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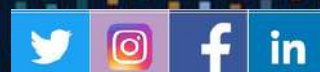
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MAPPING THE DEFENCE TECHNOLOGY GAP: SUPPLY CHAINS, INDUSTRY, AND THE ROOTS OF DEPENDENCE

MS NANDANA KAKARLA



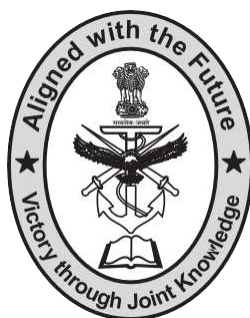
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**MAPPING THE DEFENCE TECHNOLOGY GAP:
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Mapping the Defence Technology Gap: Supply Chains, Industry, and the Roots of Dependence



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Abstract

Indigenous defence technology is critical in a world where modern warfare is defined by multi-domain operations and where supply chains underpinning a country's defence industrial base can be controlled by a small number of firms in a handful of countries. This article examines the gaps and vulnerabilities in India's defence technological base. It argues that the gap lies not in platforms themselves, but in the layers beneath them: components, materials and data that determine outcomes in multi-domain warfare. This gap is sustained by chronically low investment in research and development. Although Atmanirbhar Bharat has produced capable platforms, India's defence industrial base continues to rest on foreign inputs at these enabling layers. Progress toward self-reliance by 2047 will depend on shifting attention from platforms to these enabling layers, raising and re-targeting research investment, and securing dependable pathways, including positions within transnational supply chains.

Key words: *Atmanirbhar Bharat; defence indigenisation; multi-domain warfare; critical minerals; defence research and development; defence supply chains; Viksit Bharat 2047.*

Introduction

Self-reliance in defence has moved from an industrial preference to a strategic necessity. The Atmanirbharta initiative, tied to the wider vision of a developed and capable nation by 2047, seeks to change a long history in which India was among the world's largest arms importers.¹ The nature of warfare, meanwhile, is changing faster than most institutions can absorb, with multi-domain operations demanding that capabilities across domains be built, connected and fielded at speed.² Meeting that pace depends on sustained research and development, yet India allocates an estimated six per cent of its defence budget to research, against roughly twenty per cent for China and twelve per cent for the United States.³ This low and narrow base of research investment is the central constraint in building resilient and Indigenous Defence technologies.

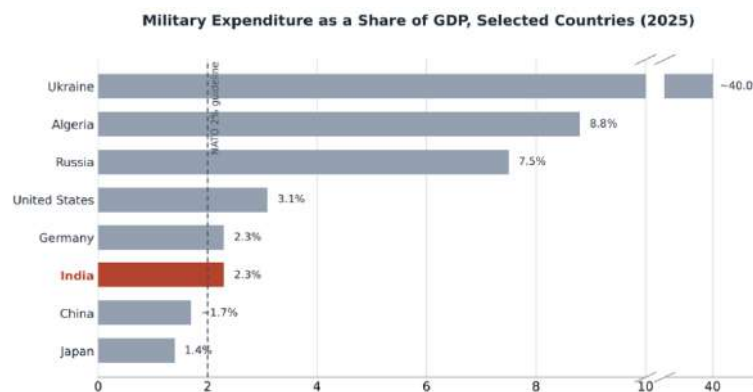


Figure 1: Military expenditure as a share of GDP **Source:** Sipri ⁴

This article analyses India's defence technological gap where Atmanirbharta meets multi-domain warfare, tracing it empirically from the research base through industrial and supply-chain constraints to the evidence of current theatres of war, before setting out policy considerations for the road to 2047.

