INDIA'S DEEP TECH STARTUP ECOSYSTEM - ECONOMY

NEWS: Recently, Commerce and Industry Minister Piyush Goyal issued a provocative critique of the Indian startup ecosystem at the second edition of the Startup Mahakumbh.

- He urged startups to shift from low-value ventures (food delivery, quick commerce) to high-impact sectors (semiconductors, robotics, deep-tech), which are critical for national security and global competitiveness.

- India's consumer-focused startup scene with China's strategic investments in advanced manufacturing, AI, and EVs, implying India is falling behind in the global innovation race.

WHAT'S IN THE NEWS?

What is Deep Tech?

- **Deep Tech**, or **Deep Technology**, refers to a category of technology that is **based on advanced scientific discoveries and complex engineering innovations**.

- These are not superficial or easily replicable solutions, Instead, it addresses **fundamental challenges** in society, industry, or nature by relying on long-term, research-driven innovation.

- These are mainly based on **artificial intelligence or machine learning, or new or existing emerging technologies l**ike blockchain, computer imaging, and VR.

    - **Examples:** AI applied to predict **natural disasters or molecular imaging technologies** that identify disease or predisposition to disease.
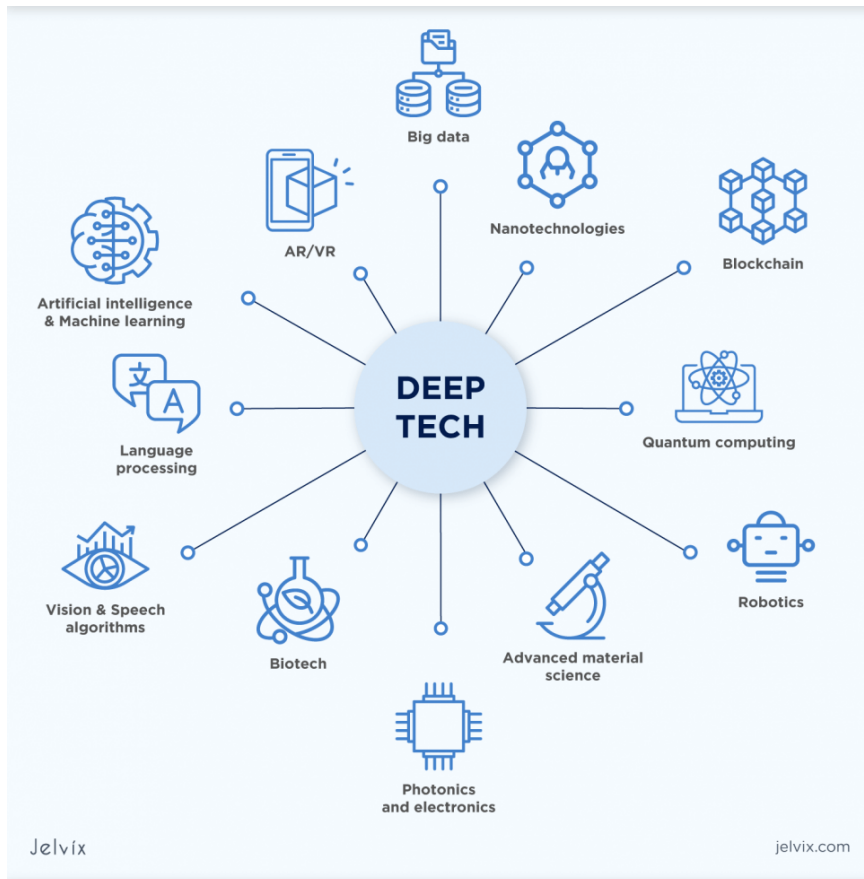
What is a Deep-Tech Startup?

- A **Deep-Tech Startup** is a company that aims to **commercialize breakthrough innovations grounded in science or advanced engineering**.

- It differs from typical digital or consumer-focused startups in that it doesn't rely on business model innovation alone but rather on solving real-world problems using **cutting-edge, original technologies**.

- Unlike conventional start-ups, deep-tech ventures demand **extensive R&D, require long development cycles, a**nd operate at the intersection of science and engineering.

About Startup Mahakumbh

- Startup Mahakumbh is a flagship event bringing together startups, unicorns, soonicorns, investors, industry leaders, and ecosystem stakeholders.

- **First Edition (2019)**: Over 500 startups, investors, and industry leaders participated.

- **The second edition of Startup Mahakumbh concluded on a high note at Bharat Mandapam, New Delhi, from April 3 to 5, 2025.**

Status of Deep-Tech Startup in India

- **Deeptech Ecosystems:** India now ranks **6th among the top 9 deep-tech** ecosystems globally with **3,600 such startups**.

