

Defence Technology, Conventional and Emerging, Challenges

July 10, 2026 • vajiramandravi.com



Defence technology is a broad term that refers to the **use of technology in military operations**, including the research, development, procurement, and deployment of systems and equipment used by armed forces to protect national interests. With the emergence of **cyberwarfare, artificial technology, hypersonic missiles**, etc., the nature of warfare is changing. Technology plays a crucial role in redefining conflict parameters, particularly in hybrid warfare, replacing the human-centric approach.

India has also emphasised **defence and aerospace** as a priority for the '**Atma Nirbhar Bharat**', with a strong focus on the building of **indigenous manufacturing infrastructure** supported by a necessary research and development environment.

Domains of Warfare

The domains of warfare are **physically defined areas** of an operational environment that require unique warfighting skills and capabilities. They are in three dimensions: **physical, human, and information**.

- The **multi-domain operations (MDO)** and joint all-domain operations (JADO) models in defence include four physical domains: **sea, air, land, and space**.
- It also has one functional domain called **cyber and electromagnetic spectrum (EMS)**, known collectively as the five operational or warfighting domains.
- **Land domain:** Historically, **territorial conflicts and expansion** were limited to land, which could be accessed by **foot or mechanised means**.
- **Sea domain:** The **ability to sail oceans** created new fronts for warfare, with governments assembling massive ships to **project power, control trade routes, and conquer new territory**.
- **Air domain:** The invention of **aeroplanes** established air as a new arena in warfare. Technological advances have made air power play a critical role in military strategy, providing deep **reach and flexibility**.
- **Space domain:** **Space has evolved as the most recent domain in combat, with satellites used for surveillance, communication, navigation, early warning systems, and reconnaissance**.
- **Example:** Mission Shakti, India's first-ever **anti-satellite missile test (ASAT)**.
- **Cyber and Electromagnetic Spectrum (EMS):** Cyberwarfare targets **digital infrastructure, computer systems, and networks**. EMS is a unique domain as it will always interact with all other domains.
- **Example:** The **Defence Research and Development Organisation (DRDO)** is working on a DURGA 2 laser weapon. (directed-energy weapons)

Conventional Defence Technology

These are well-established technologies that have been in use for some time. They form the backbone of military capabilities and strategies. Following are some examples of conventional defence technology:

- **Rifles and Firearms:** Traditional small arms, including rifles, pistols, and machine guns.
- **Tanks and Armored Vehicles:** Battle tanks, armoured personnel carriers, and other tracked or wheeled vehicles.
- **Aircraft:** Fighter jets, bombers, transport planes, and helicopters.
- **Naval Vessels:** Ships, submarines, and aircraft carriers.
- **Missiles and Rockets:** Surface-to-air missiles, cruise missiles, and ballistic missiles.
- **Artillery:** Cannons, howitzers, and rocket launchers.
- **Electronic Warfare Systems:** Jamming devices, radar systems, and communication equipment.
- **Cybersecurity Measures:** Protecting military networks and information systems.

Emerging Defence Technology

‘Emerging Technology’ refers to the development of either a new technology or the continuing advancement of existing technologies, which may be widely available in the near future.

- **Artificial intelligence (AI):** This has applications ranging from **data analysis to autonomous decision-making systems**.
 - **Example: US Army Project Maven** uses AI to interpret video images and improve the targeting of drone strikes.

- **Hypersonic missiles:** A hypersonic missile is a weapon that can travel at **Mach 5 or faster**, which is at least five times the speed of sound.
 - **Example:** Russia's **Kinzhal missile**.
- **Internet of Military Things (IoMT):** It is a network of devices that use the **internet to increase military capabilities**. It links **sensors, weapons, and vehicles** to improve situational awareness and operational efficiency.
 - **Example:** The use of **armed, unmanned aerial drones** on the battlefield.
- **Military drones:** They are also known as **unmanned aerial vehicles (UAVs)**. They are remote-controlled devices used in military warfare. They are used for surveillance, intelligence, and target acquisition.
 - **Example:** **MQ-9B armed drones** of the US army.
- **Robotics and autonomous systems:** Defence robots are **professional service robots** used by the military in war situations. They are frequently designed to improve a soldier's present capabilities while keeping them out of harm's way wherever possible.
 - **Example:** Daksh robot developed by DRDO
- **Stealth technology:** Stealth is any military technology that is intended to make vehicles or missiles **nearly invisible** to enemy radar or other electronic detection.
 - **Example:** The aircraft like **F-22 Raptor and F-35** fighter aircraft.

