NEXT IAS

DAILY EDITORIAL ANALYSIS

TOPIC

INDIA'S DEEP-TECH PUSH: INDIA NEEDS ALLIANCES

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Context

- The recent visit of India's Prime Minister to the **Nordic countries, Italy and the Netherlands** was significant for India's strategic outreach aimed at strengthening partnerships in deep technology, innovation, green energy and digital sovereignty.

What is Deep Tech?

- **Deep Tech** refers to technology-driven innovation based on substantial scientific or engineering advances.
- **Deep-tech startups** work on cutting-edge sectors such as Artificial Intelligence (AI), semiconductors, quantum computing, robotics, biotechnology blockchain and crypto, green energy technologies, and space technology, unlike conventional startups focused mainly on digital services.
- **Unlike conventional startups** that scale digital services quickly, deep-tech ventures **require high capital, long research cycles, and tight collaboration** between academia, industry, and government. This is what makes them difficult and strategically invaluable.

Why is Deep Tech Now a Geopolitical Issue?

- **Strategic Advantage:** The world is entering what can be called a **"deep-tech order."** Nations that control AI infrastructure, semiconductor supply chains, quantum-secure communication, and green energy technology will hold **decisive strategic advantage over those that do not.**
- **Tech-colonisation:** AI systems, cloud infrastructure, and advanced semiconductor technologies are dominated by a few US and Chinese firms. Countries lacking domestic technological capabilities risk **long-term dependence, inheriting not only technology but also embedded biases, foreign legal influence, and strategic vulnerabilities.**
- **Supply Chain Weaponisation:** The US-China trade war has shown that semiconductor export controls are as powerful a geopolitical weapon as sanctions. India, which imports nearly $50 billion worth of chips annually while producing only $2–3 billion domestically, is directly exposed.
- **Data Sovereignty Gap:** India generates roughly 20% of global data but lacks proportional domestic data storage and processing capacity. The value extracted from Indian citizens' data largely benefits foreign cloud platforms.

India's Deep-Tech Ecosystem: Present Status

- **Growing Startup Ecosystem:** India has emerged as the **world's third-largest startup ecosystem** and is steadily expanding its deep-tech capabilities.
  - India has over 1 lakh recognised startups. More than 3,000 startups are engaged in deep-tech sectors. Bengaluru, Hyderabad and Pune are emerging as deep-tech hubs.
- **Strength in Digital Public Infrastructure:** India's Digital Public Infrastructure (DPI) has become globally recognised Aadhaar, UPI, DigiLocker, and CoWIN.
  - These systems demonstrate India's capacity for large-scale digital innovation.
- **AI and Semiconductor Push:** The government launched the **IndiaAI Mission** with an outlay of over ₹10,000 crore to strengthen AI computing infrastructure, AI startups, indigenous AI models, and skill development.
  - India has announced semiconductor incentive schemes worth ₹76,000 crore to promote chip manufacturing.
- **Global Partnerships:** India is actively pursuing India-EU Free Trade Agreement (FTA), technology partnerships with Nordic countries; and semiconductor cooperation with the US, Japan and Taiwan.
  - These collaborations aim to reduce technological dependence on a few countries.

Challenges Facing India's Deep-Tech Ecosystem

- **Low R&D Expenditure:** India spends around **0.7% of GDP** on Research and Development.
  - India's annual R&D expenditure is about **$13 billion**. In comparison, Nvidia alone spends over **$18 billion annually** on R&D.
- **Limited Private Investment:** Most deep-tech initiatives remain government-driven.
  - Venture capital prefers quick-return sectors such as fintech and e-commerce.
  - Deep-tech projects require long gestation periods and high risk tolerance.
- **Semiconductor Dependency:** India remains heavily dependent on imports for chips, advanced electronics, and semiconductor fabrication equipment.
  - It creates supply chain vulnerabilities.
- **Talent Drain:** Many Indian researchers and engineers migrate abroad due to better funding, superior research infrastructure, and higher salaries.
- **Weak Industry-Academia Linkages:** Research institutions and industries often function in silos, limiting commercialisation of innovation.

Government Efforts to Strengthen Deep-Tech Ecosystem

- **IndiaAI Mission:** It was launched to create a robust AI ecosystem through GPU infrastructure, AI innovation centres, startup support, and ethical AI frameworks.
- **National Quantum Mission (NQM):** It was approved in 2023 with an outlay of ₹6,000 crore.
  - Key focus areas are quantum computing, quantum communication, and quantum sensing.
- **Semiconductor Mission:** The India Semiconductor Mission aims to develop domestic fabrication plants, promote chip design ecosystem, and attract global semiconductor firms.
- **Anusandhan National Research Foundation (ANRF):** It was established to improve research funding, university-industry collaboration, and innovation ecosystem.
- **Startup India and Digital India:** These initiatives provide ease of doing business, funding support, digital infrastructure, and innovation incentives.

Way Forward: How India Can Strengthen its Deep-Tech Ecosystem?

- **Increase R&D Spending:** India should gradually raise R&D expenditure to at least 2% of GDP.
- **Encourage Private Sector Participation:** Tax incentives for R&D, deep-tech venture funds, and public-private partnerships.
- **Build Semiconductor Manufacturing Capacity:** India needs to accelerate fabrication units, supply chain resilience, and the electronics ecosystem.
- **Strengthen Research Universities:** Improve global rankings, promote interdisciplinary research, increase autonomy and funding.
- **Foster International Collaboration:** Strategic partnerships with EU, Nordic countries, Japan, and US can accelerate technology transfer and innovation.
- **Develop Skilled Human Capital:** Focus on AI education, quantum computing skills, semiconductor engineering, and research fellowships.

Daily Mains Practice Question

[Q] Discuss the major challenges faced by India in achieving technological sovereignty. Examine India's efforts to strengthen its deep-tech ecosystem.

Source: IE

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