



India's Defense Modernization: Challenges and Opportunities

For Prelims: [Defence Research and Development Organisation \(DRDO\)](#), [Agni and Prithvi series of missiles](#), [Light Combat Aircraft, Tejas](#), [Department of Military Affairs \(DMA\)](#), [Integrated Guided Missile Development Program](#), [S-400 Air Defence Systems](#), [Sukhoi-30MKI aircraft](#)

For Mains: Modernization and Indigenisation of Defence Sector, Challenges and Opportunities Related to the Defence Sector, Technological Absorption in India's Defence Sector.

India's aspiration to become a global power necessitates the **modernization of its defense forces**, driven by both **strategic ambitions** and **security threats** from its neighborhood. Unresolved border disputes with China and Pakistan, terrorism in Jammu & Kashmir, insurgency in the North East, [Left-Wing Extremism \(LWE\)](#), and the growing challenge of urban terrorism all compound India's security challenges. To effectively address these threats and prepare for modern warfare, India must equip its military with **advanced, cutting-edge weaponry**.

What is Defense Modernization?

▪ About:

- Defense modernization is a continuous process that involves **updating a country's weapons, surveillance systems, and technology** to keep their military ready to meet security challenges **based on threat perception, operational necessities** and **technological changes**.
- A strong defense is important for a nation to **protect itself from hostile countries** and to restrain aggression.

▪ Need of Defense Modernization:

- **Enhancing Combat Capabilities:** Equipping the armed forces with state-of-the-art technology and weaponry to **boost combat readiness**.
- **Improving Operational Efficiency:** Streamlining processes to ensure **rapid and effective responses** to security threats.
- **Integration and Joint Operations:** Fostering greater **coordination and synergy** between the Army, Navy, and Air Force to enhance joint operational effectiveness.
- **Emergence of Hybrid Warfare:** Currently, advancement in defense technology has led to emergence of new threats such as **Information warfare**, [Electronic warfare](#), [Cyber warfare](#), **Weaponization of Space** etc. which needs to be tackled with advanced defense equipment.
 - **Information warfare** involves operations aimed at gaining an information advantage over an opponent. It includes managing and safeguarding one's own information, while acquiring and utilizing the opponent's information, disrupting their information systems, and hindering information flow.
 - **Weaponization of space** is the process of deploying weapons in space to destroy targets in orbit or on Earth's surface.

▪ **Focus of India's Defense Modernization:**

- India's defense modernization focuses on **boosting domestic production** through "[Make in India](#)," **reforming procurement** policies to prioritize indigenous development, **enhancing R&D**, **forging strategic partnerships** for advanced technology, and **integrating network-centric warfare**.

Note:

- India imports its defense equipment mainly from Russia, accounting for around 62% of its defense imports by value since 2008. Other major suppliers include **France (11%)**, the **United States (10%)**, and **Israel (7%)**.

What Initiatives have been Undertaken to Modernize India's Defense Forces?

▪ **Acquisition of Advanced Weaponry:**

- **Rafale Jets:** Induction of [Rafale fighter jets](#) from France has enhanced India's air superiority.
 - Rafale is a **twin-jet combat aircraft** manufactured by **Dassault Aviation** and is capable of carrying out a wide range of **short and long-range missions**.
 - India procured [36 Rafale jets in 2016](#) from France and a deal is underway to further purchase 26 Rafale Marine fighter jets for the [INS Vikrant](#).
- **S-400 Air Defence System:** Acquisition of the [S-400 Triumf](#) from Russia strengthens air defense capabilities.
 - The S-400 Triumf is a **mobile, surface-to-air missile**, capable of **intercepting and destroying various aerial targets**, with a range of up to 400 km, at an altitude of up to 30 km, and the ability to engage up to 36 targets simultaneously.
 - India signed a contract with Russia for five S-400 missile squadrons in 2018-19.
- **Arjun Mk-1A Tanks:** India has upgraded its armored capabilities with indigenous **Arjun Mk-1A** main battle tanks.
 - The [Arjun Mk-1A](#) is an upgraded version of the Arjun Mk-1 main battle tank (MBT) with enhanced tank's lethality, mobility and survivability.
 - The engines for Arjun Mk-1A were imported from Germany but now India is developing an indigenous engine for the tanks.

