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Indian defence manufacturing landscape-DRDO, public & private sector

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Abstract
Multiple policy initiatives under Atma Nirbhar Abhiyan are driving defence manufacturing sector through a major transformation with primary aim of reducing India’s historical dependence on imports. This shift is orchestrated through a complex interplay of the DRDO, DPSUs, and rapidly expanding private sector. The MoD’s Defence Acquisition Procedure (DAP) 2020 and the Positive Indigenisation Lists (PILs) serve as foundational policy instruments, aiming to streamline procurement, foster domestic production, and attract investment. While these policies demonstrate a clear commitment to indigenous capabilities, persistent bureaucratic hurdles, challenges in technology absorption, and the need for enhanced R&D investment highlight areas requiring further reforms. The corporatisation of the OFB into seven new DPSUs represents a significant structural change, with early performance indicators suggesting a positive trajectory in efficiency and market responsiveness. The private sector, including MSMEs, is increasingly recognized as a critical driver of innovation and production, yet faces specific hindrances related to level playing field, long-term order visibility, funding access, and intellectual property protection. Achieving true strategic autonomy requires sustained efforts to deepen collaboration, rationalise procurement processes, and significantly boost national R&D expenditure across the entire defence ecosystem.

Keywords: Defence manufacturing, Atma Nirbhar Abhiyan, indigenisation, defence policy reforms, research and development

Introduction

India's Strategic Imperative for Defence Self-Reliance

"Make in India" and "Atmanirbhar Bharat" initiatives are driven by strong national ambition for self-reliance, and reduced dependence on imports from major defence powers. The overarching goal is to shift India from being a major importer to a growing global manufacturing hub for defence products [1]. This strategic push for indigenisation is deemed crucial for national security, strategic autonomy, and broader economic growth [2]. The consistent framing of these initiatives across various policy documents, linking them directly to national security, strategic autonomy, and reducing import dependency, indicates that the government's primary motivation transcends mere industrial growth or job creation. It positions indigenous defence manufacturing as a critical enabler of India's ability to exert influence and safeguard its interests independently on the global stage, implying a sustained, long-term commitment to these policies, even if they occasionally entail higher costs or slower adoption compared to immediate foreign procurement. Evidence of this transformation includes a record defence production value of ₹1.27 lakh crore in FY 2023-24, marking a substantial 174% increase from 2014-15 levels. Concurrently, defence exports have surged to an all-time high of ₹23,622 crore in FY 2024-25, representing a remarkable 34-fold increase over the past decade. The government has set ambitious targets of achieving ₹50,000 crore in defence exports and ₹3 lakh crore in defence production by 2029 [3].

The Indian defence industrial base comprises of numerous governmental and private entities. At the core are DRDO, DPSUs, with an increasingly prominent private sector trying to garner better share of the pie. DRDO, with its network of over 50 laboratories, serves as the nation's primary R&D agency for defence technologies [4]. The DPSU segment comprises 16 central public sector undertakings, including major players like HAL and BEL, alongside the seven newly corporatised entities that emerged from the former OFB. The private sector is a diverse group, encompassing over 430 licensed companies and approx. 16,000 MSMEs that contribute significantly to the defence supply chain.

India has been the world's largest defence importer, accounting for 9.8% of global arms imports during the period 2019-2023, according to data published by the Stockholm International Peace Research Institute (SIPRI) [5]. This marks a continued trend of strategic dependence on foreign suppliers, despite ongoing efforts to strengthen indigenous manufacturing under the Make in India and Atmanirbhar Bharat initiatives [6]. The government (Ministries of Defence and Home) acts as the dominant, almost sole, buyer, thereby shaping the market into a monopsony and till a few years back it was a monopolistic market also with only government entities supplying the defence goods, which could be manufactured in the Country and rest being imported. Despite the inherent monopsonic/ monopolistic characteristics, the market benefits from a diverse seller base, encompassing state-owned entities (DRDO, DPSUs, and the corporatised OFB units) and a growing number of private sector players. While the aspect of monopsony can be addressed by opening the exports, a lot of effort has been put to change the supply side monopolies of DPSUs/ OFB. The current reforms aim to transition from this monopsony model to a more competitive system, explicitly seeking to "break the monopoly of defence PSUs and empowering the private sector to play a leading role" [7]. The private sector is increasingly recognised as a vital partner capable of introducing competition and enhancing efficiencies. The deliberate policy shift from a pure monopoly to a more competitive system is driven by the need for innovation and efficiency. This move acknowledges that competition can drive R&D and improve product quality. However, defence procurement is not a typical commercial market; it involves "technological complexity, foreign suppliers, high cost, foreign exchange implications and geo-political ramifications" [8]. The sector's inherent "low-risk, low-return" perception by financial markets, coupled with the imperative for "foolproof" technologies and the "fear of scrutiny from oversight agencies", means that a purely market-driven approach is impractical [9]. Thus, the ongoing transition of diversification is likely to remain a carefully managed hybrid ecosystem, balancing market dynamics with stringent national security and strategic oversight requirements. There is a need to understand as to why India is the largest importer of defence goods despite a fairly large industrial ecosystem.

