GENERAL STUDIES III

Technological Sovereignty in India | UPSC 2027

Faculty/Author: Faculty Editorial Board	**Date:** 05 November 2026
Platform: Civil Service Gurukul Research Wing	**Reading Time:** 5 Mins

Technological sovereignty has emerged as a strategic priority for India amid growing competition over semiconductors, artificial intelligence, defence systems, critical minerals and global technology standards. A November 2026 current-affairs headline highlighted Defence Minister Rajnath Singh's emphasis on achieving technological sovereignty. For UPSC aspirants, the issue connects national security, industrial policy, innovation, international relations and economic resilience. This article explains why domestic assembly alone cannot guarantee technological independence, the importance of the India Semiconductor Mission, research institutions, standards-setting bodies, intellectual property, skilled manpower and trusted international partnerships. It also evaluates the challenges of subsidies, supply-chain concentration and technological dependence, with Prelims MCQs, Mains questions and a model answer.

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UPSC CURRENT AFFAIRS | SCIENCE & TECHNOLOGY | NATIONAL SECURITY

India's Technological Sovereignty: Semiconductor Mission, Defence Innovation, Global Standards and Strategic Autonomy

1. Why Is Technological Sovereignty in News?

A current-affairs topic index dated 4 November 2026 highlighted a statement attributed to Defence Minister Rajnath Singh emphasizing that India must achieve technological sovereignty.

The headline brings attention to India's need to develop reliable capabilities in critical technologies, including semiconductors, defence systems, digital infrastructure, advanced manufacturing and strategic supply chains.

The complete speech and any associated policy announcements require confirmation from official records.

> **UPSC Relevance:** This issue connects strategic autonomy, science and technology, industrial policy, national security, international relations and economic development.

2. What Is Technological Sovereignty?

Technological sovereignty refers to the capacity of a country to make secure, informed and independent strategic choices concerning critical technologies.

It involves the ability to develop, access, operate, maintain and govern technologies that are essential for national development and security.

Technological sovereignty does not necessarily require producing every component domestically.

Instead, it requires a combination of indigenous capabilities, diversified supply chains, trusted partnerships, skilled manpower and control over critical technological decisions.

> **Prelims Concept:** Technological sovereignty is different from complete technological isolation or autarky.

3. Technological Sovereignty vs Technological Self-Reliance

Technological Sovereignty	Technological Self-Reliance
Focuses on strategic decision-making capacity	Focuses on developing domestic technological capabilities
Can involve trusted global partnerships	Emphasizes reducing excessive dependence on imports
Includes standards, intellectual property and supply-chain resilience	Emphasizes domestic production, skills and research
Seeks freedom from coercive technological dependence	Seeks stronger indigenous capabilities

Both approaches can reinforce each other when combined with openness to innovation and international cooperation.

4. Why Are Semiconductors Strategically Important?

Semiconductors are foundational components of modern electronic systems.

They are used in smartphones, computers, communication networks, automobiles, medical equipment, industrial machinery and defence technologies.

Modern economies depend on reliable access to semiconductor components and related technologies.

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Disruptions in semiconductor supply chains can therefore affect multiple sectors simultaneously.

5. Understanding the Semiconductor Value Chain

The semiconductor industry includes several interconnected stages.

Chip Design

Engineers design integrated circuits according to specific functional requirements.

Fabrication

Semiconductor fabrication plants manufacture chips using specialized equipment and processes.

Assembly, Testing and Packaging

Manufactured chips are assembled, tested and packaged for use in electronic products.

Equipment and Materials

Fabrication depends on specialized machinery, chemicals, materials and software tools.

> **Strategic Insight:** A country may have domestic assembly or packaging facilities while remaining dependent on imported fabrication equipment, design software or advanced materials.

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6. India Semiconductor Mission

The India Semiconductor Mission is an important policy initiative supporting the development of India's semiconductor and display manufacturing ecosystem.

Its broader objectives include strengthening domestic capabilities, supporting investment and developing the semiconductor ecosystem.

The success of semiconductor policy depends not only on financial incentives but also on infrastructure, skilled manpower, reliable utilities, technology partnerships and commercial viability.

Specific project approvals, subsidy amounts and implementation milestones should be verified against current official releases.

7. Why Domestic Assembly Alone Is Not Enough

Domestic assembly can create employment and strengthen manufacturing capacity.

However, assembly facilities may still rely heavily on imported components, equipment, software and intellectual property.

Technological sovereignty requires attention to the complete value chain rather than focusing only on final-stage manufacturing.

This includes research, design, testing, equipment access, skilled workers and secure software systems.

8. Critical Technologies and National Security

Critical technologies are technologies whose availability, security or performance can significantly affect national security and economic resilience.

Examples include:

- Semiconductors and advanced electronics.
- Artificial intelligence and high-performance computing.
- Cybersecurity technologies.
- Secure communication systems.
- Advanced materials.
- Defence electronics and sensors.
- Space technologies.
- Strategic manufacturing equipment.

Dependence on a limited number of foreign suppliers can create strategic vulnerabilities during geopolitical tensions or supply disruptions.