▪ **Indigenous Development:**

- **LCA Tejas Fighter Aircraft:** Development and induction of the indigenous [Tejas Light Combat Aircraft \(LCA\)](#).
 - LCA Tejas replaced the aging [MiG-21 planes](#).
 - It was developed by the [Aeronautical Development Agency \(ADA\)](#) and is manufactured by the state-owned [Hindustan Aeronautics Limited \(HAL\)](#).
 - It is the **lightest, smallest, and tailless multi-role supersonic fighter aircraft** that can carry [air-to-air, air-to-surface, precision-guided weapons](#), with air-to-air refueling capability, a maximum payload capacity of 4000 kg, a top speed of Mach 1.8, and a range of 3,000 km.
 - **Variants of Tejas:**
 - **Tejas Trainer:** 2-seater operational conversion trainer for training air force pilots.
 - **LCA Navy:** Twin- and single-seat carrier-capable for the Indian Navy.
 - **LCA Tejas Navy MK2:** This is phase 2 of the LCA Navy variant.
 - **LCA Tejas Mk-1A:** This is an improvement over the LCA Tejas Mk1 with a higher thrust engine.
- **INS Arihant:** It is India's first nuclear-powered ballistic missile submarine (SSBN) commissioned into the Indian Navy in 2016. It has enhanced underwater capabilities.
- **Missile Systems:** India has upgraded indigenous missile systems like **Agni**, **Prithvi**, and **BrahMos** to improve strike capabilities.
 - The [Agni](#) series of ballistic missiles have a range of 700 km to 5,000 km.
 - [Prithvi](#) is a series of short-range surface-to-surface ballistic missiles with a range of

150 km to 500 km.

- **BrahMos** is an **Indo-Russian joint venture missile** with a range of **290 km**, capable of reaching a top speed of Mach 2.8, making it the fastest cruise missile in the world. It is available in **land, ship, submarine, and air-launched** variants.

▪ **Technological Advancements:**

- **Network-Centric Warfare:** The Indian Army is enhancing its capabilities through integration of **network-centric operations** for **real-time data sharing** and **coordinated responses** across services. Projects undertaken under this are:
 - **Project Sanjay:** Establishes a **Battlefield Surveillance System** with multiple centers, integrating sensors for comprehensive situational awareness linked to the **Artillery Combat Command and Control System (ACCCS)**.
 - **Project E-Sitrep:** It develops an enterprise-class **GIS platform** for situational reporting, starting with the Northern Command.
- **Cyber Warfare Capabilities:** Strengthening cyber capabilities to protect critical infrastructure and counter cyber threats. It includes initiatives such as:
 - **National Cyber Security Policy:** The **National Cyber Security Policy** aims to **safeguard cyberspace**, develop capabilities to **prevent and respond to cyber attacks**, and **minimize damages** through coordinated efforts across **institutional structures, people, processes, and technology**.
 - **Cybersecurity Legislation** is for enacting laws to address **cybercrimes** and establish clear **legal frameworks for data protection** and incident reporting.
 - **CERT-In (Indian Computer Emergency Response Team)** is a central agency responsible for collecting, analyzing, and disseminating information on cyber incidents.
- **Artificial Intelligence and Robotics:** In the defense sector, AI-based technologies are used for **intelligence, surveillance, and reconnaissance (ISR)** operations.
 - These AI-based technologies are used for various functions including **training, surveillance, logistics, cybersecurity, Unmanned Aerial Vehicles (UAVs)**, and advanced military weaponry like **Lethal Autonomous Weapon Systems (LAWS)**.
- **Airborne Early Warning and Control (AEW&C) Aircraft:** The IAF has started the **Netra-I AEW&C aircraft program**, which is based on the Brazilian Embraer aircraft.
 - The Netra-I AEW&C aircraft program is a project by **DRDO** that provides the IAF with a **crucial surveillance and command and control asset**, enhancing its ability to monitor and respond to threats in the air and on the ground.
- **iDEX: Innovations for Defence Excellence (iDEX)** is a government initiative to **modernize the Defence Industry**, launched in April 2018.
 - It aims to **promote innovation and technology development** in Defence and Aerospace by engaging Industries, **MSMEs, start-ups, individual innovators, R&D institutes, and academia**, providing them with **funding and other support** for Research & Development.

