



## India's Deep Tech Vision

This editorial is based on [“India’s march towards deep tech”](#) which was published in The Hindu on 11/09/2024. The article highlights India's shift from traditional software to deep tech, driven by the need for solutions to global challenges like climate change and healthcare. With strong government support and advanced startups, India is positioning itself for leadership in the global deep-tech landscape.

**For Prelims:** [Skyroot Aerospace](#), [National Deep Tech Startup Policy](#), [Artificial intelligence](#), [National Mission on Quantum Technologies and Applications](#), [National Deep Tech Start-up Policy 2023](#), [Anusandhan National Research Foundation](#), [Vikram-S rocket](#), [National Supercomputing Mission](#).

**For Mains:** Growth Drivers of Deep Tech in India, Major Roadblocks in Development of the Deep Tech Sector in India.

**India's tech story** has traditionally focused on **software and consumer internet**. However, a growing need for solutions to global challenges like [climate change](#) and [healthcare](#) has driven a shift towards **deep tech**. These cutting-edge startups leverage scientific discovery and engineering to create groundbreaking solutions.

This new wave of Indian innovation is tackling complex problems with advanced technologies like **AI, robotics, and biotechnology**. Startups like [Skyroot Aerospace \(space launch\)](#) and **ideaForge (drones)** are pioneering solutions that were once dominated by established international players. The government is also playing a key role, with initiatives like the National [Deep Tech Startup Policy](#) and increased funding for research institutions. This supportive ecosystem, coupled with [India's strong STEM education](#) and vibrant startup culture, positions the country for **leadership in the global deep-tech race**. While challenges remain, such as navigating regulations and attracting talent, India's deep-tech push has the potential to propel the nation to the forefront of innovation.

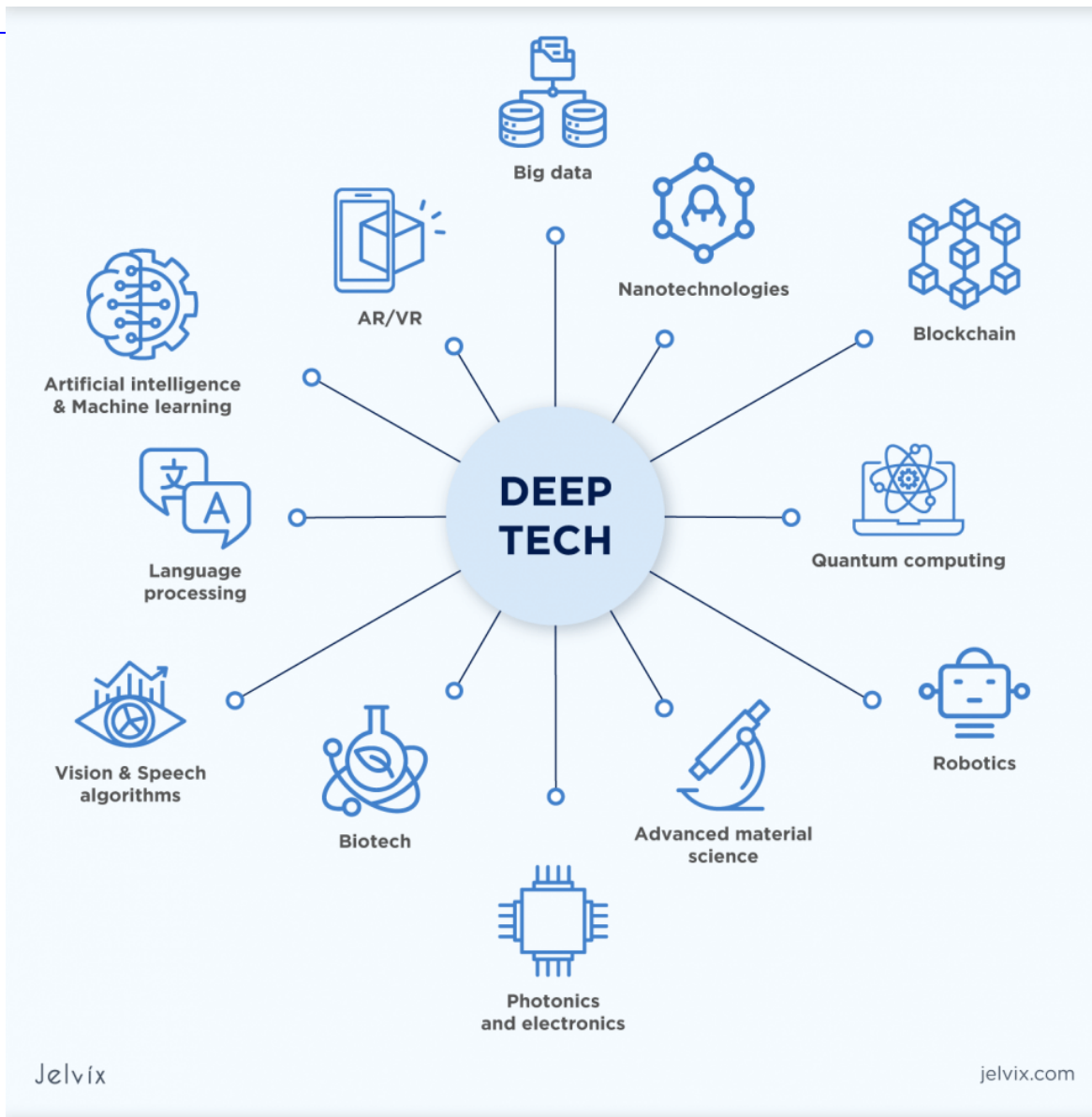
### What is Deep Tech?