  - **As per Nasscom, India's 4,000 deep-tech startups attracted $1.6 billion in 2024, a 78 per cent increase year-on-year.**

- **Department for Promotion of Industry and Internal Trade (DPIIT)-Recognized Deep-Tech Startups (2023):** India has over 10,000 deep-tech startups recognized by DPIIT, operating across sectors like AI, robotics, semiconductors, biotech, and space tech.

- **Share of Deep-Tech in Indian Startup Funding:** Deep-tech startups account for only ~**5% of India's total startup funding**, significantly lower compared to countries like **China (~35%).**

- **Global Deep-Tech Market Projection:** The deep-tech sector is projected to exceed **$3 trillion globally by 2030**, driven by breakthroughs in AI, quantum computing, and synthetic biology.

- **Quantum Computing Market Outlook:** Quantum computing is projected to reach **$7.6 billion by 2027**, growing at a compound annual growth rate (**CAGR) of 48.1%.**

- **Synthetic Biology Growth Forecast:** The synthetic biology market is expected to grow at a CAGR **of 28.3%, reaching $116 billion by 2032.**

- **Startup IPO Activity in 2025:** 23 Indian startups, including deep-tech ventures, are preparing for IPOs in 2025, reflecting investor confidence in emerging sectors.

Importance of Deep Tech for India

- **Strategic Self-Reliance (Atmanirbhar Bharat):** Deep tech is critical for **national security and technological sovereignty**.

  - India's heavy dependence on foreign-made **semiconductors** (importing over 90%) creates supply vulnerabilities.

  - Indigenous ventures like **Mindgrove** (India's first RISC-V chip) and **Tata-PSMC's $11B chip fab in Gujarat** aim to reduce this reliance.

  - In defense, **iDEX** and **Technology Development Fund** support startups building AI-based surveillance and smart munitions.

- **Solving India's Developmental Challenges:** Deep-tech startups are solving **complex, India-specific challenges**.

  - **AI in healthcare**: Startups like **Qure.ai** and **Niramai** use AI for low-cost tuberculosis and breast cancer screening.

  - **SpaceTech**: Startups like **Skyroot Aerospace** and **Agnikul Cosmos** are developing indigenous launch vehicles under ISRO's support.

  - **Agritech**: Startups like **Fasal** use AI and IoT to assist small farmers in climate-resilient farming.

- **Economic Growth and Global Export Potential:** Deep-tech can drive **high-revenue, IP-led economic growth**.

  - India's deep-tech startups raised over **$10 billion** in the last five years, though still <5% of total startup funding.

- Global deep-tech market is projected to reach **$3 trillion by 2030**. India has the opportunity to capture a large share if supported by the right policies.

- Deep tech innovations like Gen AI could **add $1 trillion to India's GDP by FY30**.

- Export-ready sectors include **quantum cryptography (QNu Labs)**, **robotics (Addverb)**, and **medical devices (Sigtuple)**.

- **Scientific and R&D Ecosystem Development:** Deep-tech fosters long-term **scientific output and patenting**.

  - The **National Deep Tech Startup Policy (NDTSP 2023)** aims to boost R&D through institutional linkages and CSR-driven research.

  - IP-rich startups like **CrisprBits** (gene editing) are helping India build a bio-innovation pipeline.

- **Global Technological Competitiveness:** Deep-tech can help India emerge as a **technology leader**, not just a service provider.

  - Through initiatives like **IndiaAI**, **National Quantum Mission**, and **Indo-US iCET**, India is actively investing in global-scale innovation.

  - **Deep-tech diplomacy** (e.g., tech corridors with UAE, US, and Japan) reflects India's ambition to be a knowledge superpower.

- **Social Equity and Public Good:** Deep-tech solutions often address **core development goals**.

  - **AI in public service delivery**: Used in PM Gati Shakti, eCourts, and PM-Kisan databases.

  - **Precision agriculture**, **low-cost diagnostics**, and **disaster early warning systems** (e.g., using geospatial tech) directly benefit rural and vulnerable populations.

  - Initiatives like **Digital India GENESIS** aim to support deep-tech startups from Tier-2/3 cities and marginalized communities.

- **Future-Ready Workforce Development:** Deep tech stimulates demand for **STEM education, skilling, and advanced research training**.

  - India has **only 255 researchers per million**, far below China (1200+) or OECD nations (4000+).

  - The **National Education Policy (NEP) 2020** promotes tinkering labs, innovation hubs, and AI education to fill this gap.

- **Public-private R&D tie-ups** (e.g., ISRO–Social Alpha SpIN platform) offer hands-on research exposure to students and innovators.