▪ **Infrastructure Development:**

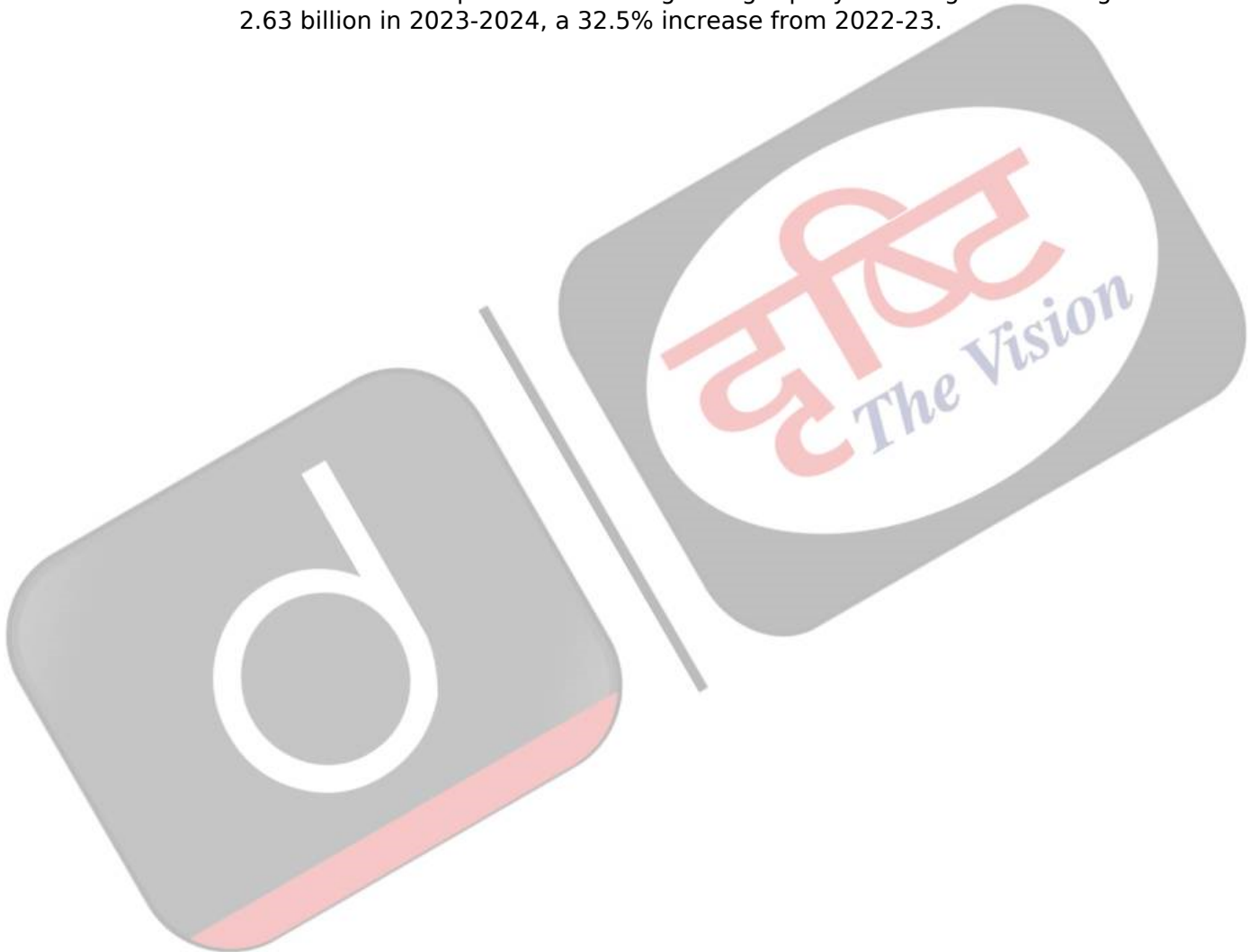
- **Strategic Road and Rail Networks:** India is building road and rail networks in border areas for rapid troop and equipment mobilization. These include initiatives such as:
 - **Comprehensive Integrated Border Management System (CIBMS)**
 - **Integrated Check Posts (ICPs)**
 - **Border Infrastructure and Management (BIM) Scheme**
- **Advanced Air Bases:** Upgrading and constructing airbases, especially in strategic locations like the northeastern states.
 - Example: India has been upgrading two key airbases near the China border, one at **Bagdogra Air Base** in West Bengal's Darjeeling, and other at **Chabua Air Base**, located in Assam's Dibrugarh.