9. Defence Technology and Strategic Autonomy

Modern defence systems depend increasingly on advanced electronics, secure software, communication networks, sensors and specialized materials.

Strategic autonomy is strengthened when a country can maintain, upgrade and adapt critical defence technologies without excessive dependence on external suppliers.

Indigenous research and development, trusted procurement and domestic industrial capacity can contribute to this objective.

International cooperation may also remain essential for accessing advanced technologies and developing complex systems.

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10. Role of Standards in Technological Sovereignty

Technical standards help ensure that products and systems meet agreed requirements for safety, quality, compatibility and performance.

Standards can influence market access, industrial competitiveness and technological interoperability.

Participation in international standards-setting processes can help countries shape the rules governing emerging technologies.

Technological sovereignty therefore includes the capacity to understand, implement and contribute to relevant technical standards.

11. Bureau of Indian Standards

The Bureau of Indian Standards, or BIS, is India's national standards body.

It operates under the Bureau of Indian Standards Act, 2016.

BIS performs functions relating to standardization, conformity assessment and quality assurance within its statutory framework.

For UPSC, the role of standards should be linked with manufacturing competitiveness, consumer protection and technological governance.

12. Intellectual Property and Technology Transfer

Intellectual property rights influence access to technological knowledge, commercial incentives and innovation.

Patents, trade secrets, licensing arrangements and technical know-how can affect the ability of firms to develop and manufacture advanced products.

Technology transfer may support domestic capability building, but it does not automatically guarantee mastery of complex production processes.

Long-term capacity requires domestic research, skilled workers, practical experience and the ability to innovate independently.

13. Research Institutions and Human Capital

Universities, public research laboratories, engineering institutions and industrial research centres are important parts of a national innovation ecosystem.

They support:

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- Fundamental research.
- Applied research and prototyping.
- Skilled workforce development.
- Testing and certification.
- Industry–academia collaboration.
- Commercialization of research.

Technological sovereignty requires sustained investment in both physical infrastructure and human capital.

14. Global Semiconductor Supply-Chain Risks

Semiconductor production involves geographically distributed and highly specialized activities.

Concentration of important capabilities in limited locations or suppliers can create vulnerabilities.

Potential risks include:

- Geopolitical restrictions.
- Export controls.
- Supply disruptions.
- Natural disasters.
- Shortages of specialized equipment.
- Cybersecurity incidents.
- Dependence on proprietary design tools.

Supply-chain diversification can reduce some risks, although complete elimination of dependence is neither simple nor necessarily efficient.

15. Atmanirbhar Bharat and Technological Capacity

Atmanirbhar Bharat emphasizes strengthening domestic productive capabilities and reducing vulnerabilities arising from excessive dependence.

In the technology sector, self-reliance can involve domestic research, manufacturing capacity, skill development and stronger supply chains.

However, self-reliance should not be confused with complete withdrawal from global technology networks.

India can pursue indigenous capability building while continuing to benefit from international research, trade and trusted partnerships.

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16. Challenges to India's Technological Sovereignty

High Capital Requirements

Advanced semiconductor manufacturing and testing facilities can require substantial investment.

Technology Complexity

Modern chip production depends on highly specialized knowledge and equipment.

Skill Gaps

Specialized engineering and manufacturing talent takes time to develop.

Supply-Chain Dependence

Critical materials, tools and components may remain concentrated among a small number of suppliers.

Research Commercialization

Research outcomes must be translated into commercially useful products and processes.

Fiscal Trade-Offs

Public subsidies must be evaluated against measurable economic and strategic benefits.

17. Balancing Strategic Autonomy with Global Trade

Technological sovereignty does not require rejecting international trade.

Global cooperation can provide access to specialized capabilities, markets, investment and knowledge.

The central policy challenge is to avoid excessive dependence while preserving innovation and competitiveness.

Overdependence	Resilient Technological Sovereignty
Concentrated suppliers	Diversified trusted supply chains
Limited domestic research	Strong research and innovation ecosystem
Dependence on imported design tools	Greater domestic capability and secure access
Limited participation in standards	Active standards development and cooperation
Subsidies without evaluation	Transparent, outcome-based industrial support

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18. Governance and Ethical Dimensions

Accountability

Public funding for strategic industries should be subject to transparent evaluation.

Fair Competition

Industrial policy should consider market competition and opportunities for smaller firms.

Public Interest

Technology policy should support national security, economic opportunity and social welfare.

Transparency

Policy outcomes should be assessed using clear and measurable indicators.

Long-Term Responsibility

Public investment decisions should consider fiscal sustainability and future technological needs.

19. Way Forward: Building India's Strategic Technology Capacity

- Invest in semiconductor design and advanced packaging.
- Strengthen public research institutions.
- Develop shared testing and prototyping facilities.
- Support specialized technical education.
- Improve secure software supply chains.
- Participate actively in international standards development.
- Diversify trusted technology partnerships.
- Promote domestic intellectual property creation.
- Support commercially viable technology enterprises.
- Evaluate industrial subsidies using measurable outcomes.

