domain expertise, and have tailored support systems that address the unique technology/sector challenges of commercialisation.

7.3 Prioritise and Incentivise Knowledge Creation and Use

A robust Science, Technology, and Innovation (STI) ecosystem is characterized by its ability to generate value through the application of advances in technology, in conjunction with innovation and entrepreneurship, to translate scientific and technological progress into productive economic activity. The key to value creation as highlighted by OECD (2007) is intellectual assets taken as a whole that includes aggregate measures of human

capital, R&D and capacity to conduct it, patent valuations, alongside other intangible assets such as brand value, and firm-specific knowledge.

Suggested Actions:

- **Ease of Doing R&D:** Systematic efforts need to be initiated to provide ease of doing R&D by 'Removing Obstacles and Promoting Enablers'. Not only the funding for STI activities need to be scaled up significantly, but the regulatory environment also needs to be overhauled for effective utilization of R&D grants.
- **Ready to Accept Failures:** Many STI projects are not able to achieve desired results and while there may be indications mid-way in the execution, they are continued due to fear of accepting failures and audit issues. STI support agencies should be empowered to recognize that some projects and initiatives may fail or become irrelevant over time and therefore a course correction is a possible option mid-way.
- **Mandate Translational Pathways:** All public funded research projects except those that are dedicated 'blue sky' projects should include a detailed plan for knowledge utilization. R&D personnel in the government sector may be allowed to create knowledge spinoffs, startups etc. to promote translation of knowledge generated into useful products and technologies.
- **Monitoring & Evaluation Mechanism:** The various policy initiatives that have been articulated by the government to create an enabling STI ecosystem need to have periodic assessment of value creation with a strong feedback system built in that identifies the bottlenecks that impede value creation. However, the monitoring and evaluation needs to be based on a 'Premise of Trust' and 'Outcome Oriented Evaluation', rather than lengthy and time-consuming compliances which are not really effective.

7.4 Facilitate Mobility between Academia and Industry

New and emerging science-driven technologies, such as those underpinning the 4IR technologies, calls for effective institutional mechanisms that facilitate the mobility of human resources between universities and industry. This enabling government approach can strengthen university-industry linkage creating strong Triple Helix configuration. This mobility fosters knowledge exchange, skill development, knowledge co-creation, enhances the absorptive capacity of firms, and strengthens university-industry collaboration.

Suggested Actions:

- **Create Supportive Mobility Schemes:** Introduce schemes that allow researchers, and faculty to be associated with industry in various ways including formally spending a few years in industry without loss of career progression. It should be seen as an achievement and special weightage to be provided in their evaluation assessment keeping in view the contributions made during the association with industry. Industry professionals' linkages with academia and research institutions

need to be formed. This would provide them the necessary space to contribute effectively and to address the specificity of the industry engagement. Flexibility has to be built in the schemes as there can be various unanticipated challenges.

- **Joint Project/Programme Development:** Public-Private partnership model should have uniform functional framework across academia and research institutions nationwide/across different funding bodies including programmes and missions. Further, for a particular technology domain there can be differentiation but not at the cost of changing the uniform functional programme. This will provide clarity and strengthen public-private partnership.

7.5 Dedicated Support for Exploring Knowledge Frontiers

Knowledge frontiers challenge the established research calling for taking risky leaps into radically novel ideas. It is a long term sustained investment in creating new institutions that brings together an interdisciplinary team with researchers of high excellence, having access to sophisticated instruments who can mentor young researchers with liberal large funding availability. This builds up the capacity and capability for successfully engaging with frontier technologies. Synergistic linkages between cutting edge scientific research in the frontier areas with translational research can create a strong base for deep technology firms and startups to emerge.

Suggested Actions:

- **Dedicated Funding Programs:** Establish flexible, long-term funding programs to support high-risk, high-reward exploratory research in emerging areas such as quantum technologies, advanced materials, synthetic biology, and space sciences, even where immediate commercial outcomes are not evident. Complement this with high-value fellowship schemes to attract and retain leading researchers from India and abroad, fostering global talent exchange and strengthening national research capacity. Each innovation-driven ministry should institute dedicated funding allocation mechanisms to ensure sustained support across relevant stakeholders.