What are the Other Recent Initiatives for Defense Modernization?

- **Integrated Theatre Commands:** An **integrated theater command** has been proposed for **unified control of the Army, Air Force, and Navy** under a **single commander** for strategic geographical areas.

- This structure allows the commander to effectively utilize resources from all three services to **enhance operational efficiency**.
- **Recruitment:** The Army has approved the [Agnipath Scheme](#) recruitment scheme for Indian youth to serve in the Armed Forces.
- **Defense Production and Export:**
 - **Atmanirbhar Bharat:** Government is focused on **increasing domestic defense production** and reducing dependency on imports.
 - Recently, India's indigenous defense production reached a record high of Rs 1.27 lakh crore in 2023-24, a growth of 16.7% over the FY 2022-23.
 - **Defence Acquisition Procedure (DAP) 2020:** [Defence Acquisition Procedure \(DAP\)](#) is focused on attracting [Foreign Direct Investment \(FDI\)](#) in defense manufacturing and indigenization of the manufacturing prices.
 - **Export of Defense Equipment:** India is becoming a defense exporter, with **Vietnam** and the **Philippines** interested in [BrahMos missiles](#) and the US and Australia keen on the **Tejas** aircraft.
 - India's defense exports have been growing rapidly reaching a record high of USD 2.63 billion in 2023-2024, a 32.5% increase from 2022-23.

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DEFENCE MANUFACTURING



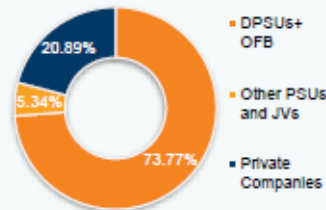
MARKET SIZE

Defence Production in India (US\$ billion)



SECTOR COMPOSITION

Defence Production in India by Sector in FY23 (%)

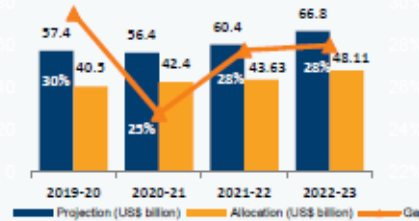


Value of Production by Defence PSUs (US\$ billion)