Roles and Performance of Key Entities

India’s R&D Ecosystem

It is a proven reality that innovation and consequent self-reliance in defence/ any critical technology is directly related to investments in R&D and building academic excellence like South Korea. India's overall R&D spending is a critical concern, with the country allocating merely 0.70% of its GDP to R&D (2020-21), significantly lower than global averages (1.79%) and major defence economies like the US (3.45%), Israel (6.35%), Turkey (1.42%) and South Korea (4.96%). This reflects in India’s rankings in World Innovation Index-2024 at 39th position despite being 5th largest economy in the world [10]. India’s Gross Expenditure on Research and Development (GERD) has more than doubled over the past decade, rising from ₹60,197 crore in 2010-11 to ₹127,381 crore in 2020-21 but remains way below international averages. India rankings have seen significant increase from 66th in 2013 to 39th in 2024.

The composition of GERD in 2020-21 reveals a dominant role of the public sector, with contributions from the Central Government being 43.7%, State Governments at 6.7% and academic higher education institutions contributing at 8.8% [11]. This public-led R&D financing model underscores the need for greater private sector participation and translational research linkages. The private sector's contribution to India's GERD is only 30-37%, compared to over 68% in the US and 75% in China.

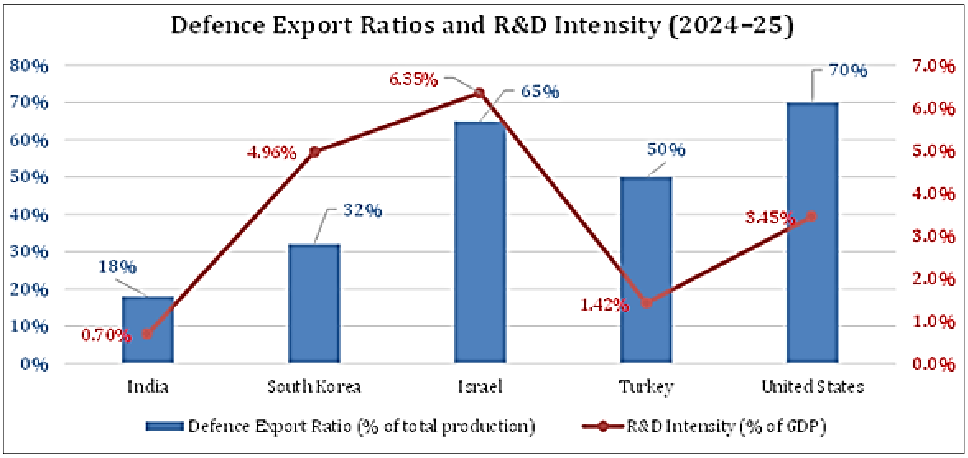

Fig 1: Co-relation between Defence Exports and R&D Expenditure (Source: Multiple)

This low overall R&D investment directly impacts the defence sector, which receives only about 5% of the total defence budget for R&D. This figure is notably lower than the 15% allocated by the US for R&D, limiting India's ability to develop advanced military technologies outside the public sector and engage in knowledge exchange through joint ventures [12]. This further translates into lower defence export ratios. A comparison has been drawn at Table-1 of the R&D Intensity and defence exports. It is clearly evident that India needs to spend more on defence R&D to grow its defence industry and consequent exports.

The academic contribution to defence research is almost negligible and faces its own set of challenges, which is a sub-set of overall deficiency in our national R&D

ecosystem. There is a recognised "poor academia-industry link," with fewer than 10% of Indian R&D institutions having strong collaborations with industry. Niti Aayog in a recent Study has taken note of the same and recommended an urgent reset [13]. This fragmentation limits applied research and the effective transition of academic innovations into industrial applications. While DRDO has established 15 Industry Academia Centres of Excellence at premier institutions like IITs/IISc to promote collaborative research in 84 technology verticals, the journey from lab-based research to real-world defence implementation is fraught with challenges due to higher stakes and rigorous testing requirements. Unlike consumer technologies, defence technologies must be foolproof before deployment, requiring patience, which is often lacking in risk capital for deep tech development [14].

India's defence innovation landscape remains predominantly state-driven, with limited private sector participation in R&D-intensive activities. Despite policy efforts to reserve 25% of defence R&D funds for private entities, uptake has been constrained by high capital requirements, uncertain procurement cycles, and weak intellectual property (IP) monetization pathways [15]. To address these structural bottlenecks, India must urgently take some of the following measures: -

Introduce targeted fiscal incentives such as tax rebates, design-linked schemes, and Production Linked Incentive (PLI)-type frameworks, specifically tailored to defence technologies.

The Department of Scientific and Industrial Research already offer tax exemptions under Section-35 of the Income Tax Act, 1961, and customs/excise duty waivers for recognized in-house R&D units [16]. However, procedural complexity and limited awareness have resulted in low adoption among private defence companies. In contrast, the ₹120 crore PLI scheme for drones has demonstrated early success in attracting private innovation [17]. Industry stakeholders now advocate for its expansion to cover broader defence domains, including autonomous systems, electronic warfare, and propulsion technologies [18].