> **Policy Principle:** Technological sovereignty is best understood as the ability to make independent strategic choices through strong domestic capabilities, resilient partnerships and secure access to critical technologies.

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20. UPSC Prelims Quick Revision

- Technological sovereignty does not require complete isolation from global trade.
- Semiconductors are essential components of modern electronic systems.
- Chip design, fabrication, assembly, testing and packaging are distinct stages.
- Semiconductor fabrication requires specialized equipment and materials.
- The India Semiconductor Mission supports semiconductor ecosystem development.
- BIS is India's national standards body.
- The Bureau of Indian Standards Act was enacted in 2016.
- Technical standards influence quality, safety and interoperability.
- Intellectual property can affect access to advanced technologies.
- Strategic autonomy depends on domestic capacity and resilient international partnerships.

21. UPSC Prelims Practice MCQs

Question 1

Which statement best describes technological sovereignty?

A. Complete isolation from international technology trade

B. Capacity to make strategic choices using resilient domestic and international capabilities

C. Mandatory domestic production of every technological component

D. Elimination of international standards

Correct Answer: B

Technological sovereignty emphasizes strategic capacity, resilience and informed technological choices.

Question 2

Which activity is part of the semiconductor value chain?

A. Chip design

B. Fabrication

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C. Testing and packaging

D. All of the above

Correct Answer: D

The semiconductor value chain includes design, fabrication, assembly, testing and packaging.

Question 3

The Bureau of Indian Standards is primarily associated with:

A. Monetary policy

B. Standardization and quality assurance

C. Electoral registration

D. Foreign exchange reserves

Correct Answer: B

BIS is India's national standards body.

Question 4

Which of the following can create semiconductor supply-chain vulnerability?

A. Concentration of specialized suppliers

B. Export restrictions

C. Disruption of critical equipment access

D. All of the above

Correct Answer: D

All these factors can increase supply-chain risk.

Question 5

Which approach is most consistent with long-term technological sovereignty?

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A. Subsidies without performance evaluation

B. Eliminating all foreign research cooperation

C. Research, skills, trusted partnerships and transparent policy evaluation

D. Depending permanently on a single supplier

Correct Answer: C

Long-term strategic capacity requires a combination of research, talent, partnerships and accountability.

22. UPSC Mains Practice Questions

GS Paper II — International Relations

Question: Explain how technological sovereignty can strengthen India's strategic autonomy in an increasingly interdependent global economy. (250 words)

GS Paper III — Science and Technology

Question: Discuss the importance of the semiconductor ecosystem for India's economic resilience and national security. (250 words)

GS Paper III — Economy

Question: Evaluate the benefits and limitations of public subsidies for strategic technology industries. (150 words)

23. Model UPSC Mains Answer

Question: Explain how India can build technological sovereignty without sacrificing innovation and trade.

Introduction:

Technological sovereignty is the capacity to make independent strategic choices concerning critical technologies, supply chains, standards and intellectual property.

Body:

- **Domestic capabilities:** Invest in research, design, manufacturing and advanced packaging.
- **Human capital:** Develop specialized engineering skills and research talent.
- **Supply-chain resilience:** Diversify suppliers and strengthen trusted partnerships.

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- **Standards:** Participate in global standards-setting while improving domestic quality infrastructure.
- **Innovation:** Support startups, research institutions and industry–academia collaboration.
- **Industrial policy:** Use transparent, measurable criteria to evaluate public incentives.
- **Global engagement:** Preserve access to international knowledge, investment and markets.

Conclusion:

India should pursue technological sovereignty through competitive domestic capabilities and resilient international integration rather than technological isolation.

24. Key Takeaways for UPSC Aspirants

- Define technological sovereignty clearly.
- Distinguish strategic autonomy from technological isolation.
- Understand the semiconductor value chain.
- Revise the role of the India Semiconductor Mission.
- Remember the role of BIS and technical standards.
- Connect intellectual property with technology transfer.
- Discuss the importance of R&D and specialized skills.
- Explain why domestic assembly alone cannot guarantee strategic independence.
- Balance industrial policy with international trade and innovation.

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Frequently Asked Questions

What is technological sovereignty?

It is the capacity to make secure and independent strategic decisions concerning critical technologies through domestic capabilities, resilient supply chains and trusted partnerships.

Why are semiconductors important for India?

Semiconductors support modern electronics, communication, industry, healthcare, transport and defence systems.

What is the India Semiconductor Mission?

It is an Indian policy initiative supporting the development of the semiconductor and display ecosystem.

Does technological sovereignty require banning imports?

No. Technological sovereignty can be strengthened through diversified international partnerships alongside domestic research and production capabilities.

What is the role of BIS?

The Bureau of Indian Standards is India's national standards body and performs statutory functions relating to standardization and conformity assessment.

Why is domestic assembly alone insufficient?

Assembly operations may still depend on imported chips, equipment, design tools, intellectual property and specialized materials.

Why is technological sovereignty important for UPSC 2027?

It connects science and technology, national security, industrial policy, economic development and international relations.

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