- **About:** Deep tech is driven by **scientific discoveries and engineering breakthroughs**, turning theoretical concepts into real-world applications.
  - Unlike conventional tech, which focuses on **incremental improvements**, deep tech ventures leverage **novel technologies for competitive advantage**, often through long and uncertain R&D processes.
- **Key Characteristics of Deep Tech:**
  - **Scientific Intensity:** Rooted in fundamental scientific discoveries or engineering innovations.
  - **Long R&D Cycles:** Typically require extended periods of research and development.
  - **High Capital Intensity:** Often need significant investment in specialized equipment and talent.
  - **Potential for Disruptive Impact:** Capable of creating new markets or significantly

transforming existing ones.

- **Core Areas of Deep Tech:** Artificial Intelligence and Machine Learning, Robotics and Automation, Quantum Computing, Biotechnology and Synthetic Biology, Advanced Materials Science, Nanotechnology, Blockchain and Distributed Ledger Technologies etc.

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- **Status of India in Deeptech:** India now ranks **6th among the top 9 deeptech ecosystems** globally with 3,600 such startups, which received **USD 850 million funding in 2023**.
  - [Artificial intelligence \(AI\)](#) is the top focus for founders and investors, with **74% of new deep tech startups in 2023** centered on AI and **86% of funded startups having an AI focus**.
    - AI also dominates patent filings, making up 41% of all deep tech patents.

## What are the Growth Drivers of Deep Tech in India?

- **Government Policy Push:** The Indian government's proactive policies have been instrumental in fostering deep tech growth.
  - The [National Mission on Quantum Technologies and Applications](#), with its **₹8,000 crore budget**, exemplifies this commitment.
  - The [draft National Deep Tech Start-up Policy 2023](#) aims to accelerate technological growth and enhance global competitiveness.
  - The [Anusandhan National Research Foundation](#), with its ₹1 lakh-crore corpus, is investing

heavily in research across various fields.

- These initiatives create a **conducive environment for deep tech innovation**, providing both financial support and regulatory frameworks that encourage experimentation and risk-taking.
- **Surge in Venture Capital Investments:** Deep tech now accounts for about **20% of annual venture capital investments** worldwide, up from 10% a decade ago.
  - In 2023 alone, deep tech start-ups globally raised nearly **USD 40 billion**, despite economic slowdowns.
  - This trend is mirrored in India, with companies like **Observe.AI raising over USD 214 million** for its conversational intelligence platform.
  - The **increasing willingness of investors to back long-gestation**, high-risk deep tech projects indicates a maturing ecosystem and growing confidence in India's innovative capabilities.
- **Rising Demand for Indigenous Solutions:** India's push for self-reliance, particularly in **strategic sectors like defense and space**, is driving demand for homegrown deep tech solutions.
  - **Skyroot Aerospace's** successful launch of the [Vikram-S rocket](#) in 2022 demonstrates this trend.
  - **ideaForge Technology's** advanced **drones for defense and homeland security** applications further illustrate how deep tech start-ups are meeting critical national needs.
  - This demand not only provides a ready market for deep tech innovations but also **encourages the development of cutting-edge technologies** tailored to India's unique requirements.
- **Robust STEM Talent Pool:** India's strong foundation in **Science, Technology, Engineering, and Mathematics (STEM)** education provides a rich talent pool for deep tech innovation.
  - With over **1.5 million engineering graduates annually**, India has a vast reservoir of technical expertise.
  - The challenge now lies in **retaining this talent and channeling it towards deep tech entrepreneurship**, a trend that's gaining momentum with increased industry-academia collaborations.
- **Focus on Solving Grand Challenges:** Deep tech start-ups in India are increasingly focusing on solving grand challenges in areas like **healthcare, climate change, and sustainable energy**.
  - **Biotech firms** such as Biocon and Syngene are leading in **genomics and personalized medicine research**.
  - **Cell Propulsion's work on electric mobility solutions** addresses both transportation and environmental challenges.
  - This focus on **high-impact, long-term solutions not only attracts talent and investment** but also positions Indian deep tech start-ups as global problem solvers, enhancing their relevance and market potential.