The Gap Below the Platform

- **Comparative of India's defence industry with Global Peers**

India's defence industry gained unprecedented momentum and expanded manufacturing and defence capabilities with the launch of the Atmanirbharta initiative in 2020.⁵ The defence budget has grown from ₹2.53 lakh crore in 2013-14 to ₹6.81 lakh crore in 2025-26⁶ and reached an all-time high of 7.85 lakh crore in the 2026-27 budget.⁷ The indigenous Defence production rose from ₹46,429 crore in 2014-15 to ₹1.78 lakh crore in 2025-26. Defence exports surged from ₹686 crore in 2013-14 to a record ₹38,424 crore in 2025-26, with exports reaching over 80 countries.⁸

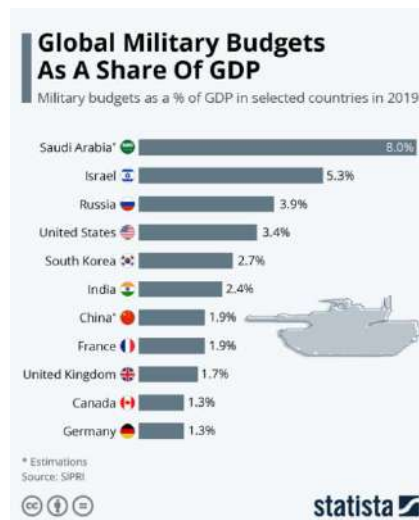


Figure 2: Global military budgets as a share of GDP **Source:** Statista⁹

However, India spends an estimated six per cent of its defence budget on R&D, compared with roughly twenty per cent for China and twelve per cent for the United States, and its wider research base is comparatively small, at about 0.66 per cent of GDP against 3.45 per cent for the United States and 5.44 per cent for Israel.¹⁰ In absolute terms, India's dedicated defence research budget of roughly three billion US dollars compares with American defence research, development, test and evaluation funding of about 143.7 billion dollars in 2025 and combined OECD government defence research of about 107.7 billion.¹¹

Indian private firms, heavily dependent on DRDO for R&D, spent an average of 3.5 % of revenue on R&D between FY2021 and FY2025 compared to 5.9% of global peers. According to the study, Indian defence companies generate only around 7.3 patents for every US\$1 billion in revenue, compared with nearly 240 patents per US\$1 billion among global peers. Global firms investing in R&D end up with intellectual property rights for next-gen military technology like DEWs, sensors, etc., making it a strategic vulnerability for India in the long run. Focus needs to be on intellectual property creation only enabled by higher R&D.¹² Risk aversion also plays an important factor in lower R&D, as it is capital intensive and slow to yield results, making it easier to depend on foreign components but also making it strategically expensive.¹³

- **Indigenous content and critical mineral supply chains**

Defence Acquisition Procedure (DAP) 2020 measures indigenisation through Indigenous Content (IC) thresholds based primarily on domestic value addition, a methodology that fails to account for the technological criticality of imported components and therefore provides an incomplete assessment of defence self-reliance. The most strategically critical technologies remain imported.¹⁴ DAP 2026 revised the Indigenous Content from 50% to 60%.¹⁵ But it does not address the import of strategically important critical technologies. Critical systems such as aero-engines, propulsion modules, advanced materials, titanium blocks, sensors, microelectronics and RF seekers continue to be imported from foreign sources.¹⁶ For example, the Arjun main battle tank, sanctioned in 1974 and inducted three decades later, entered service with close to 69 per cent of its components sourced from foreign vendors.¹⁷

Critical minerals and rare earth elements play a fundamental role in defence applications and C4ISR capabilities that define multi-domain operations. Lithium-ion batteries, antimony, germanium, yttrium, neodymium are, to name a few, essentials for radio sets, night vision goggles, thermal imaging and range finding capabilities, lasers, precision weapon systems, etc. Jet engines require metal alloys. China itself controls 99% of the world's supply of samarium, which is a heavy, rare earth irreplaceable for missiles and space operations.¹⁸ Domestic midstream processing is essential for channelling necessary critical

minerals towards the manufacture of components. However, midstream processing is largely controlled by PRC, making it critical for India to secure supply chains of critical minerals.