- **Capacity building:** Dedicated capacity-building funds should be established to provide sustained support for advanced training, international fellowships, and exposure to frontier technologies such as quantum computing, AI, and synthetic biology in an intent to expand the national talent base and enhance the country's ability to lead in transformative research and innovation.

- **Strengthen Global Scientific Engagement and Knowledge Exchange:** Creating attractive frameworks for diaspora scientists, researchers, and engineers to return or collaborate with domestic institutions. Such initiatives would unlock the flow of cutting-edge knowledge, advanced skills, and global best practices into the national research landscape. Equally important is the active participation and investment in international big-science programs. By engaging in large-scale, frontier research initiatives and collaborative infrastructure projects, the country can gain early access to transformative technologies, strengthen cross-border

partnerships, and reinforce its position as a key player in shaping the global research and innovation agenda.

- **Create new skilling programs:** Various types of upskilling and reskilling of human capital for deep technology startups need to be created. This has to be sector specific and allow various types of flexibility. Dual apprenticeship with startups vocational training system is provided for startup work in AI and robots in Germany for example.

7.6 Development of a Deep Technology Ecosystem

A deep technology ecosystem comprises co-locations of universities, knowledge intensive firms, deep technology startups with many incubated in universities. Handholding is always needed for any startup; it is much needed for creating high-technology start-ups as they face higher levels of risk and uncertainty and take a much longer period for maturation. One of the critical requirements in technology development is to cross the "Valley of Death". The academic/research institutions generally work in TRL level 1 to 4. The technology maturation is at the TRL level 8 and 9. Industry involvement and support system is mainly visible at TRL level 7 to 9. Critical support is required particularly from TRL level 4 to 6, typically called the 'valley of death' as many startups fail at this stage. Thus, high technology startups that primarily enter at TRL 4-5 level need strong handholding in reaching technology maturation and then for scaling the technology appropriately to become a viable product ready for commercialisation. At scaling or early commercialisation stages startups may look for exit. In a good enabling ecosystem, various options are visible for startups to cover these many stages. India has created various instruments for supporting startups that have led to an entrepreneurial culture. However, the next phase of transition calls for startups to translate towards knowledge intensive firms, position strongly in the global value chain, and create high end job growth, and become key drivers of frontier technology enabled products.

Suggested Actions:

- **Public Procurement:** R&D intensive firms, startups that are creating innovative products should have high support through public procurement. This will be a catalyst for a new landscape of innovation and develop a technology driven market
- **Public-Private Seed Fund:** This can help to bring private partners early in the technology development with industry having stake in development of the technology. It brings the complementary skills of public research institutions/ universities and industry.
- **Regulatory Sandbox:** Establish regulatory sandbox provision in deep technology domains. Regulatory sandbox is a system with regulations on new products and are relaxed under limited conditions in order for market participants to test new products. Sandboxes allow regulators to monitor performance, assess risks, and intervene early before full-scale deployment. Many countries with high-technology space have this provision such as the USA, Republic of South Korea,

United Kingdom etc. India needs to implement this particularly in high technology areas by embedding it in the programme and clearly define a pathway for its implementation. MeitY has taken an early lead in the country by framing this provision within IoT and AI.

- **Provide high end scaling support for selected startups:** Identify startups that have global scaling potential for capital intensive support.
- **Increase the diversity of funding:** Various ways of funding support should be there for startups to exploit. This includes non-dilutive (financial support that does not require the recipient to give up equity, ownership, or control of their company), dilutive, equity funding, viable gap funding (to cover the cost that industry/private entity is not able to commit i.e., the full capital required for commercialisation/ operationalisation), equity crowd funding (raising money online by offering equity to many small investors), etc. BIRAC has successfully established non-dilutive funding. TDB has multiple provisions—non-dilutive, dilutive, equity funding. These funding models have to be introduced aggressively in other schemes. India does not allow equity crowd funding. This type of funding has played a key role in growth of startups particularly deep technology startups in different countries. With proper safeguards this type of funding needs to be introduced.
- **Create new opportunities for growth:** Need to provide easy exit mechanisms for startups. This can be through IPO (Initial Public offering), acquisition, secondary sale, buyback, etc. This helps to develop the knowledge market, increase confidence of investors, entrepreneurs, and attract foreign institutional investors. India has established through SEBI in 2019 a listing platform the investors growth platform. There is low participation of startups in this platform. Revisit is needed to ease the eligibility norms, liquidity concerns, make exit alternatives more attractive, create awareness etc.