Challenges in India's Deep-Tech Ecosystem

- **Low Investment in R&D and Innovation:** India spends **less than 0.7% of its GDP on R&D**, compared to **2.4% in China** and **3.5% in countries like the US**.

  - Private sector R&D participation is limited — **over 55% of India's R&D is public-funded**, unlike OECD nations where it is mostly private-driven.

  - This leads to a limited pipeline of **deep-science-based innovation** and fewer globally competitive patents.

- **Funding Gap:** India's efforts, such as the **Rs 10,000 crore IndiaAI Mission and a Fund of Funds for deep tech**, pale in comparison, with total tech investment from **2014-2024 estimated at $160 billion**, against **China's $845 billion.**

  - This funding gap **stifles startups aiming to tackle complex problems**.

- **Low Early-Stage and Patient Capital:** Most Indian deep-tech startups struggle to access early-stage, risk-tolerant funding.

  - The **Indian VC ecosystem** largely prefers consumer tech or quick-return models, while deep-tech require**s long gestation periods (5–10 years).**

  - Nearly **98% of deep-tech startup funding** comes from foreign sources, risking IP flipping and external control.

- **Weak Intellectual Property (IP) Framework:** Startups face **delays in patent approval**, lack of clarity on algorithm/software patenting, and **poor enforcement** of IP rights.

  - There is no **single-window IP support** for deep-tech innovators; legal complexity discourages patent filings.

  - As a result, India ranks **7th in global patent filing**s but lags in **patent-to-commercialisation conversion**.

  - India ranks **40th in the Global Innovation Index (GII) 2023**

- **Limited Access to Infrastructure and Testbeds:** Most startups lack access to **world-class labs, prototyping equipment, simulation tools, and testing environments**.

  - High import duties on scientific instruments, sensors, and microcontrollers also raise costs for hardware-heavy deep-tech startups.

  - Public institutions often do not allow **shared access** to their infrastructure.

- **Valley of Death in Early-Stage Innovation:** Deep-tech startups face a "**Valley of Death**" phase after initial proof-of-concept due to **lack of long-term capital**.

  - Most funding in India is skewed toward **late-stage consumer tech startups**.

  - Few sources of **patient capital** (e.g., tech bonds, CSR funds, deep-tech specific FoFs) are available to help cross this gap.

- **Talent and Skill Gaps in Frontier Technologies:** India has only **255 researchers per million people**, compared to 1,200 in China and 4,000+ in developed nations.

  - Academia–industry collaboration is weak; **PhD and postdoc ecosystems remain disconnected from commercial innovation**.

  - India produces **approximately 24,000 PhD graduates annually,** driving advancements in science and engineering.

  - However, the country paid **$14.3 billion in IPR royalties** in 2024, while **earning only $1.5 billion**, highlighting a significant gap.

- **Policy Fragmentation and Lack of Coordination:** Multiple ministries (DST, MeitY, DRDO, MoE, MoHFW) run **parallel schemes** with overlapping objectives and separate portals.

  - There is **no centralized deep-tech mission office** to coordinate investments, policy incentives, or global tie-ups.

- **Lack of Diversity and Inclusion:** Less than **15% of Indian deep-tech startups are led by women**, and representation from **Tier-2 and Tier-3 regions is still nascent**.

  - Most incubation and funding is concentrated in urban tech hubs like Bengaluru, Hyderabad, and NCR.

Government Initiatives Supporting Deep-Tech Startups

- **Technology Development Fund (TDF) – Operational Since 2016**

  - Run by **DRDO**, this fund provides **up to ₹10 crore per project** to startups and MSMEs for developing defence-related technologies.

- **iDEX (Innovations for Defence Excellence) – Launched in 2018**

  - Implemented by the **Ministry of Defence,** iDEX funds startups to develop dual-use defence technologies through design challenges and startup grants.

- **India Semiconductor Mission (ISM) – Launched in 2021**

- With an outlay of **₹76,000 crore,** ISM supports semiconductor fabs, display fabs, compound semiconductor units, and **design-linked incentives (DLI Scheme)**.

- **PLI Scheme for Drones – Launched in 2021**

  - Incentivizes **drone and drone component manufacturers** with up to **20%** benefit on value addition to promote local deep-tech hardware startups.

- **Startup India Seed Fund Scheme (SISFS) – Launched in 2021**

  - Offers up to **₹20 lakh** in seed funding and **₹50 lakh** in follow-on funding to early-stage startups, including those in the deep-tech domain.

- **National Deep Tech Startup Policy (NDTSP) – Draft Released in 2023**

  - India's **first deep-tech-specific policy** aims to create a sovereign innovation ecosystem through R&D support, IP reforms, shared infrastructure, and regulatory clarity.

  - Final policy pending notification.