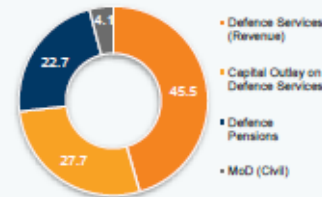


KEY TRENDS

Mod's Resource Projection and Allocation under Defence Services Estimates



Breakdown of fund allocation in Defence Industry as per the Budget 2024-25



GOVERNMENT INITIATIVES

Increased Cooperation with Vietnam on Surveillance and Shipbuilding Technology



Defence Production and Export Promotion Policy 2020

Defence Park in Kerala to Promote MSMEs and Boost 'Make in India' Initiative



ADVANTAGE INDIA

- **Growing demand:** Till April 2023, a total of 606 industrial licences were issued to 369 companies operating in the defence sector. Defence exports US\$ 2.63 billion in FY24, up by 32.5% from last year; India now exports to over 83 countries due to collaborative efforts. Annual defence production hits record high of approx. Rs. 1.27 lakh crore (US\$ 15.34 billion) in FY24 up by 16.7% from last year.
- **Competitive advantage:** India has the world's fourth-largest defence expenditure, as of 2022, and has set a target of US\$ 6.02 billion (Rs. 50,000 crore) worth of annual defence exports by 2028-29. In the Regular Union Budget of FY23, Ministry of Defence (MoD) has been allocated Rs. 6,21,940.85 crore (approx. US\$ 75 Billion), the highest among the Ministries.
- **Government support:** Under the Atmanirbhar Bharat Initiative, five positive indigenization lists of 509 products have been promulgated by the Department of Military Affairs and Ministry of Defence to be manufactured domestically for the defence sector, instead of being sourced via imports.
- **Opportunities:** The government has established 2 Defence Industrial Corridors in Uttar Pradesh and Tamil Nadu. India has around 134 defence tech startups building innovative tech solutions to empower and support the country's defence efforts.

What are the Challenges to Defense Modernization in India?

▪ Budgetary Constraints:

- India's defense spending, though increasing, remains below the global average for major powers, limiting the acquisition of advanced weaponry. Competing priorities between defense, social welfare, and economic development often result in compromises in defense allocation.
 - According to [SIPRI](#), India's military expenditure reached **USD 83.6 billion** in 2023, making it the **fourth-largest defense spender** globally.

- The **US** leads in defense spending at USD 916 billion (3.4% of GDP), followed by **China** at USD 296 billion (1.7% of GDP) and **Russia** at USD 109 billion (5.9% of GDP).
- **Slow Decision-Making Process:**
 - India's **defense acquisition process is slow**, with significant delays between planning and execution. Reducing this lengthy process to a maximum of 1-2 years remains a major challenge.
- **Production Capacity Shortfalls:**
 - Despite government initiatives like '[Make in India](#)' and '[Atma Nirbhar Bharat](#)', the **domestic defense production capacity has not kept pace** with the growing procurement budget of the armed forces.
 - According to **SIPRI**, **India is the world's top arms importer between 2019-2023**, with a **4.7% increase in arms imports** between 2014-2018 and 2019-2023.
 - There is a **high dependence on imports for essential hardware**, as domestic production levels do not meet annual requirements.
- **Supply Chain Disruptions:**
 - The global semiconductor shortage, worsened by the [Covid-19](#) pandemic, has **delayed the production of essential military technologies**.
 - These disruptions in supply chains **hinder projects and increase dependence on foreign suppliers**, challenging India's goal of self-reliance.
- **Geopolitical Dynamics:**
 - **Regional tensions, rising powers, non-state actors, technological competition, and supply chain vulnerabilities** necessitate a **responsive and adaptable military strategy**.
 - These factors can **complicate defense planning and resource allocation**, requiring India to carefully consider the evolving security environment and **adjust its modernization efforts** accordingly.