7.7 Intellectual Property Rights Policy Update

India had for the first time articulated a National IPR Policy in 2016. This policy was instrumental in improving the intellectual property governance and also addressed some of the pressing challenges. However, the rapidly changing technology landscape exemplified by deep technologies such as artificial intelligence, biotechnology, semiconductors, and digital platforms are creating newer forms of technology monopoly, data rights, and ethical challenges. One of the most promising aspects of India's innovation Odyssey are the startups that have created an entrepreneurial culture. There is now a strong focus of the country to engage with deep technologies, develop capacity and capability and create an ecosystem that supports deep technology startups. The main focus of IPR is towards creating protection through patents, lacking focus on other forms of IPR. In recent years there is some positive shift towards geographical indications. There is no clarity for provision of utility models protection in India, which has shown to be very useful in supporting incremental innovation. The new IPR policy should address issues of misappropriation of intangible cultural artifacts Also it needs to provide a clear framework for protection of biopharmaceutical IP rights and many of the contentious

issues that are coming due to the issues of ethics and morality, and addressing the expanding scope of IPR in North countries i.e., seen as TRIP- plus i.e., obligations that go beyond the minimum standards required by the TRIPs (Trade Related Aspects of Intellectual Property Rights).

Suggested Actions:

- **Frame a New IPR Policy:** India needs to frame a new IPR policy.62 The new IPR policy has to align strongly with the Viksit Bharat 2047 vision. The new policy should be forward looking, based on the foresight of the trends and challenges of emerging technologies, and keeping the national and global challenges in perspective. Diverse stakeholders have to be involved in framing the new IPR policy with DPIIT acting as the nodal body. IPR policy has to link strongly with the economic and social welfare, startup policy, ethical governance policies in emerging technologies, digital rights policy etc. It is thus important to have on board experts who have been involved in framing/implementing policies in the above areas.
- **Utility model provision:** The new policy needs to bring in Utility Model protection as a new protection instrument. This will provide innovators, especially SMEs, startups, and grassroots entrepreneurs, with a cost-effective and simpler mechanism to protect incremental innovations. It can encourage many creative activities at different levels, in school and individuals and can be embedded in Atal tinkering laboratories.
- **Protecting Intangible Cultural Expressions:** The new policy should incorporate strong protection mechanisms for protecting intangible cultural artifacts (cultural expressions embedded in practices, traditions, and performances). This can address many of the challenges for misappropriation of India's intangible cultural artifacts and also help to create value to the community through proper benefit sharing mechanism.
- **Ownership and royalty sharing of intellectual property:** Many universities have created guidelines for ownership and sharing of intellectual property. However, there is a lack of clarity and uniformity in the majority of universities on this aspect. The new policy should articulate clear guidelines for ownership and sharing of intellectual property with start-ups emerging from university, sharing of IPR emerging from academia-industry linkages and define the incentive mechanism (fiscal/non-fiscal) from IPR exploitation. The new IPR policy should give directions for royalty distribution between research institutions and the innovators as it lacks uniformity and enforceability across research institutions.
- **Creating Awareness of different categories of IPRs:** There is a strong focus on creating awareness of patents that has created positive outcomes in terms of patent filing across different institutions and individuals. There is however not sufficient awareness of protection mechanisms of other forms of IPRs. Various provisions in the PVP&FR Act for example can provide new opportunities to