Empirical evidence from sectors such as pharmaceuticals and electronics suggests a strong correlation between fiscal incentives and patent activity. In defence, however, India's patent output remains modest, with filings concentrated in dual-use technologies [19]. Expanding fiscal incentives, especially those linked to IP creation and export readiness could significantly enhance India's innovation footprint and support the strategic objectives of Atmanirbhar Bharat in defence manufacturing.

DRDO: The Defence R&D Backbone

DRDO is the premier research and development organisation of the MoD, Government of India, responsible for developing defence technologies, systems, and equipment for the armed forces. Established in 1958, it operates through a network of 50 laboratories and establishments across the country. The DRDO's primary objective is to design and develop state of art weapons systems, sensors and technological base/infrastructure to provide the armed services a decisive edge. Its labs and establishments are organised in 10 technological clusters. DRDO's mandate includes designing, developing, and leading the production of state-of-the-art weapon systems and capabilities in disciplines like aeronautics, armaments, electronics, combat vehicles, engineering systems, instrumentation, missiles, advanced computing and simulation, special materials, naval systems, life sciences, training, information systems and agriculture [20]. Key products and achievements include missile systems like Akash and BrahMos, Varunastra torpedoes, and various radar systems such as Revathi and Bharani Mk-I [21]. The research behemoth is organised in seven verticals each headed by directors of the labs, as per the functional organisation chart given below: -

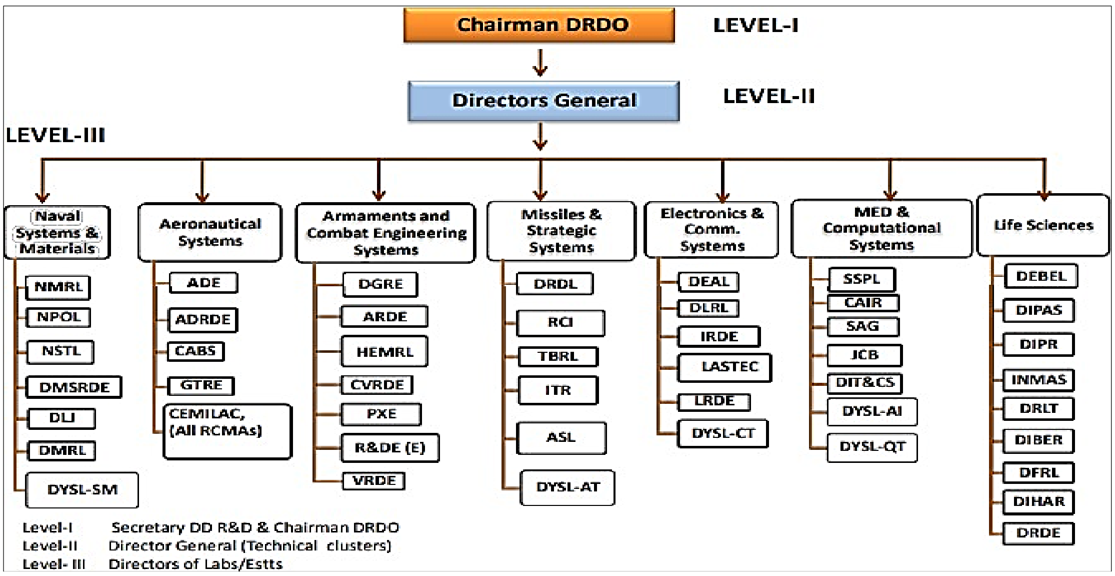

Fig 2: Organisation Chart od DRDO Laboratories

Performance Evaluation, Achievements and Strategic Advancements of DRDO

In alignment with the Government of India's declaration of 2025 as the "Year of Defence Reforms," DRDO has demonstrated notable progress across multiple domains. These achievements reflect its evolving role as a technology enabler and strategic partner to the Armed Forces.

Emerging Technologies and Ecosystem Integration

The integration of emerging technologies, particularly Artificial Intelligence (AI), Augmented Intelligence, quantum computing, and autonomous systems has redefined the contours of defence R&D. Start-ups and private innovators are increasingly contributing to disruptive capabilities, necessitating a shift in DRDO's engagement models. Organisational structures must evolve to accommodate these actors, fostering co-development, rapid prototyping, and scalable deployment.

Integrated Air Defence Weapon System (IADWS)

On 23 August 2025, DRDO successfully conducted the maiden flight test of the IADWS off the coast of Odisha. It is a critical component of the broader Sudarshan Chakra Mission, aimed at shielding vital installations through hybrid ground-space defence architecture. This multi-layered, indigenously developed system comprises of Quick Reaction Surface-to-Air Missiles (QRSAM) with indigenous RF seekers, Very Short-Range Air Defence Systems (VSHORADS), High-Powered Directed Energy Weapons using laser-based neutralisation and Centralised Command and Control Centre integrating radar and EO/IR sensors.

Directed Energy Weapons (DEWs): DRDO has achieved over 70% indigenisation in its DEW programme, notably through the Mk-2(A) laser system developed under Project Sahastra Shakti. This system has demonstrated precision engagement of drones and surveillance assets, positioning India among the few nations with operational DEW capabilities. Key features include 30-kW laser output via six 5-kW fibre lasers, EO/IR sensor suite for 360° threat detection, Mobile deployment platform for tactical flexibility and Operational cost per engagement equivalent to a few litres of petrol.

