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5. Deep-Tech Innovation – Science & Technology

The Union Education Minister stated that Bharat Innovates reflects India's emergence as a global innovation hub while addressing the concluding session of the Bharat Innovates Deep-Tech Pre-Summit at IIT Bombay. Deep-tech innovations offer India pathways to technological sovereignty, economic growth, and solutions for local challenges. India's deep-tech ecosystem is critical for competing in emerging technologies and reducing import dependence.

1.Bharat Innovates 2026 Program

Program Overview

1. Bharat Innovates is a national programme of the Ministry of Education, Government of India.
2. It is designed as a global accelerator and collaboration framework for deep-tech ventures emerging from India's higher education and research ecosystem.
3. Core Purpose - Acts as a long-term collaboration bridge connecting India's top deep-tech startups and research parks with global stakeholders, including investors, corporations, and international governments.

Technology Focus Areas

1. The program spotlights innovations across 13 frontier sectors including semiconductors, biotechnology, space and defence, AI and cloud computing, green energy, and smart mobility.
2. Focus on frontier technologies ensures relevance to India's future competitiveness.

2.Understanding Deep Technology

Definition

1. Deep tech refers to advanced and disruptive technologies that have the potential to trigger transformative change and provide solutions for the future.
2. Deep tech involves sophisticated research-based innovations, not incremental improvements.

Key Areas of Deep Tech Research

1. Nanotechnology enables manipulation of matter at atomic and molecular scales.
2. Biotechnology including gene therapy and synthetic biology creates new medical treatments.
3. Material sciences develop novel materials with superior properties.
4. Quantum technologies including quantum computing enable exponential computing power.
5. Semiconductors form the foundation of modern electronics and computing.
6. Artificial Intelligence and data sciences drive intelligent systems.
7. Robotics enable automation and autonomous systems.
8. 3D printing enables additive manufacturing transforming production.

3.Significance of India's Deep-Tech Ambitions

Global Leadership Positioning

1. It positions India as a trusted R&D hub in the "China+1" global landscape, providing alternative supply chains.
2. India's massive STEM talent pool can lead in frontier technologies including Quantum Computing and 6G.

3. Positions India as a research partner for developed nations reducing dependence on single supplier countries.

Technological Sovereignty

1. Reduces critical reliance on foreign imports for national security, defence, and space ensuring independence.
2. Indigenous deep-tech capabilities prevent vulnerability to global supply chain disruptions.
3. Self-reliance in critical technologies strengthens national security.

Solving Local Challenges

1. Enables India-first solutions for massive social hurdles such as AI for rural healthcare addressing doctor shortages.
2. Precision agriculture for food security maximizing yields with limited resources.
3. Green hydrogen for energy independence decarbonizing India's energy system.
4. Deep-tech solutions tailored to Indian contexts are more impactful than imported technologies.

Economic Value Creation

1. A robust deep-tech ecosystem enables India to move up the global value chain.
2. Shifting from low-cost services and assembly-based manufacturing to high-value research, design, and intellectual property creation.
3. IP creation generates royalties and licensing revenue providing sustainable economic returns.

4.Challenges Facing India's Deep-Tech Ecosystem

Low R&D Expenditure

1. India's Gross Expenditure on Research and Development (GERD) remains around 0.64% of GDP, significantly lower than major innovation economies.
2. US, China, South Korea, and Israel invest over 2% of GDP in R&D.
3. Low R&D spending limits research capacity and innovation output.

Limited Private Sector Participation

1. Public institutions account for majority of R&D spending while private-sector contribution remains around 36%.
2. Countries where industry drives over 70% of R&D investment show superior innovation outcomes.
3. Private sector brings market discipline, efficiency, and commercial focus to R&D.

Funding Constraints for Deep-Tech

1. Venture capital in India largely favours quick-return sectors including fintech and e-commerce.
2. Deep-tech ventures require high-risk investments, patient capital, and long gestation periods (5-10 years).
3. Risk-averse venture capital ecosystem fails to support capital-intensive deep-tech ventures.

Semiconductor Dependence

1. India continues relying heavily on imports of semiconductors, advanced electronics, and fabrication equipment.
2. This creates technological and supply-chain vulnerabilities to export controls and trade restrictions.
3. Indigenous semiconductor manufacturing is essential for technology sovereignty.

Brain Drain Challenge

1. Large numbers of highly skilled researchers and engineers migrate abroad seeking better research infrastructure, funding opportunities, and higher remuneration.
2. Loss of talent weakens domestic research capacity.

Weak Industry-Academia Linkages

1. Limited collaboration between universities, research institutions, and industry restricts technology transfer.
2. Patent commercialization remains low indicating poor translation of research to products.
3. Scaling of research-driven innovations is constrained without industry partnerships.

Global Competitive Pressures

1. Rapid advancements in Artificial Intelligence, quantum technologies, biotechnology, and advanced manufacturing by major powers pose significant competitive challenges.
2. India risks falling further behind in critical technologies.

5.Government Initiatives for Deep-Tech Ecosystem

Research Development and Innovation (RDI) Scheme Fund

1. The scheme has an outlay of Rs 1 lakh crore over 6 years with Rs 20,000 crore allocated for FY 2025-26.
2. Key objectives include encouraging private sector to scale up RDI in sunrise domains relevant for economic security and self-reliance.
3. Finances transformative projects at higher Technology Readiness Levels.
4. Supports acquisition of critical or strategically important technologies.
5. Facilitates setting up of a Deep-Tech Fund of Funds.

National Deep Tech Startup Policy (NDTSP)

1. Seeks to strengthen India's deep-tech ecosystem through enhanced funding, research commercialization, and intellectual property support.
2. Talent development and enabling regulations for frontier technologies including AI, semiconductors, quantum computing, biotechnology, and space technology.

India Semiconductor Mission (ISM)

1. Launched with financial outlay of ₹76,000 crore to develop semiconductor and display manufacturing in India.
2. Provides up to 50% fiscal support for semiconductor fabs, ATMP facilities, chip design, and related infrastructure.
3. Aims to establish India as a semiconductor manufacturing hub reducing import dependence.

National Quantum Mission (NQM)

1. Approved in 2023 for the period 2023-2031 seeking to build capabilities in quantum computing, quantum communication, quantum sensing, and quantum materials.
2. Positions India in emerging quantum technology frontier.

Atal Innovation Mission (AIM)

1. Promotes innovation and entrepreneurship through Atal Incubation Centres (AICs) and Atal Tinkering Labs (ATLs).
2. Provides infrastructure and support for early-stage innovation.

6.Way Forward

Increase R&D Investment

1. Raise India's Gross Expenditure on Research and Development (GERD) to at least 2% of GDP through greater public funding and stronger private-sector participation.
2. Increased funding enables larger-scale research and supports more researchers.

Industry-Academia Collaboration

1. Establish innovation clusters around leading universities and research institutions to accelerate technology transfer and commercialization.

2. Co-location facilitates collaboration and knowledge exchange.

Attract and Retain Talent

1. Improve research funding, academic autonomy, and career opportunities to curb brain drain and attract global scientific talent.
2. Competitive salaries and research infrastructure are essential.

Promote Global Partnerships

1. Expand international collaborations in critical technologies while safeguarding intellectual property and national interests.
2. Global partnerships accelerate technology development and provide market access.

Source - https -//ddnews.gov.in/en/bharat-innovates-showcases-indias-rise-as-global-innovation-hub-dharmendra-pradhan/