## What are the Major Roadblocks in Development of the Deep Tech Sector in India?

- **The Long Gestation Conundrum:** Deep tech innovations often require extended periods of **research and development before commercialization**.
  - This long gestation period clashes with the **typical 3-5 year investment horizons of most venture capital firms**, creating a funding gap for deep tech start-ups.
  - This mismatch between **development timelines and investor expectations** can **stifle innovation**, particularly in capital-intensive sectors like biotech and advanced materials.
- **The Talent Tug-of-War:** While India produces a large number of STEM graduates, there's a significant shortage of specialized talent in deep tech fields.
  - Only **3% of engineers** have new-age technological skills in areas such as **artificial intelligence, machine learning, data science and mobile development**.
    - The employability in new-age jobs is pegged at an average 1.7%.
  - The brain drain to global tech hubs exacerbates this issue. Indians formed the largest cohort of global tech industry workers **who flocked to Canada between April 2022 and March 2023**,
    - This talent crunch slows down R&D efforts and increases the cost of innovation for deep tech start-ups.

- **Regulatory Labyrinth:** Deep tech often operates at the **cutting edge of technology**, where regulations are either **non-existent or rapidly evolving**.
  - For example, [drone manufacturers](#) had to navigate shifting regulations as India formulated its drone policy between **2018 and 2021**.
  - In emerging fields like **gene editing or AI**, the lack of clear regulatory frameworks creates uncertainty for start-ups.
  - This regulatory ambiguity can deter investment and slow down the adoption of innovative technologies.
- **Market Readiness Mismatch:** Many deep tech innovations are so advanced that they **outpace market readiness**, creating an adoption challenge.
  - For example, while quantum computing start-ups like **BosonQ Psi** are making strides, the market for quantum solutions in India remains nascent.
  - This lag between innovation and adoption can lead to a "**chicken and egg**" problem, where lack of market traction deters further investment, and lack of investment slows down market development.
- **Infrastructure Deficits:** Deep tech research often requires specialized infrastructure and testing facilities.
  - India has under **2% of the world's USD 1 trillion worth of computer infrastructure**, which is several times less than countries like the US and China which together have nearly 60%.
  - The lack of such infrastructure **not only increases costs for start-ups but also slows down the pace of innovation**.
    - While initiatives like the [National Supercomputing Mission](#) are addressing some gaps, the infrastructure deficit remains a significant roadblock for many deep tech sectors.
- **Intellectual Property Challenges:** Securing and defending intellectual property (IP) is crucial for deep tech start-ups, but it remains a complex challenge in India.
  - The [World Intellectual Property Organization's 2023 report](#) ranked **India 40th globally in innovation**, highlighting the need for stronger IP protection.
  - The **high costs of global patent filing and enforcement**, coupled with a relatively slower patent grant process in India (average **58 months compared to 23 months in the US**), can put Indian deep tech start-ups at a disadvantage in the global innovation race.
- **Funding Crunch:** The **NASSCOM and Zinnov** report reveals a 77% drop in funding for Indian deep tech startups in 2023, with total investments falling to **USD 850 million and deal numbers decreasing by 25%**.
  - Key challenges include securing funding for scaling, attracting talent, and global expansion.
  - The **investor pool has diminished by 60%** compared to June 2022, with large global investors notably absent, leading to a preference for lower-risk seed-stage ventures.