Strategic Missile Advancements: Missile program of DRDO has been the most successful undertaken till date. In August 2025, DRDO successfully test-fired the Agni-5 intermediate-range ballistic missile, validating all operational parameters under the Strategic Forces Command. An upgraded variant with a projected range of 7,500 km is under development, reinforcing India's strategic deterrence posture. Prithvi, Agni Series and other missiles have been a shining example of indigenous resilience and scientific competence.

Technology Transfers to Indian Industry

DRDO's performance in technology transfer has been a critical component of India's indigenisation drive. The organisation actively transfers technologies to both DPSUs and private companies for commercial production. Recent examples include the transfer of technologies for nine land systems and weapon platforms, such as CBRN reconnaissance vehicles to BEL and mounted gun systems to Bharat Forge. Technologies related to the Arjun Main Battle Tank, including the full trailer tank transporter and maintenance/repair vehicles, have also been transferred to companies like BEML and Tata International Vehicle Applications [22]. This demonstrates a concerted effort to expand the domestic manufacturing base and reduce dependence on foreign suppliers [23]. While ToT portal has been created under Directorate of Industry Interface & Technology Management (DIITM) and listed as Cat A & B. It is expected that with momentum building up in defence manufacturing, the pickup of ToT by private sector will improve and contribute to decent revenues for DRDO/ Government.

Focus on Critical Technologies. DRDO has now tried to open up the field of innovation for private industry wherein 183 items/ technologies have been identified for Industry to 'Design, Develop and Manufacture' in line with the objective of capitalising the capability of Indian industry for design and development of Defence System. DRDO may provide scientific/ technological/ testing support, wherever required for the development of these systems and subsystems on case-to-case basis [24]. This effort will save crucial resources and steer DRDO towards critical technologies.

Challenges Faced by DRDO

DRDO stands at a critical juncture. While its legacy contributions to strategic deterrence and indigenous capability development are undeniable, future relevance demands structural agility, stakeholder alignment, and technological foresight. Despite these efforts, DRDO faces several challenges in its R&D performance and technology absorption and organisational performance has been subject to scrutiny from multiple quarters. These are listed below: -

Historically, DRDO's has focused more towards strategic and high-technology areas, often due to technology denial regimes, leading to relatively lower priority being assigned to conventional weapons development [25].

Developing indigenous expertise across diverse fields like precision munitions, advanced materials, and sensor fusion simultaneously is challenging. At the same time, DRDO has faced criticism for initiating projects without formal requirement generation from the Services, leading to systems that are showcased but not inducted, raising concerns about resource utilisation and strategic coherence.

Major weapons systems often entail gestation periods extending up to 15 to 20 years, which poses significant challenges in the context of India's volatile security environment. Such extended timelines risk technological obsolescence and strategic vulnerability, particularly when urgent procurement from foreign vendors becomes necessary to bridge capability gaps [26]. Moreover, the successful and timely induction of DRDO-developed systems into service is frequently bottlenecked by the domestic industry's limited capacity to absorb these technologies and manufacture them at scale with consistent quality [27]. Notably, over 40% of mission-mode projects undertaken by DRDO have experienced substantial time overruns, thereby affecting induction cycles and compromising operational readiness. As a result, systems often arrive at deployment already lagging behind contemporary technological benchmarks [28].

While Transfer of Technology (ToT) agreements do exist, the effective absorption and mastery of these technologies for independent design and innovation remains a lengthy and complex endeavour. DRDO has, on occasion, been criticised for not fully leveraging ToT mechanisms to build indigenous design capabilities [29]. Despite recent policy reforms, the pace of technology internalisation across industry partners, especially MSMEs has been uneven.

Bureaucratic processes and a lack of institutional agility in responding to evolving military requirements frequently result in project delays and mid-course changes to qualitative parameters [30]. The Defence Acquisition Procedure (DAP) remains procedurally intensive, and several indigenous programs have suffered from time and cost overruns due to fragmented decision-making and delayed approvals [31].

Despite numerous technological achievements, DRDO's engagement with the Armed Forces continues to be episodic and reactive [32]. Key operational challenges include:

Communication gaps and differing perspectives between DRDO, the Armed Forces (as end-users), and the industry, which impede collaborative development [33].

Systems often fail to meet evolving qualitative requirements due to limited joint design reviews and inadequate feedback loops [34].

Post-induction maintenance, spares provisioning, and upgrade pathways remain poorly coordinated, particularly for multi-vendor systems, affecting lifecycle support and operational readiness [35].

For FY 2025-26, DRDO has been allocated ₹26,817 crore, a 12% increase from the previous fiscal year [36]. A major share of this, ₹14,924 crore, is allocated for capital expenditure to fund R&D projects, strengthening DRDO in developing new technologies, especially deep technology, and supporting private parties through schemes like the Technology Development Fund (TDF). Despite this increase, India's defence R&D budget, at about 5% of total defence spending, lags significantly behind countries like the U.S., which allocates around 15%. This underinvestment, coupled with a systemic fear of failure due to stringent audits (where R&D by nature involves failure), discourages risk-taking and innovation. The lack of sufficient risk capital for deep tech development, which often has long gestation periods, further exacerbates this challenge [37].

