

India and the China-US Technology Race

Mains: *GS III – Science and Technology*

Why in News?

The global technology race is entering a new phase, with China and the United States competing to integrate artificial intelligence (AI), scientific research and industrial production.

What is China's Science-Industrial Strategy?

- **Merging as a Superpower** - China is attempting to transform itself from a manufacturing power into a **global science and technology superpower**.
- Its strategy focuses on developing “new quality productive forces”, with AI at the centre.
- China seeks to integrate AI into the physical economy, including, Robotics and machine tools, Automobiles and advanced manufacturing, Biotechnology and new materials, Energy and agriculture and Scientific research and drug discovery
- China's major advantage is its **deep manufacturing ecosystem**. Having spent decades absorbing and improving foreign technologies, it is now attempting to move from technological adaptation to **original innovation and scientific discovery**.
- The underlying logic is straightforward:

AI → faster scientific discovery → new technologies → industrial transformation → greater economic and geopolitical power.

- China has also significantly increased its R&D expenditure, demonstrating that scientific capability is being treated as an important component of national power.

What is the strategy of The United States?

- **Reconnecting Science with Manufacturing** - The United States begins from a different position.
- It possesses some of the world's leading **universities, research laboratories, technology companies and financial markets**. However, decades of globalisation shifted significant manufacturing capacity overseas.
- This created a gap between **innovation and production**.
- American companies could design advanced technologies domestically while depending on global supply chains, particularly for manufacturing.

- The pandemic, China's technological rise and growing geopolitical competition exposed the vulnerabilities of this model.
- Consequently, the US is attempting to rebuild domestic manufacturing capacity and reconnect **scientific research, technological innovation and industrial production**.
- Thus, the two countries are approaching the same objective from opposite directions:

China: Manufacturing strength → advanced science and original innovation

United States: Scientific strength → advanced manufacturing and resilient supply chains

What Is the Nature of the China-US Technology Race?

- The competition is fundamentally about creating an integrated **science-industrial ecosystem**.
- The decisive advantage will increasingly depend on how effectively a country can connect:

Research institutions + skilled talent + private capital + technology + energy + manufacturing + supply chains + markets.

- AI is important because it can accelerate scientific discovery, improve industrial productivity and reduce the time between an idea and its commercial application.
- Therefore, technological leadership is increasingly becoming a determinant of **economic competitiveness, national security and geopolitical influence**.

What are the Major Structural Weakness of India?

- **Inadequate Investment in R&D** - India's expenditure on research and development remains significantly below that of major technological powers.
- According to the figures cited in the passage, India's R&D expenditure is around **0.64% of GDP**, compared with approximately **2.8% in China and 3.5% in the United States**.
- More importantly, Indian private capital has not yet developed a sustained commitment to **basic research, frontier technologies and long-term scientific capacity**.
- This represents a departure from India's earlier industrial tradition.
- Indian philanthropists and industrialists played an important role in establishing institutions such as the **Indian Institute of Science** and supporting pioneering scientific research.
- Greater private participation in science and research is required once again.
- **Lack of Deep Institutional Reform** - India's scientific institutions have not undergone reforms comparable to those undertaken by China since the late 1970s.
- The Indian scientific system continues to face problems such as, excessive

bureaucratization, slow decision-making, limited institutional autonomy, inadequate research funding, weak university-industry linkages.

- Difficulty in attracting and retaining global scientific talent, Limited incentives for high-risk, long-term research.
- **The Problem of Scientific Temper** - echnological progress cannot be sustained merely through declarations of civilisational or technological superiority. Scientific advancement requires **evidence, experimentation, critical inquiry, peer review and openness to questioning established ideas**.
- India's scientific policy must therefore strengthen scientific temper rather than allow mythology or political rhetoric to substitute for empirical research.
- India's confidence should come not from claiming that every modern scientific achievement existed in the past, but from creating the conditions for **future Indian contributions to global science**.

What India could do?

- **Increase R&D Expenditure** - India should progressively raise public and private R&D expenditure towards levels comparable with major technological economies, with greater emphasis on **basic and frontier research**.
- **Mobilise Private Capital** - Large Indian corporations, philanthropies and venture capital funds should be encouraged to invest in long-term scientific research and deep technology.
- Tax incentives, research grants, challenge funds and public-private partnerships can encourage such investment.
- **Reform Scientific Institutions** - Scientific institutions require greater **autonomy, accountability and flexibility** in recruitment, funding and research collaboration.
- Performance evaluation should focus more on research quality and long-term impact rather than procedural compliance.
- **Strengthen University-Industry Linkages** - India needs stronger connections between universities, laboratories, startups and industry so that scientific discoveries can move efficiently from the **laboratory to the marketplace**.
- **Attract and Retain Talent** - India should create competitive research environments, improve research infrastructure and provide greater opportunities for young scientists to pursue ambitious projects.
- **Develop Strategic Technologies** - Greater attention should be given to AI, semiconductors, quantum computing, biotechnology, advanced materials, robotics, clean energy and other technologies that will shape future economic and strategic power.
- **Build a Robust Manufacturing Ecosystem** - India must complement its software and services strengths with greater capabilities in **advanced manufacturing, electronics, machinery and strategic supply chains**.
- **Self-Reliance Must Not Mean Isolation** - India must also avoid repeating the mistakes associated with excessive technological isolation.
- Technological self-reliance should not mean cutting India off from global knowledge and innovation.
- Instead, India needs a **dual strategy**:

Global integration + domestic capability building

- India should, Deepen collaboration with global universities and research institutions.
- Attract international technology and venture capital.
- Encourage global companies to establish advanced manufacturing and R&D facilities in India.
- Facilitate international mobility of researchers and scientific talent.
- Simultaneously strengthen domestic research institutions and manufacturing capabilities.
- Develop resilient domestic supply chains in strategic technologies.
- Such an approach would combine the benefits of globalisation with the requirements of strategic autonomy.

What lies ahead?

- For Viksit Bharat 2047, technological self-reliance should not mean technological isolation. India must build an ecosystem where knowledge leads to innovation, innovation leads to production, and production generates prosperity and strategic strength.
- The goal should not merely be to participate in the China-US technology race, but to develop an independent and globally competitive Indian science-industrial system.

Reference

[The Indian Express| India& US -China Technological Race](#)