Current theatres of war and India's multi-domain preparedness

The war in West Asia is a next-generation, all-domain war in which artificial intelligence is deeply integrated into military technology, and its most striking feature is how deeply the enabling infrastructure behind that technology is controlled by commercial actors rather than the states fighting the war, as Figure 3 demonstrates. The pattern recurs, in different form, across the domains examined below.

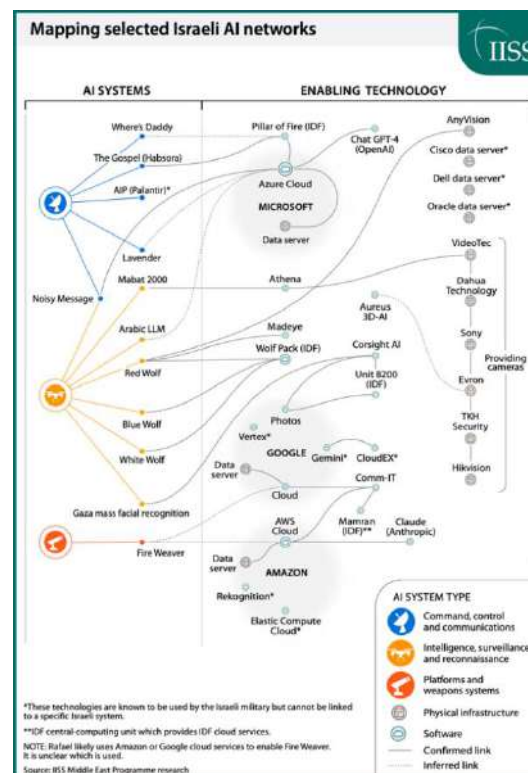


Figure 3: Mapping selected Israeli AI networks Source: IISS¹⁹

A small number of United States firms now supply the cloud computing and machine-learning infrastructure that underpins much of the region's targeting, surveillance and data-analysis capability. Under Project Nimbus, a joint 1.2 billion United States dollar contract signed in 2021, Google Cloud and Amazon Web Services provide cloud and artificial-intelligence services to Israeli government and military agencies, Microsoft's Azure platform has separately supplied computing and storage services to the Israeli

military, and Palantir Technologies has a confirmed partnership supplying data analytics and decision-support software for military operations.²⁰ This infrastructure has itself become a target: in March 2026, strikes attributed to Iran struck Amazon Web Services data centres in the United Arab Emirates and Bahrain, reportedly the first deliberate attack on commercial cloud infrastructure during a major conflict.²¹ India currently has no comparable government-level arrangement with a major cloud or artificial-intelligence provider for defence purposes; its digital defence rests instead on domestic institutions such as the Indian Computer Emergency Response Team. The same dependency is visible in the space domain closer to home. During Operation Sindoor in 2025, India drew on commercial satellite imagery from the United States firm Maxar Technologies to obtain the revisit frequency the operation required, since its own constellation could not provide a comparably persistent picture; Pakistan-based entities are separately reported to have sought Maxar imagery of the Pahalgam area in the period preceding the Pahalgam attack.²² Both cases reveal the same vulnerability: commercially available space-based intelligence and cloud infrastructure are available on the open market to more than one party, and Indian firms are not yet positioned to compete in either.

The cyber domain offers a partial counterpoint. During Operation Sindoor in May 2025, Indian critical infrastructure and digital systems faced over 1.5 million coordinated cyberattack attempts from Pakistan-linked threat groups, of which only around 150 resulted in an actual breach.²³ That resilience is real, but the scale of the attempted campaign, and the prospect of similar intrusions increasingly enabled by artificial intelligence, points to a domain where current defences will need continuous reinforcement rather than one-off vindication.