Reports from the Comptroller and Auditor General (CAG) and the Controller General of Defence Accounts (CGDA) have consistently raised concerns regarding leadership, accountability, cost overruns, and product quality in DRDO-managed projects [38]. Notably, certain mission-mode projects have witnessed cost escalations of more than 400%, with audit highlighting serious flaws in planning, estimation, and execution [39]. These systemic inefficiencies have also been linked to irregular closures and premature declarations of success despite non-achievement of key performance parameters [40].

Persistent negative media coverage has further contributed to a perception of inefficiency within the organisation, adversely impacting morale particularly among early-career scientists and technologists [41]. While DRDO offers structured career progression and training opportunities, the reputational challenges stemming from public scrutiny and delayed project outcomes have created dissonance between institutional aspirations and field-level motivation [42].

Comparison with International R&D Powerhouses DARPA and Chinese Defence R&D

DARPA (USA) operates with approx. 220 personnel, of which around 10% are uniformed military officers. Despite this, its engagement with the Services is deep and continuous. All developmental programs originate from services after operational gaps have been enunciated by combatant commands. Armed Forces liaison officers and transition partners from the Services, who are linked to each project ensure relevance and scalability. DARPA's program managers operate on 3-to-5-year tenures with autonomy and milestone-based funding, which keeps performance pressure on each employee.

Chinese Defence R&D model is characterised by long-term strategic alignment with PLA doctrine. Chinese defence establishment ensures close coordination between research labs and state-owned defence enterprises. China as a State leverages global talent networks for tech scouting and reverse engineering. The results of focused R&D are clearly visible, where China is the leader in the world today in many critical technologies like quantum computing or hypersonic vehicles, well ahead of even the USA.

Reforms in DRDO

Multiple expert committees including the Kelkar Committee (2005) and the Rama Rao Committee (2008), have proposed comprehensive restructuring measures to modernise DRDO's organisational architecture in the fields of inter-agency coordination, R&D Synergy with all stakeholders, and organisational structures/ governance etc. Recent studies, including the Standing Committee on Defence (2021-2023) and the Vijay Raghavan Committee (2023), have identified several priority areas for reform. These recommendations have so far aimed to transform DRDO into a responsive, agile, and innovation-driven organisation capable of delivering strategic technologies within compressed timelines. To meet evolving strategic demands, DRDO must transition from a lab-centric, incremental model to a mission-driven, agile, and user-embedded framework, drawing lessons from the U.S. DARPA and Chinese defence R&D institutions. A few important ones are listed below: -

- DRDO has consolidated its network of over 50 laboratories into approx. 25 thematic clusters, such as Aeronautical Systems, Missiles & Strategic Systems, and Soldier Support Systems. This restructuring aims to reduce duplication, enhance cross-domain synergy, and align research efforts with future capability needs [43].
- DRDO's 2025 Transfer of Technology (ToT) policy includes provisions for a dedicated commercial interface to accelerate technology transfer, monetise intellectual property, and deepen industry partnerships. Over 2,100 licensing agreements have been executed, with a growing emphasis on dual-use technologies and MSME participation [44].
- DRDO has introduced fast-track promotions under the Flexible Complementing Scheme (FCS), sabbatical opportunities, and global research fellowships to attract and retain high-performing scientists. These incentives are designed to foster merit-based growth and international exposure [45].
- A dedicated MSME cell has been established within DRDO, supported by the Technology Development Fund (TDF) scheme. Challenge-based funding, simplified vendor protocols, and targeted outreach have enabled MSMEs and startups to participate in defence R&D, with over ₹350 crore sanctioned across 81 projects [46].
- DRDO has begun deploying milestone-based dashboards and AI-enabled risk flags to improve project transparency, track deliverables in real time, and reduce

cost and time overruns. These tools support predictive analytics and automated reporting across critical programmes [47].
- A proposal is under consideration to establish a high-level Defence R&D Investment Board to vet strategic proposals, align them with national capability roadmaps, and ensure prioritisation of deep-tech domains. The initiative was highlighted during DRDO's 67th Foundation Day as part of the broader reform agenda for 2025 [48].

DRDO's transformation into a mission-driven, user-centric R&D ecosystem is not merely a structural adjustment but a strategic imperative. By adopting best practices from DARPA and Chinese and other international models, while tailoring them to India's institutional context, DRDO can evolve into a globally competitive engine of defence innovation. The integration of Services, MSMEs, and academia must be institutionalised, not incidental, to ensure that indigenous technologies are not only developed but deployed with operational confidence.

DPSUs: The Traditional Pillars of Defence Manufacturing: DPSUs have historically formed the backbone of India's defence production, playing a significant role in achieving self-reliance. There are 16 DPSUs under the Department of Defence Production (DDP) including seven newly corporatised OFB entities. These entities are producing variety of systems including arms and ammunition, tanks, armoured vehicles, heavy vehicles, fighter aircrafts and helicopters, warships, submarines, missiles, ammunition, electronic equipment, earth moving equipment, special alloys and special purpose steels. A snapshot of these DPSUs is given below.

