

Preparing India for an Innovation-Led Economy, Initiatives, Challenges

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India's goal of becoming a developed nation by 2047 increasingly depends on strengthening its innovation ecosystem. Despite strong policy intent through increased funding, regulatory reforms and support for startups, outcomes remain limited due to low R&D spending, weak private sector participation and poor research-to-market linkages. Addressing these structural gaps and encouraging industry-led innovation will be crucial for translating policy ambition into sustainable technological and economic growth.

Government Initiatives to Promote an Innovation-Led Economy

In recent years, the Government of India has taken significant steps to strengthen the country's research and innovation ecosystem.

- **Expansion of research funding:** The government has created a ₹1 lakh crore **Research, Development and Innovation (RDI) Fund** aimed at supporting advanced technological research and encouraging high-risk innovation projects.

- **Support for deep-tech startups:** A ₹20,000 crore corpus has been announced to **promote startups working in emerging technologies** such as artificial intelligence, quantum computing, robotics and advanced materials.
- **Promotion of innovation culture:** The expansion of **Atal Tinkering Labs** in schools aims to encourage scientific curiosity and experimentation among students, helping to nurture the next generation of innovators.
- **Regulatory reforms for research:** Restrictions that earlier limited young deep-technology firms from accessing certain government research schemes have been removed, making the research ecosystem more accessible to startups.
- **Opening new technological domains:** Legislative reforms such as the **SHANTI Act, 2025** allow patents for peaceful uses of nuclear energy and radiation, creating opportunities for private sector participation in advanced scientific fields.

These initiatives indicate that India is attempting to build a supportive ecosystem for innovation and technological advancement.

Structural Challenges in India's Innovation Ecosystem

Despite these policy initiatives, India's innovation ecosystem continues to face several structural challenges that restrict the country's ability to emerge as a global technology leader.

- **Low R&D expenditure:** India spends only about 0.65% of its GDP on research and development, which is significantly lower than innovation leaders such as South Korea, Japan and the United States. Limited investment restricts the scale of scientific research and technological breakthroughs.
- **Limited private sector participation:** In most innovation-driven economies, industry accounts for the majority of research investment. In India, however, the government still bears a large share of R&D expenditure, reflecting the private sector's cautious approach toward long-term and high-risk innovation.
- **Weak global technological presence:** Although domestic patent filings have increased in recent years, India's share in international patent applications remains relatively small compared with major innovation powers such as China, the United States and Japan. This indicates limited global technological influence.
- **Human capital constraints:** Innovation thrives in environments with strong research talent and knowledge-intensive employment. India faces shortages in skilled researchers and scientific professionals, which limits the country's ability to generate cutting-edge innovations.
- **Gender gap in scientific research:** The relatively low participation of women with advanced degrees in science and technology reduces diversity in research environments and weakens the overall innovation potential.
- **Weak research-to-market linkages:** Many research findings generated in universities and public research institutions fail to reach the market because technology transfer mechanisms remain underdeveloped. Limited collaboration between academia and industry further reduces opportunities for applied research and product development.
- **Structural economic constraints:** India's development trajectory has relied heavily on services rather than large-scale industrialisation. As a result, many startups operate in service-based or platform-based

models rather than deep technology sectors, reducing incentives for sustained industrial research and technological innovation.

Together, these structural challenges highlight the need for deeper reforms in the innovation ecosystem.

Way Forward

Addressing these challenges requires a comprehensive and coordinated strategy.

- **Increase national R&D expenditure** to strengthen the scientific research base and support long-term technological development.
- **Encourage private sector investment** in innovation through tax incentives, research partnerships and easier access to funding.
- **Strengthen industry-academia collaboration** so that universities and research institutions can work closely with businesses to develop market-ready technologies.
- **Develop effective technology transfer systems** within universities to facilitate the commercialisation of scientific discoveries.
- **Promote deep-tech entrepreneurship** by expanding venture capital support and providing patient funding for long-gestation technologies.
- **Enhance participation of women in STEM** fields in order to broaden the talent pool and improve diversity in research.
- **Strengthen advanced manufacturing capabilities** to create a stronger industrial base that supports technological innovation.

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