Way Forward

- **Implementation of Recommendations of [Prof K Vijay Raghavan Committee](#):**
 - Prof. K Vijay Raghavan Committee proposed several recommendations to enhance defense research and development in India. These include:
 - **Department of Defense Science, Technology, and Innovation:** Creating a new department headed by a technocrat to **promote defense research and development within academic institutions** and start-ups.
 - **Defense Technology Council:** Establishing a **high-level council** chaired by the Prime Minister to **determine India's defense technology roadmap**.
 - **National-Level Laboratory Facilities:** Setting up **centralized, state-of-the-art research laboratories** instead of relying solely on DRDO facilities.
- **Streamlining Regulatory and Procurement Processes:**
 - Simplifying documentation requirements and reducing processing times to streamline regulatory and procurement processes.
- **Engaging the Private Sector:**
 - There is a need to **create opportunities for the private sector and protect their investments**. Given the high costs of weapon system development, **clarity in government policies** and **support for Public Sector Undertakings (PSUs)** are essential to mitigate **financial risks** for private companies.
 - The **private sector's contribution** to defense production in **2023-24 was 20.8%**, up from **19% in 2022-23**, which needs to be increased further.
- **Creation of Specialist Officer Cadre:** The creation of specialized officers and specialized cadres, such as **cyber experts**, by providing **specific training and education** through **civil-military integration**.
- **Investing in the Defence Economy:**
 - The defense sector can be a profitable venture. By modernizing and reducing imports, India could increase its **GDP** by 2-3% and create millions of jobs, fostering economic growth and self-reliance while positioning itself as a defense exporter.
- **Modernizing Port Infrastructure:**
 - Enhancing port facilities is crucial for efficient maritime operations. Initiatives like

the [Sagarmala](#) project aim to revitalize this infrastructure.

- **Integrating the Marine System:**
 - There is a need for a **comprehensive approach to maritime security** that includes **naval support and coordination among merchants, fisheries, and trade**. Establishing a central coordinating body will enhance this integration.
- **Harnessing the Blue Economy:**
 - India should fully exploit the [blue economy](#), balancing national interests with responsibilities toward smaller neighboring nations. Developing strong maritime industrial infrastructure will help India address its own needs while supporting its maritime partners.

Initiatives Related to Domestic Production of Defence Equipment

- **Increased Capital Acquisition Budget (CAB) for Domestic Sector**
- [Defence Industrial Corridors](#)
- [Corporatization of the Ordnance Factory Boards](#)
- [Defence India Startup Challenge](#)
- **SRIJAN Portal**
- [Draft Defence Production and Export Promotion Policy 2020](#)
- [Innovations for Defence Excellence \(iDEX\)](#)
- [Mission Raksha Gyan Shakti](#)

Conclusion

As countries pursue military modernization in response to significant geopolitical changes, advanced technologies are becoming crucial in warfare. The future battlefield will be largely influenced by technology, with technological superiority playing a key role in determining the outcomes of future conflicts. Therefore, prioritizing technological self-reliance is essential.

UPSC Civil Services Examination, Previous Years Questions (PYQs)

Q. What is “Terminal High Altitude Area Defense (THAAD)”, sometimes seen in the news? (2018)

- (a) An Israeli radar system
- (b) India’s indigenous anti-missile programme
- (c) An American anti-missile system
- (d) A defence collaboration between Japan and South Korea

Ans: c

Q. Consider the following in respect of Indian Ocean Naval Symposium (IONS): (2017)

1. Inaugural IONS was held in India in 2015 under the chairmanship of the Indian Navy.
2. IONS is a voluntary initiative that seeks to increase maritime co-operation among navies of the littoral states of the Indian Ocean Region.

Which of the above statements is/are correct?

- (a) 1 only
- (b) 2 only
- (c) Both 1 and 2
- (d) Neither 1 nor 2

Ans: (b)

Q Which one of the following is the best description of ‘INS Astradharini’, that was in the news

recently? (2016)

- (a) Amphibious warfare ship
- (b) Nuclear-powered submarine
- (c) Torpedo launch and recovery vessel
- (d) Nuclear-powered aircraft carrier

Ans: (c)

Mains:

Q. How is S-400 air defence system technically superior to any other system presently available in the world? **(2021)**

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