Hindustan Aeronautics Limited (HAL)

The largest DPSU, HAL is a Navratna company that has over the years build itself as comprehensive centre for Design, Development, Manufacture, Maintenance and Upgrade of Fighter, Trainers, Helicopters, Transport Aircrafts, Aero-Engines, Avionics, Systems and Accessories. HAL has 20 Production Divisions and 10 R&D Centres and one Facility Management Division spread across the Country. It has so far produced 17 types of aircraft from in-house R&D and 14 types under license. HAL is currently manufacturing Light Combat Aircraft (LCA) Tejas, Dornier Do-228 Light Transport Aircraft, Dhruv- Advanced Light Helicopter, Light Combat Helicopter (LCH) and Light Utility Helicopter (LUH) along with associated engines, avionics & accessories. It also has a production line for the Su-30 MKI Aircraft, Hawk Advance Jet Trainer, Chetak and Cheetal Helicopters. It has been supporting the fleet of Indian Defence for fifty years now. Currently, HAL is providing ROH for 12 types of aircraft/ helicopters and 14 types of engines. HAL has also diversified its business into Aerospace structure and Industrial Marine Gas Turbines [49]. In FY 2024-25, HAL reported revenue of ₹34,532 crore and a net profit of ₹5,827 crore, with a workforce of approx. 22,033 personnel.

Bharat Electronics Limited (BEL): Another Navratna category DPSU. It manufactures state-of-the-art electronic products and systems for the three-armed services. It is involved in the production of Navigation systems, communications, land-based radars, naval systems, electronic warfare systems, avionics, electro-optics, C4I systems, shelters and masts, simulators, batteries. It has since diversified into various areas like homeland security solutions, smart cities, e-governance solutions, space electronics including satellite integration, energy storage products including e-vehicle charging stations, solar, network & cyber security, railways & metro solutions, airport solutions, Electronic Voting Machines, telecom products, passive night vision devices, medical electronics, composites and software solutions. Its diversification reflects a strategic pivot towards dual-use technologies and national infrastructure support. For FY 2024-25, BEL posted revenue of ₹23769 crore and a net profit of ₹5330 crore, employing approx. 11,199 personnel [50].

Bharat Dynamics Limited (BDL): BDL has been working in collaboration with DRDO & foreign Original Equipment Manufacturers (OEMs) for manufacture and supply of various missiles and allied equipment to Indian Armed Forces. It has become part of a select few industries in the world having state-of-the-art facilities for manufacture and supply of Guided Missiles, Underwater Weapons, Air-borne products and allied defence equipment. It also offers Product Life Cycle Support and Refurbishment / Life Extension of vintage Missiles. BDL has progressed from a missile manufacturer to a Weapon System Integrator and provides complete solution for the armed services. It has been manufacturing various types of indigenously designed and developed missiles and underwater weapons in collaboration with the DRDO, like the Akash Weapon System, Astra beyond-visual-range air-to-air missiles, and heavyweight/lightweight torpedoes, some of which are now being exported. BDL also provides lifecycle support and refurbishment services for legacy missile systems. In FY 2024-25, the company recorded revenue of ₹3,479 crore and a net profit of ₹742 crore, with a workforce of around 2,400 personnel [51].

BEML Limited (BEML): It is Asia's second-largest manufacturer of earth moving equipment and it controls 70% of India's market in that sector. It manufactures a wide range of products in the field of mining, construction, power, irrigation, fertiliser, cement, steel and rail sectors, defence and aerospace. The earthmoving equipment includes bulldozers, dump trucks, hydraulic excavators, wheel loaders, rope shovels, walking draglines, motor graders etc., loaders for underground mining applications. Railway products include integral railcoaches, electric multiple units, rail buses, track-laying equipment etc., BEML manufactures heavy-duty trucks and trailers and hydraulic aggregates for the transportation sector. high power diesel engines and heavy-duty hydraulic aggregates. Rocket launchers, Recovery Vehicles, Bridge Set, Armoured Recovery Vehicles. BEML's dual-use product strategy enables it to serve both strategic and civilian sectors. In FY 2024-25, BEML reported revenue of ₹4022 crore and a net profit of ₹294 crore, employing 4,700 personnel [52].

Mishra Dhatu Nigam Limited (MIDHANI): MIDHANI a Mini Ratna was set up with a view to achieve self-reliance in production and supply of various super alloys, special steels, soft magnetic alloys to Defence and other Strategic

Sectors such as Energy, Space and Aeronautical applications. It is the leading manufacturers of special steels, Superalloys, and the only manufacturer of Titanium alloys in India. The state-of-the-art facilities are capable of catering to complex and dynamic requirements of critical materials. It has diversified and has set up several facilities such as Wide Plate Mill (WPM)- a state of art facility, capable of rolling plate with 3 Meter width owing to the growing needs in the Strategic Sectors, Armor facility at Rohtak, Haryana to cater to the need for high end Armour products and Springs Project that ease its presence in Railway sector. It has recently joined hands with National Aluminium Co. Ltd (NALCO) in a 50:50 joint venture to set up aluminium alloy plant known as Utkarsha Aluminium Dhatu Nigam Limited. In FY 2024-25, MIDHANI posted revenue of ₹1053 crore and a net profit of ₹109 crore, with a workforce of 770 personnel [53].