[62] https://or.niscpr.res.in/index.php/JIPR/article/view/11022

farmers and seed startups, and community rights to traditional varieties.63 Similarly various opportunities can emerge from protection through 'geographical indications' (GI), design registration, trademarks. There are various provisions under copyright law apart from the copyright protection of published documents. This includes performers' rights (actors, musicians, dancers, etc.), broadcast reproduction rights (TV, radio organizations), rights of producers of sound recordings and cinematograph film. Not much awareness is there on these provisions to the practitioners. Clear guidelines need to be formulated for trade secret protection. Material transfer agreement is another key provision that is not clearly articulated and implemented in India. As India is giving a strong focus on creating indigenous chips, awareness has to be created on protection mechanisms through the Semiconductor Integrated Design Layout Act. Protecting products through multiple IPR protections can create strong protection to creativity and prevent misappropriation and help exploit the intellectual property.

7.8 Strengthen Synergies across Ministries and Departments

Many ministries have come up with promising programs to strengthen the research-innovation-commercialisation value chain. One of the primary challenges is that many programs operate in silos, with minimal inter-ministerial collaboration. For instance, research-focused programs under DST and MoE often do not have direct linkages to startup-oriented schemes under DPIIT and MSME, leading to a gap between research, innovation and commercialization. Establishing inter-ministerial partnerships, where research outputs from academic institutions are seamlessly transferred to startup incubators and industry collaborators, can significantly enhance the effectiveness of India's innovation ecosystem.

Suggested Actions:

- **Creation of an inter-ministerial centralised database:** The centralised database needs to be populated with programs created by different ministries, research projects funded, research papers and patents emerging from the projects, startup ventures supported by the ministries, and other intangible assets that have been created by different ministries. This database should be accessible to all ministries for streamlining efforts and preventing duplication.
- **Create Inter-Ministerial Programs:** Keeping in view the strong interdisciplinarity needed for addressing SDG goals, collaborative inter-ministerial projects programs need to be created. Programs should have institutional mechanisms to pool resources across ministries and establish a governance mechanism for coordination and monitoring.

7.9 Establishing STI Intermediary Organisations and an Overarching Body

STI intermediary institutions have traditionally been established within the science, technology, and innovation (STI) ecosystem. However, a new approach to bridging the gap between the STI ecosystem and the industrial ecosystem is to embed STI intermediary organizations directly within the industrial ecosystem, and connect it to the relevant line

63 http://op.niscair.res.in/index.php/JIPR/article/view/34538

ministry. At the same time an overarching meta-institution can be created to bridge the fragmentation in the innovation landscape, improve inter-ministerial coordination, create directionality in funding, reduce redundancy, and strengthen the efforts of programs of other institutions. This can help align innovation directed towards national priorities, policy integration, and scaling innovation, and help in global positioning. A long-term perspective of creating capacity and capability in frontier technology areas can be one of the core mandates of this body. This body may also be entrusted with guiding the monitoring and evaluation process.

Suggested Actions:

- **Create Apex policy-making and Strategic body:** This body should be chaired by the Prime Minister or a designated senior minister, and have members from head/ key functionaries from the S&T bodies, PSA office, NITI Aayog, inter-ministerial bodies, etc. This body will provide directionality to shaping India's inclusive innovation approach towards Vishit Bharat 2047.
- **Creation of STI Intermediaries:** Apart from creating STI intermediaries within their own line ministries, establish new STI intermediaries in other ministries where there is a high level of technology application and sectoral industrial impact. Such cross-placement will strengthen interdisciplinary and inter-sectoral linkages and create new innovation pathways in that sector.

