Technology and the Rise of Great Powers

Mains Syllabus: GS III - Science and Technology- developments;

Why in the News?

Recent tariff war between US and China on electric cars has reignited the talks on role of technology in global power transition.

What is the role of technology in global power transition?

- **Technology & Power** - Transitions in the balance of power in the international system are often driven by technology.
- **Current global power transition** - Technology is at the core of the current great power competition between China and the United States.
- **Sectoral competition** - Countries gain advantage by getting ahead in what are known as the leading sectors.
- **Technology dominance** - They innovate, acquire the lead-in, and then, for a brief period, accrue first-mover advantage or monopoly rents from their dominance in leading technologies.
    - During the Industrial Revolution, Britain acquired a leading edge in critical innovations in industries like textiles.
    - During the Second Industrial Revolution, Germany challenged Britain, by acquiring an edge in leading sectors, like the chemical industry.
    - In the late 1970s, Japan dominated industries like consumer electronics and cars.
- **Economic influence** - Nations that invest in cutting-edge technology, like artificial intelligence, renewable energy, and biotechnology, tend to gain a competitive advantage in global markets.
- **Military dominance** - Technological advancements such as cyber warfare capabilities, drone technology, and advanced surveillance systems significantly impact military power.
- **Global influence** - Robust digital ecosystems, including widespread internet access and data infrastructure enhances country’s global influence in sectors such as trade, education, and communication
- **Soft power** - Technology enables nations to project cultural and ideological influence through social media, streaming platforms, and digital content.
- The ability to shape narratives and foster international collaboration strengthens soft power.

What is the role of General Purpose Technologies?

- **General Purpose Technologies (GPTs)** - They are innovations that have widespread applications across various industries and economic sectors.

Examples of GPTs	
Electricity	Revolutionized energy production, distribution, and usage, impacting industries and daily life.
Internal Combustion Engine	Enabled the development of mass-produced vehicles and transformed transportation.
Information Technology (IT)	Includes the internet and computing, fundamentally changing communication, information processing, and business operations.
Artificial Intelligence (AI)	Potentially a transformative GPT, offering numerous applications across various industries.

- **Economic transition** – GPTs can affect an entire economy and are often seen as catalysts for major shifts in economic activity.
- **Sustained growth** - GPTs can be a backbone for sustained economic growth by increasing the efficiency and productivity of various sectors.
- **Waves of innovation**- The development and adoption of GPTs often lead to periods of rapid innovation and productivity growth.
- **Macroeconomic effects** - GPTs can have far-reaching effects on the overall economy, including changes in productivity, employment, and income distribution.

Key Differences between General Purpose Technologies (GPTs) and Dominant Technologies		
Feature	**General Purpose Technologies (GPTs)**	**Dominant Technologies**
Scope of Impact	Economy-wide, cross-sectoral	Specific sector or market
Role	Enable further innovation and productivity gains	Become standard within a product/industry class
Innovation	Spawn complementary innovations across sectors	May limit innovation to incremental improvements
Adoption	Broad, transformative, often leads to new industries	Widespread within a niche, may block alternatives
Persistence	Long-term, due to continuous improvement and adaptability	Due to network effects, interrelatedness, and switching costs
Examples	Electricity, steam engine, internet	QWERTY keyboard, VHS, Windows OS, Electric Car

How had GPTs empowered countries than dominant sectors?

- **Britain's GPT in 1st Industrial Revolution** - Britain's ability to produce and diffuse iron-based machines across a large number of sectors played a crucial role in it's power dominance in the 19th century than the it's textile sector.
- **2nd Industrial Revolution** - In the second revolution, Germany was ahead in most leading sectors.
- But the US became the power by being able to diffuse engineering skills and instituting standards that allowed general-purpose technologies like electricity to be adopted far more rapidly.
- **3rd Industrial Revolution** – During this period, though Japan seemingly had the advantage in some leading sectors like consumer electronics, its ability to diffuse GPTs like computerisation was limited.
- The US, by contrast, did not rely on dominance in a few sectors, but greater diffusion of technology that could transform a number of sectors simultaneously.
- **Contemporary GPTs** - A contemporary example might be that AI is a technology that can potentially be adopted across a large number of sectors, leading to productivity gains across the economy.

What is the takeaway for India?

- The basis of national power will have to be the diffusion of GPTs that enhance productivity across the economy and produce a range of accumulated improvements across complementary sectors.
- To become a technology leader, we have to focus more on broad-based policies that allow for the diffusion of GPTs, than getting dominance in specific sectors and more on.
- Diffusion of GPTs requires more systemic change as widespread enhancement of human capital, institutional adaptability and facilitating interoperability of technologies.
- It requires consistent, widespread and foundational investments rather than the creation of technologies in mission mode.

Reference

The Indian Express | How technology affects balance of power

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