



DAILY EDITORIAL ANALYSIS

TOPIC

**LONG MARCH AHEAD
TO TECHNOLOGICAL
INDEPENDENCE**

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LONG MARCH AHEAD TO TECHNOLOGICAL INDEPENDENCE

Context

- India's pursuit of technological independence has become a strategic imperative, as digital sovereignty increasingly aligns with national security.

Need for Technological Autonomy in India

- Technological autonomy** refers to a nation's **capacity to innovate, manufacture, and maintain critical technologies** without excessive reliance on foreign entities.
 - It encompasses sectors like defense, healthcare, energy, digital infrastructure, and advanced manufacturing.
- The **strategic autonomy** in foreign policy is increasingly intertwined with **technological independence**.
 - Dependence on imported semiconductors, defense equipment, and digital platforms poses risks to national security, as **current global dynamics and geopolitics** are shaped more by **cyber warfare, software, and drones**.
 - Indigenous capabilities** in these areas are **essential to ensure sovereign decision-making** and reduce vulnerability to external pressures.

WHY DOES TECHNOLOGICAL AUTONOMY MATTER?



National Security



Economic Independence



Digital Sovereignty



Innovation Ecosystem



Resilience in Global Disruptions

India's Developmental Journey in Technological Autonomy

- Foundations of a Scientific Nation:**
 - The **First Five-Year Plan (1951)** laid the groundwork for agricultural reform, infrastructure development, and scientific research.
 - Institutions like **CSIR (1942)**, **Department of Atomic Energy (1954)**, **DRDO (1958)**, **Department of Space (1972)** were established to drive indigenous research and innovation across critical sectors.
 - India enshrined the **development of a scientific temper in its Constitution** (in 1976), affirming that inquiry, rationality, and humanism were civic duties — a visionary move that continues to shape its scientific ethos.
- Agriculture and Food Security:** India's **Green and White Revolutions** in the 1960s and 1970s transformed it from a food-deficient nation to one of self-sufficiency.
 - High-yielding crop varieties, mechanization, and indigenous pesticide development — led by CSIR and ICAR — enabled India to permanently reduce its dependence on food imports.
- Space and Strategic Technologies:** ISRO's rise from humble beginnings to launching **missions like Chandrayaan and Mangalyaan** reflects India's commitment to space autonomy.
 - The **Pokhran nuclear tests** in 1974 and 1998 marked milestones in strategic self-reliance, leading to the declaration of **National Technology Day on May 11th**.
- Health and Innovation:** India's pharmaceutical sector, bolstered by public R&D and private enterprise, now supplies affordable medicines globally.
 - India developed indigenous vaccines and digital platforms like CoWIN, showcasing its ability to respond swiftly and independently to global crises.

Current Government Initiatives

- Anusandhan National Research Foundation (ANRF):** It was established **as an apex body** through the **ANRF Act, 2023**.
 - It is designed to provide high-level strategic direction for research, innovation, and entrepreneurship across a wide range of fields in India.
- Space Reforms (ISRO + IN-SPACe)** encourage private sector participation in space technologies.

- **National Initiative on Developing and Harnessing Innovations (NIDHI):** To foster a robust innovation-driven entrepreneurial ecosystem.
- **SUPRA (Scientific and Useful Profound Research Advancement) Scheme:** It supports individual researchers and groups in India for fundamental research with long-term impact.
- **TARE (Teachers Associateship for Research Excellence) scheme:** It facilitates faculty mobility from State and private institutions to central research centers for hands-on research experience.
- **Indian Science, Technology, and Engineering facilities Map (I-STEM):** It provides researchers, startups, and academic institutions across India with transparent access to publicly funded scientific equipment and R&D facilities.
- **Atmanirbhar Bharat Abhiyan** emphasizes indigenization in defense, electronics, and space technology.
- **Digital India Programme** focuses on digital infrastructure, services, and literacy.
- **National Education Policy 2020** stresses research and innovation ecosystems through **NRF (National Research Foundation)**.
- **Semiconductor Mission (2021)** promotes domestic chip manufacturing to reduce dependency on East Asian suppliers.

Challenges Ahead

- **Low R&D spending:** India invests ~0.7% of GDP in research, far below global leaders like South Korea (>4%).
- **Technology gaps:** Dependence continues in semiconductors, advanced materials, and medical equipment.
- **Software Sovereignty:** India currently lacks a **home-grown operating system, database, or foundational software** it can fully trust.
- **Skilled workforce:** A mismatch exists between education and rapidly evolving technological needs.
- **Global competition:** Rapid advances in AI, quantum computing, and biotechnology demand accelerated efforts.

Roadmap: Towards a Mission for Technological Independence

- **Enhance R&D funding** through public-private partnerships.
- **Strengthen academia-industry collaboration** for translational research.
- **Promote indigenous startups** in frontier technologies with incentives.
- **Data localization and cybersecurity frameworks** to ensure digital sovereignty.
- **Regional technology clusters** for semiconductor fabs, biotech hubs, and AI labs.
- **International collaboration with self-reliance** – engage globally but prioritize indigenous capacity building.
- **Ensure financial sustainability** through models that are self-supporting, rather than entirely dependent on government or corporate funding.

Conclusion

- India has the talent, expertise, and resources to achieve technological sovereignty, but it needs the **collective will**.
- Technological independence demands a national mission, same as political independence requires unity and persistence, one that combines open-source innovation, strategic investment, and a self-sustaining ecosystem.

Source: TH

Daily Mains Practice Question

Q. Examine the importance of technological autonomy in India's development strategy. How can policy, innovation, and global collaboration shape this journey?