Underwater drones are an increasingly decisive and increasingly contested domain in their own right. Ukraine's Magura V5 uncrewed surface vessel, designed and manufactured domestically, has sunk or damaged more than a dozen Russian naval vessels in the Black Sea and is credited with the first destruction of an enemy warship and, later, an aircraft by a naval drone.²⁴ Iran has fielded the 'Azhdar' stealth underwater drone,²⁵ and the United States military has separately relied on underwater drones to clear mines from the Strait of Hormuz.²⁶ India's own response is still at an early stage but is under way: the Ministry of Defence awarded a contract

to Sagar Defence Engineering in Pune to build underwater drones in April 2025, and the Indian start-up AquaAirX is separately developing amphibious drones.²⁷

India's own procurement choices in the air and maritime-surveillance domain illustrate the gap between preference and investment. The Ministry of Defence recently signed a contract with the United States firm General Atomics to lease two additional MQ-9B Sea Guardian drones for long-range surveillance; the armed forces had ordered 31 of these aircraft, but first deliveries are scheduled only from early 2029,²⁸ which shows mature imported technology being preferred over long-term investment in indigenous alternatives through increased research and development. Indigenous programmes struggle because they are denied the time, funding and tolerance of failure required to mature, which leads the Ministry of Defence to sign contracts with foreign alternatives judged to be more mature.²⁹ The procurement of military equipment under India's complex and highly bureaucratic system compounds the problem, since it must pass through a lengthy chain of approvals, evaluations and bidding rounds.³⁰ A lower-cost, faster-to-field alternative already exists elsewhere: Ukraine has mass-produced interceptor drones costing between 1,000 and 15,000 dollars each,³¹ a capability India should aim to replicate and eventually export, given that the sheer volume of low-cost drones during Operation Sindoor already tested the Akash and Akashteer air-defence network.³²

The recurring choice of imported platforms over indigenous ones across these domains is not simply a matter of preference; it reflects the structural friction facing India's private defence sector, even as that sector has grown substantially under the Atmanirbharta initiative, with close to 1,000 start-ups now operational in Indian defence.³³ Firms encounter obstacles in acquiring land and infrastructure and in navigating overlapping central and state jurisdictions, compounded by the absence of a single-window clearance for defence manufacturing, which requires them to engage several ministries with differing timelines. These frictions raise cost and uncertainty and fall most heavily on the small firms and start-ups expected to supply innovation, while procurement delays make it harder to bridge the distance from prototype to production order. The iDEX scheme, modelled on the United States Defence Innovation Unit, has supported start-ups in encryption, communications, radar and unmanned systems, many of them dual-use, but its effect is limited by this surrounding uncertainty.³⁴

Policy Considerations

The evidence above points to a common structural problem across the material, industrial, and data layers of India's defence technology base: capability is being assembled faster than it is being generated. The following measures target that gap directly, moving from the research base upward to procurement, supply chains, and doctrine.

- **Raise and re-target defence research and development investment.** India should set a defined target of at least 2 per cent of gross domestic product for national research and development, supported by direct skilling partnerships with industry and a stronger STEM education pipeline. Within the defence budget specifically, private-sector participation in research needs targeted financial support, including R&D-linked incentives and insurance instruments that offset the capital intensity and slow returns which currently discourage private firms from research-heavy investment. Technologies such as quantum need dedicated funding and closer engagement with security establishment, since only sustained investment at this level ultimately determines intellectual property ownership of next-generation military technologies.³⁵
- **Reform how indigenisation itself is measured.** The Defence Acquisition Procedure's Indigenous Content threshold was raised from 50 to 60 per cent in DAP 2026. However, these metric measures self-reliance by domestic value addition rather than by criticality of the technologies imported. A manufactured item can meet indigenous content threshold while strategically sensitive components like aero-engines, propulsion modules, advanced materials, sensors, and microelectronics remain imported. Indigenisation policy should shift toward a technology-based measure of self-reliance that tracks control over these critical layers directly, rather than the current value-based calculation.
- **Secure critical mineral and midstream-processing supply chains.** Because China controls the overwhelming majority of global midstream processing for critical minerals and rare earth elements, including 99 per cent of the world's supply of samarium, a heavy rare earth with no substitute in missile and space applications, India needs greater synergy between the Ministry of Mines and the Ministry of Defence, paired with sustained investment

in domestic midstream processing capacity. Where domestic capacity cannot be built quickly enough, joint ventures with resource-rich partners, particularly in African nations, offer a faster route to diversified and secure supply.