- **National Quantum Mission (NQM) – Launched in 2023**

  - With **₹6,000 crore allocated,** the NQM supports quantum computing, quantum sensing, quantum communication, and national research hubs in quantum technologies.

- **National Research Foundation (NRF) – Approved in 2023**

  - Planned as a **₹50,000 crore body under NEP 2020** to catalyze collaborative R&D among academia, startups, and industry over five years.

- **Digital India GENESIS (Gen-Next Support for Innovative Startups) – Announced in 2023**

  - Aims to support **10,000 tech startups from Tier-2 and Tier-3 cities** with funding, skilling, and infrastructure access for deep-tech and emerging technologies.

- **IndiaAI Mission – Approved in 2024**

  - Backed by **₹10,371 crore,** the mission supports **AI compute infrastructure**, open-source foundational models, skilling, startup support, and AI-based public platforms.

Global Collaborations

- **India-UAE Partnership:** India and UAE are actively building a **strategic deep-tech partnership**. Collaborations are emerging in **AI, space tech, biotech, and fintech**.

  - The **Comprehensive Economic Partnership Agreement (CEPA) (signed in 2022) f**acilitates trade, investment, and digital infrastructure development, including 5G deployment via the IMEC corridor.

- **iCET with US:** iCET seeks to bolster **collaboration across governments, businesses, and academic institutions,** with a focus on advanced technologies such as quantum computing, artificial intelligence, cyber security, 5G/6G, and space technologies.

Way Forward for India's Deep-Tech Startup Ecosystem

- **Boost Public and Private R&D Investment:** Increase **Gross Expenditure on R&D (GERD)** from the current <0.7% to at least **1.5% of GDP in the next 5 years.**

  - Incentivize **private-sector R&D** through weighted tax deductions, CSR research mandates, and R&D-linked procurement contracts.

  - Globally, countries like **China (2.4%)** and **South Korea (4.8%)** have shown how high R&D intensity drives technological breakthroughs.

Patient capital refers to investments that prioritize **long-term value creation and sustainable growth** over quick financial return**s.**

- **Unlock Early-Stage and Patient Capital:** Expand the **Deep-Tech Fund of Funds (FoF)** and create specialized financing instruments like **Technology Impact Bonds** and **Innovation Credit Guarantees**.

  - Lessons from **Israel's Yozma program and the EU's EIC Accelerator** show how patient capital bridges the "**Valley of Death."**

- **Strengthen IP Regime and Tech Commercialization:** Establish a **Unified Deep-Tech IP Support Desk** for faster filings, algorithm patent clarity, and international IP alignment.

  - Promote **patent-to-commercialization frameworks** via Technology Transfer Offices (TTOs) in academic institutions.

- **Improve Infrastructure and Testbed Access:** Create **national shared infrastructure networks** for prototyping, simulation, and pilot deployments with subsidized access for startups.

  - Import duty relief for **R&D-grade instruments** and AI/IoT components should be expanded to ease cost barriers for hardware innovators.

- Models like **France's "DeepTech Founders" and Germany's Fraunhofer Institutes** offer valuable insights.

- **Develop Talent Pipeline and Academia–Startup Linkages:** Scale up **PhD–Industry fellowships**, **postdoc entrepreneurship grants**, and incentivize faculty startups through reformed evaluation metrics.

  - For example, **Israel's success in deep tech stems** partly from seamless technology **transfer between universities and industry.**

  - The recent establishment of **AIRAWAT, India's first national artificial intelligence computing platform**, shows progress, but India needs dozens of such initiatives.

- **Create a Unified Deep-Tech Governance Architecture:** Establish a **National Deep-Tech Mission Office** to coordinate schemes across DST, MeitY, DRDO, MoE, and MoHFW.

  - This body should **monitor funding flows, streamline regulatory approvals**, and coordinate global partnerships under a single window.

- **Promote Regional Inclusion and Diversity:** Expand **Digital India GENESIS** with specific quotas for women-led ventures and startups from Tier-2/3 cities.

  - Incubators should offer **local language mentorship**, field labs, and regional IP support to increase participation from underserved geographies.

- **Fostering a Culture of Scientific Risk-Taking:** India needs a **cultural shift that celebrates scientific risk-taking.**

  - Names like **Elon Musk and Jensen Huang** have become household legends in the West, while India's entrepreneurial heroes largely come from the worlds of software and services.

Conclusion

India stands at a pivotal moment to transform from a service-driven tech hub to a **global deep-tech leader**. By fostering R&D, enabling patient capital, and promoting inclusive innovation, India can harness deep-tech not only for economic growth but also for strategic self-reliance and societal impact.

Source: https://indianexpress.com/article/opinion/columns/indias-startup-ecosystem-is-catching-up-with-china-9937327/