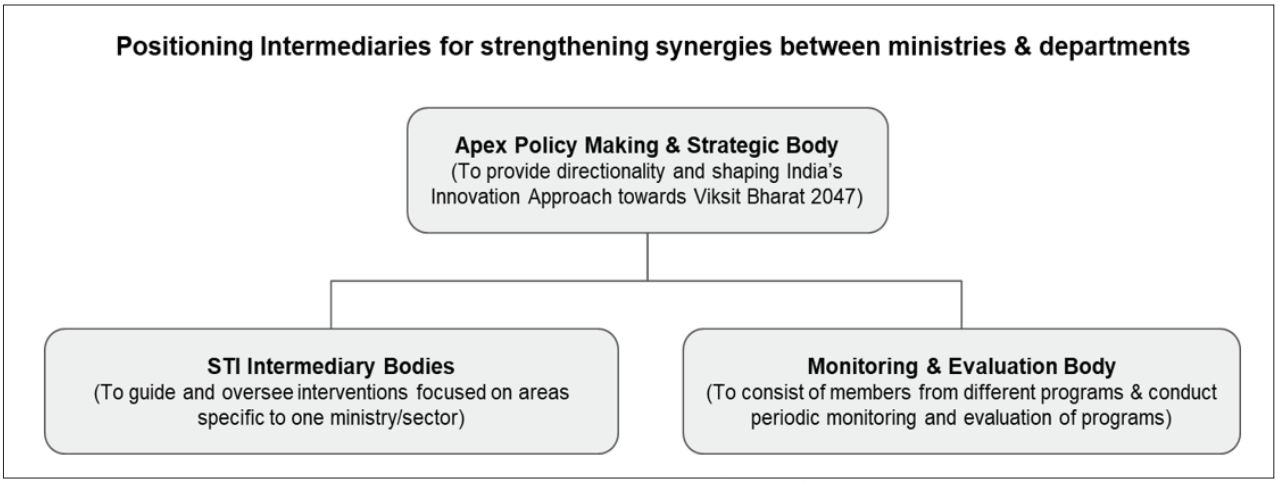


Figure 7.1: Proposed organisation of intermediary bodies

- **Monitoring and Evaluation body:** This body should have representatives from different mission mode programs, and different programs involved in strengthening the STI ecosystem. This body may be coordinated by NITI Aayog. It should focus on policy integration, innovation finance, ethics and governance, international collaboration, innovation support strategy, synergy/cross-linkages of innovation funding, address innovation gaps, etc. Periodic monitoring and assessment of programs should be integral to this body. There has to be different working groups within this body for creating the needful pathways.

7.10 Strengthen Innovation Capacity in States

Several Indian states have introduced ambitious policies to promote startups and strengthen sectors such as semiconductors, renewable energy, and biotechnology. Yet, in many cases, policy intent has outpaced actual implementation, resulting in a gap between stated objectives and on-ground outcomes.

States vary widely in **"implementation effectiveness."** Wealthier, industrialized states tend to deliver more. High-performing states include Maharashtra, Tamil Nadu, Karnataka, Gujarat and Telangana: these have strong institutions, infrastructure and technical workforce, and thus convert policies into projects. Low-performing states (e.g., Uttar Pradesh, Bihar, Jharkhand, Odisha, many in North-East) suffer from weak governance, poor infrastructure and policy gaps. For example, five advanced states (Maharashtra, Karnataka, Delhi, Tamil Nadu, Gujarat) contributed ~72% of India's direct tax revenue in FY2024, whereas UP, Bihar and MP contributed only ~5%,[64] reflecting how concentrated industry remains.

While ambitious policies to attract startups and industries have been launched, implementation often runs into familiar roadblocks. **Administrative bottlenecks** remain a major hurdle, complex and overlapping approval processes can stall even promising projects (e.g., Gujarat's SEIAA expiry in 2024).[65] **Regulatory delays** add another layer of friction, with solar and biotech ventures frequently waiting on environmental approvals, tariff decisions, or basic factory licenses. **Funding** is another pain point: while states and the Centre announce generous subsidies and seed funds, actual disbursal is slow, leaving entrepreneurs to dip into their own resources. **Infrastructure gaps** further complicate the picture, semiconductor parks, power transmission lines, or biotech lab facilities promised on paper often take years to materialize, undermining investor confidence. Finally, the **scheme's structure** itself can be unrealistic, tying incentives only to nationally cleared projects, imposing rigid employment targets, or layering on compliance burdens that deter rather than attract investors. Without periodic reviews or sunset clauses, such schemes linger even when ineffective, widening the gap between vision and execution.