Mazagaon Dock Shipbuilders Limited (MDL)
It has the capability to build warships, submarines, merchant ships up to 40,000 DWT. It has delivered frontline platforms including destroyers, frigates, and Scorpene-class submarines. For outfitting work, the company has a large number of workshops with sophisticated equipment and machines specific to hull fabrication and ship construction work. MDL’s infrastructure supports modular construction and advanced CAD/CAM/CIM based design, using the latest ship design software’s, operating from a number of work stations having the latest computer hardware to provide, up to date design and production support, enabling efficient production cycles and integration of complex systems. In FY 2024-25, MDL reported revenue of ₹11432 crore and a net profit of ₹2325 crore. While exact employment figures are not publicly disclosed, estimates suggest a workforce exceeding 2,000 personnel [54].

Goa Shipyard Limited (GSL)
It is primarily involved in designing and building variety of vessels and simulating training facility, repair and modernization of vessels and supply of stern gear. GSL has designed and constructed training simulators for the Indian Navy and Oil & Natural Gas Corporation, interceptor boats for the Ministry of Home Affairs and are used by the Coastal State Police on the west coast. GSL has also constructed a one of its kind damage control simulators in Asia. It has executed India’s first shore-based training facility for carrier borne aircraft in association with the Aeronautical Development Agency at INS Hansa, Goa and continues to execute contracts for advanced frigates and pollution control vessels. GSL’s operational model integrates shipbuilding with simulation and training infrastructure. In FY 2024-25, GSL posted revenue of ₹1,753 crore and a net profit of ₹271 crore, employing approx. 1,000 personnel [55].

Hindustan Shipyard Limited (HSL)
The shipyard based in Visakhapatnam, operates across shipbuilding, submarine refits, and repair services. Its modular construction capabilities and digital transformation initiatives have enhanced operational efficiency and reduced production lead times. HSL’s product portfolio includes cargo liners, offshore vessels, and survey ships for clients such as the Indian Navy, Coast Guard, ONGC, and port authorities. HSL's design capability embraces wide spectrum of general and special purpose vessels. The design office has been upgraded in the recent past under modernisation program. It has now mastered the art of producing composite drawings which enable adoption of integrated modular construction methodology with a high level of pre-outfitting of blocks-module. In FY 2024-25, HSL recorded revenue of ₹1586 crore and a net profit of ₹166 crore, with an estimated workforce of 1,200-1,500 personnel [56].

Garden Reach Shipbuilders and Engineers Limited (GRSE): The GRSE delivered independent India’s 1st warship, INS Vijay in 1961, GRSE, a Mini Ratna Category-1 Company has delivered 107 warships to Indian Navy, Indian Coast Guard, Mauritius Coast Guard and Seychelles Coast Guard. It is engaged in building a wide array of vessels ranging from 05-ton boats to 24600-ton Fleet Tanker, world-class frigates and fast attack crafts. Apart from ship building & ship repairs, GRSE has also, moved into engineering business, production of pre-fabricated steel bridges, various deck machinery items & assembly/testing/overhauling of marine diesel engines. Its products include frigates, anti-submarine warfare corvette, missile corvette, landing ship tank, landing craft utility, survey vessel and offshore patrol vessels. The company’s infrastructure supports both shipbuilding and ancillary production, enabling it to serve defence and civil sectors alike. In FY 2024-25, GRSE posted revenue of ₹5,411 crore and a net profit of ₹527 crore, employing 1600 personnel [57].

Overview of Corporatised DPSUs (OFB Successors)
The corporatisation of the erstwhile OFB into seven new DPSUs on October 1, 2021, was a major reform aimed at improving autonomy, accountability, efficiency, streamline production, foster innovation and export competitiveness [58]. The paragraphs below provide a structured overview of each entity’s performance and strategic contributions as of FY 2024-25.

Munitions India Limited (MIL)
MIL has demonstrated exceptional growth in both domestic and international markets. Its revenue expanded from ₹2,571.6 crore in H2 FY 2021-22 to a provisional ₹8,282 crore in FY 2024-25. Export earnings rose dramatically from ₹22.55 crore to ₹3,081 crore, positioning MIL as a prominent global supplier of ammunition and explosives [59]. The company’s portfolio includes small arms cartridges, artillery shells, grenades, and rocket systems, supported by integrated production of propellants and explosive materials. MIL’s trajectory reflects its alignment with India’s defence export strategy and recent designation as Mini-Ratna enterprise [60].

Armoured Vehicles Nigam Limited (AVNL)
AVNL has emerged as India’s principal manufacturer of combat platforms, with sales increasing from ₹2,569.26 crore in FY 2021-22 to ₹4,986 crore (provisional) in FY 2024-25. A key achievement was the complete indigenisation of engines for the T-90 tank, MBT Arjun, and BMP-II Sarath. Its product range includes battle tanks, armoured personnel carriers, mine-protected vehicles, and logistics trucks. These developments enhance operational readiness and reduce import dependency [61].

India Optel Limited (IOL): IOL has made significant advances in optoelectronic systems, with revenue rising from ₹562.12 crore in FY 2021-22 to ₹1,541.38 crore (provisional) in FY 2024-25. The company manufactures night vision devices, fire control systems, and electro-optical sensors for armoured vehicles, artillery platforms, and naval systems. These technologies are vital for precision targeting and battlefield awareness. IOL's elevation to Mini Ratna status underscores its strategic importance [62].