Defence Technology in India

India's defence technology sector is characterised by the **dominance of public sector companies** like **Hindustan Aeronautics Limited (HAL)**. The country has created a variety of indigenous defence systems. India is gradually allowing **private sector companies** to enter the Indian defence market, thereby opening up new avenues and opportunities

Defence Platforms of India

India's defence arsenal comprises a wide range of **domestically developed and imported platforms** across various categories, reflecting its growing capabilities in defence technology.

Indian defence platform	Description	Indian examples
Missile systems	- India has a range of missile systems for various ranges and purposes. - They are mainly developed under the Integrated Guided Missile Development Programme. India also developed air-to-air missiles.	- Agni series, BrahMos, ASTRA missile, etc.
Helicopters	- Versatile helicopters are used for attack, transport, reconnaissance, and search and rescue operations.	- Advanced Light Helicopter Dhruv, Rudra and Prachand Helicopter

Fighter jets	- India has already developed a lightweight fighter jet. - Now India is developing stealth fighter aircraft like the Advanced Medium Combat Aircraft (AMCA). Twin Engine Deck Based Fighter (TEDBF) for the Indian Navy.	- HAL Tejas
Submarines	- India's nuclear-powered ballistic missile submarines complete India's nuclear triad .	- INS Arihant
Aircraft carriers	- Indigenous aircraft carriers significantly boost India's blue-water naval capabilities.	- INS Vikrant
Navy warships	- Advanced warships are built in India. - They are equipped with sophisticated weapons and sensor systems.	- Kolkata-class destroyers, Visakhapatnam-class destroyers, etc.
Air defence system	- India has developed various air defence missile systems under the Indian Ballistic Missile Defence Programme. - It has so developed various surface-to-air missile systems.	- Prithvi missile, Akash missile, etc.
Hypersonic glide vehicles	- Developing technology for weapons that can reach hypersonic speeds.	- Hypersonic Technology Demonstrator Vehicle (HSTDV)
Directed-energy weapons	- High-energy lasers and microwave weapons for future warfare applications.	- KALI (Kilo Ampere Linear Injector) and DURGA (Directionally Unrestricted Ray-Gun Array).
Tanks	- India's main battle tanks feature advanced armour and fire control systems.	- Arjun main battle tank
Lightweight tanks	- Developing tanks for operations in challenging terrains like high-altitude areas.	- Zorawar light tank

Indigenisation of the Defence Sector in India

India's defence budget for the **financial year 2023-24** is set at **INR 5.93 trillion**, marking an increase from the **INR 5.13 trillion** allocated for **FY 2022-23**. India has initiated various initiatives to boost indigenous defence production.

- **Existing defence industrial base:** The Indian defence industrial base, established in the 1940s, includes:
 - Ordnance Factories (OFs)

- Defence Public Sector Undertakings (DPSUs) transformed from the Ordnance Factories Board (OFB) into seven separate entities in June 2021.

- **Current changes being implemented**

- **Promoting private sector participation:** It promotes simplifying licencing, creating a level playing field, and providing access to technology to increase private sector manufacturing of defence equipment.
- **Encouraging innovation and R&D:** Creating a robust R&D ecosystem for indigenous cutting-edge technology development.

- **Self-reliance initiatives**

- **Atmanirbhar Bharat:** This initiative aims for self-sufficiency in all sectors, including defence. It also aims to reduce import dependence and promote domestic production.
- **Defence industrial corridors:** Aims to serve as hubs for defence manufacturing and research-
 - The **Uttar Pradesh** Defence Industrial Corridor (UPDIC)
 - The **Tamil Nadu** Defence Industrial Corridor (TNDIC)

- **Major initiatives for the Indigenization of the defence sector**

- **Defence Production And Export Promotion Policy (DPEPP):** To increase domestic defence manufacturing and reduce import dependency.
- **Technology Development Fund (TDF):** This fund started as financial assistance for Indian companies to develop and manufacture defence equipment.
- **Strategic Partnership Model (SPM):** It aims to promote joint ventures between Indian and foreign companies for defence manufacturing.
- **Positive Indigenisation Lists (PILs):** It is a list of items for domestic production to enhance operational preparedness.
- **Liberalisation of Foreign Direct Investment (FDI):** This initiative encourages FDI in defence manufacturing for technology transfer and sector growth.