Suggested Actions:

- **Rigorous monitoring and evaluation:** Assign clear KPIs and timelines to each policy, and publicly track progress (e.g., in dashboards). High-level oversight works: UP's Startup Policy 2020 instituted a Chief Minister–chaired Steering Committee to review outcomes and disburse incentives[66] Other states can emulate such periodic reviews by senior officials or independent auditors to ensure accountability.
- **Centre–State coordination:** Aligning state schemes with national initiatives is crucial if policies are to work on the ground. National schemes often set the broad direction, but states need flexibility to adapt them to local realities, whether that means adjusting incentives to match local cost structures or aligning with regional priorities. Stronger joint mechanisms, like Centre–State working groups, can also help iron out disputes on issues such as land allocation or power tariffs, ensuring that both sides pull in the same direction.

[64] https://www.newindianexpress.com/amp/story/business/2025/Mar/10/five-industrial-states-contribute-72-of-direct-taxes-2?
[65] https://thesecretariat.in/article/environmental-clearance-not-infrastructure-holds-up-more-than-a-thousand-projects-in-gujarat
[66] https://medtech.stpi.in/startup-policy-2020

- **Capacity-building in administration:** Stronger administrative capacity can make the difference between a policy that stays on paper and one that delivers results. States that set up dedicated nodal agencies or project management units with skilled professionals often see smoother execution. Bringing in industry experts helps turn policy intent into real, bankable projects, while regular training for officials, especially on emerging technologies like AI in biotech ensures that decision-making keeps pace with innovation.
- **Strengthening State S&T Councils:** Different states have a dedicated S&T council which is expected to identify STI needs of the state. In many states, these councils are the central agency for coordinating STI activities and linking with different institutions in the state. However, the councils have not been able to play a very effective role and need to be strengthened. NITI Aayog recently released a detailed roadmap towards this end.[67]
- **Sunset Clauses & Periodic Reviews:** State policies should have built-in expiry dates to prevent outdated schemes from lingering without results. Sunset clauses make governments periodically review effectiveness before extending or redesigning an initiative.68 This not only curbs inertia but also ensures incentive structures remain relevant, efficient, and aligned with changing industry and technological needs.
- **Transparent Fiscal Reporting:** Fiscal transparency is critical for building credibility in state policies. States should earmark dedicated budget lines for startup and industry incentives, and publish regular reports on allocations, disbursements, and utilization. This prevents "phantom" budgets where funds are announced but never released. Clear, public reporting also helps entrepreneurs and investors track pending payments, improving confidence in state support mechanisms.

India has taken a salutary paradigm shift towards innovation driven inclusive growth. Many initiatives were undertaken from 2014 in creating an enabling STI ecosystem to make this transition possible. New policy directions, mission mode programs, institutions that can help to implement the various programs, and bringing diverse stakeholders together are reflection of them. A new innovation culture of innovation and entrepreneurship is shaping up and is reflected in many ways. Startups are creating a new vibrancy and entrepreneurial culture in the country; creating new opportunities for knowledge translations for economic wealth and social innovations. The loci of innovation are now not only in firms but across universities, research institutions, MSMEs, community and grassroot levels and individuals. Despite constraints, resilience of the innovation systems is demonstrated in many challenging situations. Ambitious new pathways are visible with new commitments to make India one of the leaders in deep-technology innovations. *Innovation is becoming central to realizing the vision of Viksit Bharat by 2047. Drawing from evidence-based analytical examination of the policies and programs, our proposition is that the recommendations that are presented can address systematic gaps and strengthen the foundation for an inclusive, innovation-driven India.*

[67] https://www.niti.gov.in/sites/default/files/2025-07/A-Roadmap-for-Strengthening-State-ST-Council.pdf
[68] https://legal.economictimes.indiatimes.com/news/law-policy/law-ministry-pitches-for-sunset-clause-fosters-clarity-and-efficiency-within-the-system-says-legal-experts/111909493

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