## What Measures can be Adopted to Accelerate the Development of Deep Tech?

- **Establishing Deep Tech Clusters:** Create specialized deep tech clusters in major cities, modeled after successful global examples like **Boston's Kendall Square**.
  - These clusters would bring together **start-ups, research institutions, and industry partners**.
  - For instance, **Bengaluru could host an AI and robotics cluster**, while Hyderabad could focus on **aerospace and defense tech**.
  - The government could offer tax incentives and subsidized infrastructure to attract key players.
  - This approach would foster collaboration, reduce infrastructure costs for start-ups, and create a critical mass of talent and resources.
- **Deep Tech-Focused Venture Funds:** Establish government-backed venture funds specifically for deep tech, with **longer investment horizons (7-10 years)** to match the extended R&D cycles.
  - The **₹10,000 crore Fund of Funds for Startups** could allocate a % specifically to deep tech ventures.
  - Partner with **private VC firms** to create **blended finance models**, where government funds de-risk private investments.

- This approach would **address the funding gap for capital-intensive, long-gestation deep tech projects**, enabling more start-ups like Skyroot Aerospace to bring their innovations to market.
- **Regulatory Sandboxes:** Implement regulatory sandboxes across various deep tech sectors, allowing start-ups to test innovations in **controlled environments with relaxed regulations**.
  - The RBI's regulatory sandbox for **fintech** could be replicated to areas like **AI, biotechnology, and quantum computing**.
  - For instance, a sandbox for autonomous vehicles could allow companies like **Ather Energy** to test advanced self-driving features in designated areas.
  - This approach would provide regulatory clarity, accelerate the development and adoption of new technologies, and help regulators formulate informed policies.
- **Deep Tech Education Initiative:** Collaborate with top IITs and private institutions to create specialized **deep tech curricula at undergraduate and postgraduate levels**.
  - Introduce **industry-sponsored PhD programs** in emerging technologies, similar to the **Prime Minister's Research Fellows scheme**.
  - This initiative would aim to increase the pool of deep tech specialists, addressing the talent shortage faced by companies like QNu Labs in quantum computing.
- **Open Innovation Platforms:** Develop **national open innovation platforms** for key deep tech sectors, facilitating collaboration between start-ups, corporates, and academia.
  - Model these after successful initiatives like the **Global South Covid-19 Digital Innovation Challenge**.
  - For instance, an AI for Healthcare platform could bring together start-ups like **Niramai (using AI for breast cancer detection)** with major hospital chains and medical research institutes.
  - This approach would help align deep tech innovations with real-world problems and create a market pull for advanced technologies.
- **Deep Tech Commercialization Fund:** Establish a Deep Tech Commercialization Fund to support the transition of research from labs to marketable products.
  - Allocate funds focusing on areas like **advanced materials, biotechnology, and energy storage**.
  - Model this after successful programs like the **US Department of Energy's Technology Commercialization Fund**.
  - For example, this fund could support a **start-up spinning out of IISc Bangalore** to commercialize its breakthrough solid-state battery technology.
- **Global Deep Tech Alliances:** Forge strategic deep tech alliances with global innovation hubs like **Silicon Valley, Tel Aviv, and Singapore**.
  - Establish **bilateral innovation funds, joint research programs, and talent exchange initiatives**.
- For instance, **the Indo-Israel Bilateral Workshop on Quantum Technologies (I2QT-2022)** is a significant development in the **advancements in quantum computing and cryptography**.

## Conclusion

India's tech landscape is witnessing a paradigm shift from **traditional software to deep tech**, driven by global challenges like **climate change and healthcare**. To address evolving challenges and accelerate growth of the sector, **NASSCOM recommends a multipronged strategy strengthening innovation clusters**, enhancing access to patient capital and computing infrastructure, expediting the **National Deep Tech Startup Policy, improving IP frameworks, and developing a robust talent pipeline**. Despite challenges, India's STEM talent and entrepreneurial spirit, bolstered by these measures, position it well to lead in deep tech innovation.

### **Drishti Mains Question:**

Deep tech is emerging as a transformative force in addressing global challenges and redefining technological frontiers. Discuss the role of deep tech in shaping India's future growth, highlighting its potential benefits and challenges.

## UPSC Civil Services Examination, Previous Year Question (PYQ)

### **Prelims:**

**Q. Atal Innovation Mission is set up under the (2019)**

- (a) Department of Science and Technology
- (b) Ministry of Labour and Employment
- (c) NITI Aayog
- (d) Ministry of Skill Development and Entrepreneurship

**Ans: (c)**

### **Mains:**

**Q. COVID-19 pandemic has caused unprecedented devastation worldwide. However, technological advancements are being availed readily to win over the crisis. Give an account of how technology was sought to aid management of the pandemic. (2020)**

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