- **India's MoU and agreements with other countries**

- A MoU has been signed between **Hindustan Aeronautics Limited (HAL)** and **GE Aerospace** for the joint production of the **F414 fighter jet engine**, which is crucial for India's **Light Combat Aircraft MK II programme**.
- Tata and Airbus Helicopters have entered into an industrial partnership for the production of **H125 helicopters**.
- In the year 2023, Russia signed a contract to supply **Igla-S** hand-held anti-aircraft missiles to India and allow production of the Igla there under licence.

- **India's defence imports**

- According to the **Stockholm International Peace Research Institute (SIPRI)**, India has retained its position as the world's largest arms importer during the period **2018-22**.
- Russia (**45%**) remained **India's largest arms supplier**. India imported cutting-edge **S-400** missile systems from India.
- **France (29%)** emerged as the second-largest supplier, with the **United States** following at 11%.

- **India's defence exports**

- India's **defence exports** have shown major growth. India is among the **top 25** countries that export defence equipment.
- India's defence exports over the last **five years** have seen a steady increase. India's defence exports reached an all-time high of approximately **Rs 16,000 crore** in the fiscal year **2022-23**.
- This growth is attributed to India exporting more defence hardware to regions such as **South-East Asia, the Middle East, and Africa**.
 - Notable exports include the **BrahMos** supersonic cruise missiles to the **Philippines** in a deal worth \$375 million and **155mm artillery guns to an unnamed country by Kalyani Strategic Systems Limited**, worth \$155.5 million.

Challenges for India's Defence Sector

India's defence sector is going through **rapid change and modernisation**. But still, it faces several issues that urgently need to be addressed.

- **Budgetary constraints**
 - In the **interim budget of 2024-25**, the defence budget was approximately **\$75 billion**, which is just **1.9 % of Gross Domestic Product (GDP)**.
- **Technological parity with adversaries**
 - The **advanced technologies** employed by adversaries, especially China, necessitate that India identify and absorb niche technologies within its defence services to establish the required parity.
- **Dependence on imports**
 - India still imports critical technologies like **jet engines, aircraft, air defence systems**, etc., from foreign countries.
- **Innovation and R&D ecosystem**
 - The **lack of a robust defence R&D ecosystem**, characterised by **low overall researcher density** and **insufficient focus** on defence-specific research, has limited India's ability to innovate and develop indigenous military technologies.
 - India spends **0.8% of its GDP on all R&D** and has **156 researchers per million** population.
- **Capital-intensive investments**
 - India's defence industry is still **dominated by government PSUs**.
 - The need of the hour is to attract more domestic private investment in the defence sector.
- **Integration of MSMEs and Start-ups:**
 - India is not able to integrate these entities into the **defence supply chain** to harness their potential for innovation and development.
 - Many **defence startups**, despite being innovative, are not getting the desired government orders.
 - The **red tape and foreign lobbies** in the defence sector are hindering the growth of the Indian defence startup industry.

Defence Technology UPSC PYQs

Question 1. Which reference to Agni-IV Missile, of the following statements is/are correct? (**UPSC Prelims 2014**)

1. It is a surface-to-surface missile.
2. It is fuelled by liquid propellant only.
3. It can deliver one-tonne nuclear warheads about 7500 km away.

Select the correct answer using the code given below.

1. 1 only
2. 2 and 3 only
3. 1 and 3 only
4. 1, 2 and 3

Answer: (a)

Question 2. Cyberwarfare is considered by some defence analysts to be a larger threat than even Al Qaeda or terrorism. What do you understand by Cyberwarfare? Outline the cyber threats which India is vulnerable to and bring out the state of the country's preparedness to deal with the same. **(UPSC Mains 2013)**

Source: <https://vajiramandravi.com/upsc-exam/defence-technology/>

© Vajiram & Ravi. For personal use only.