- **Build sovereign artificial intelligence and compute capacity, while pursuing calibrated partnerships with major technology providers.** India currently has no government-level arrangement with a major cloud or artificial-intelligence provider for defence purposes, unlike the deep commercial integration visible in West Asia. A national centre for cyber security, coordinated between the Ministry of Electronics and Information Technology and the Ministry of Defence, should anchor this effort, alongside dedicated centres of excellence for cyber security and artificial intelligence, regular cyber-risk audits, and sustained investment in indigenous cyber security technology.³⁶ In parallel, India should pursue selective, carefully scoped partnerships with major cloud and artificial-intelligence providers for specific defence applications, since these firms offer compute scale and mature tooling that cannot be replicated domestically on short notice. Such partnerships should carry clear data-sovereignty and continuity safeguards from the outset, given the vulnerability that foreign-hosted infrastructure has already shown in the region. Over the longer term, the IndiaAI Mission's compute and foundation-model pillars, combined with a dedicated defence-AI directorate, should build the indigenous compute and artificial-intelligence layer that would let foreign partnerships remain a source of additional capability rather than the only source of a decisive one.
- **Scale low-cost, exportable innovation through DRDO-enabled private facilitation.** DRDO should act as a facilitator for private-sector work on emerging technologies, including financial backing for fields such as unmanned underwater vehicles, rather than only as a developer in its own right. An indigenous low-cost interceptor-drone programme, of the kind that Ukraine has scaled to unit costs between 1,000 and 15,000 dollars, would be a far cheaper and faster-to-scale complement to missile-based air defence than relying solely on more expensive systems, and would build the same exportable capability that Operation Sindoor demonstrated a clear need for when the volume of low-cost drones tested the Akash and Akashteer network.

- **Institutionalise dual-use industrial policy, export competitiveness, and tolerance for failure.** Civilian-Defence innovation systems need to be deliberately integrated and commercialisation of dual-use technologies that can sustain private firms through both civilian revenue and defence contracts need to be encouraged. Private firms need to be positioned to dominate supply chains. This needs to be enabled by institutional mechanisms that can absorb failure like audit and financial oversight structures built for defence research, long-term risk capital, and specialised techno-financial auditors. Without them, the start-ups, MSMEs and universities expected to drive innovation will remain trapped at the research stage regardless of scale of funding.
- **Coordinate these measures through a national multi-domain strategy.** A National multi-domain strategy that aligns defence modernisation, technology innovation, and command-structure reform is needed to coordinate Atmanirbharta efforts across India's defence industry. This strategy should prioritise interoperability and digital integration across the armed services, ensuring that improvements in enabling technologies and systems translate into capabilities that can operate effectively across multiple domains rather than in isolation.³⁷

Conclusion

Atmanirbhar Bharat has advanced furthest at the upper layers of the technology stack, in platforms, integration and exports, and least at the lower layers of components, materials and data that increasingly determine outcomes in multi-domain warfare. The 2047 horizon is therefore better assessed by progress at these lower layers and by India's ability to secure them at home or obtain them reliably through international supply chains than by the number of finished platforms produced. On that measure, the task is substantial but definable: to indigenise the most sensitive inputs, to integrate deliberately into the networks that supply the rest, and to raise research effort to match the pace at which the character of warfare is changing.

Declaration

I declare that this manuscript is being submitted exclusively to CENJOWS for publication consideration, is original, and has not been published or submitted elsewhere. I further certify that it contains no classified, restricted, or sensitive information and is based entirely on open-source material suitable for publication in the public domain.

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