Yantra India Limited (YIL): YIL plays a critical role in supplying mechanical components and ammunition hardware. It reported ₹3,030 crore in revenue for FY 2023-24, with a year-on-year growth rate of approx. 20% [63]. Operating multiple production units, YIL supports other DPSUs such as MIL and AWEIL through agile manufacturing cycles and rolling contracts [64].

Gliders India Limited (GIL): GIL, headquartered in Kanpur, achieved a profit before tax of ₹95.85 lakhs within six months of its inception and secured its first export order for brake parachutes [65]. The company produces troop parachutes, cargo drop systems, and illumination devices. Its early success and export orientation reflect a forward-looking approach to niche defence manufacturing [66].

Troop Comforts Limited (TCL): TCL focuses on protective gear and troop support equipment. It has developed indigenous Bullet Proof Jackets, Ballistic Helmets, and tactical gear for extreme climate operations. These products are undergoing field trials with Army commands, supporting India's goal of self-reliance in defence apparel [67].

Advanced Weapons and Equipment India Limited (AWEIL). AWEIL has outperformed its pre-corporatisation benchmarks, with an 84.53% increase in revenue and a 73.51% rise in net profit as of FY 2023-24 [68]. It manufactures small arms, artillery systems, and weapon components for domestic and export markets. Its operational efficiency and product diversification reflect the success of corporatisation reforms [69]. AWEIL is performing better than the pre-corporatisation period [70].

Performance Evaluation of 16 DPSUs (Including Corporatised OFB Entities)

India's DPSUs (DPSUs) continue to play a pivotal role in advancing national security objectives, industrial self-reliance, and global competitiveness. The corporatisation of the Ordnance Factory Board (OFB) in 2021 catalysed structural reforms, enabling greater financial autonomy, operational agility, and export orientation. This section evaluates the performance of DPSUs in FY 2024-25 across five key dimensions.

Overall Production and Contribution. India's total defence production value reached ₹1.27 lakh crore in FY 2023-24, with DPSUs and other public sector entities contributing approx. 79% of this output [71]. Preliminary estimates for FY 2024-25 indicate continued growth, with DPSUs maintaining their dominant share through expanded order books, improved supply chain integration, and enhanced manufacturing throughput [72]. The corporatised entities, especially MIL, AWEIL, and AVNL have contributed significantly to this momentum, with MIL alone reporting ₹8,282 crore in provisional revenue [73]. BEL and MDL demonstrate the highest per capita productivity among Indian DPSUs, reflecting efficient operations and high-value output. HAL, while leading in total revenue, shows moderate productivity due to its large workforce and complex manufacturing footprint.

Table 1: Productivity Metrics of DPSUs vs Global Benchmarks (FY 2023-24) (Source: Annual Reports)

Ser	DPSU Name	Revenue (₹ Cr)	Manpower	Productivity per Employee (₹ Lakh)	Net Profit (₹ Cr)	Avg Productivity: Israel (₹ Lakh)	Avg Productivity: South Korea (₹ Lakh)
1	Hindustan Aeronautics Ltd (HAL)	26,928	28,345	95	4,800	260-300	180-220
2	Bharat Electronics Ltd (BEL)	20,200	9,749	207	3,800	260-300	180-220
3	Bharat Dynamics Ltd (BDL)	3,500	2,700	130	600	260-300	180-220
4	Mishra Dhatu Nigam Ltd (MIDHANI)	1,200	1,600	77	180	260-300	180-220
5	Mazagon Dock Shipbuilders Ltd (MDL)	6,500	2,000	325	1,200	260-300	180-220
6	Garden Reach Shipbuilders (GRSE)	2,500	1,800	139	350	260-300	180-220
7	Goa Shipyard Ltd (GSL)	1,500	1,200	125	295	260-300	180-220
8	Hindustan Shipyard Ltd (HSL)	1,413	1,600	88	295	260-300	180-220
9	BEML Ltd	4,300	7,800	55	250	260-300	180-220
10	Advanced Weapons and Equipment India	1,800	9,000	20	20 (est.)	260-300	180-220
11	Armoured Vehicles Nigam Ltd	2,000	5,500	36	100 (est.)	260-300	180-220
12	Gliders India Ltd	1,000	1,800	56	20 (est.)	260-300	180-220
13	India Optel Ltd	1,000	1,000	100	40 (est.)	260-300	180-220
14	Munitions India Ltd	2,500	6,800	37	120 (est.)	260-300	180-220
15	Troop Comforts Ltd	400	1,800	22	15 (est.)	260-300	180-220
16	Yantra India Ltd	1,200	4,000	30	60 (est.)	260-300	180-220

Productivity Metrices of all 16 DPSUs
India's DPSUs (DPSUs) form the backbone of the country's defence manufacturing ecosystem. As of FY 2023-24, sixteen DPSUs operate across aerospace, shipbuilding, armaments, and specialised equipment domains. Table:1 below presents a comparative analysis of their productivity using four key indicators: revenue, manpower, net profit, and per capita productivity [74]. Global benchmarks from Israel and South Korea are included to contextualise performance. Compared to global benchmarks, most Indian DPSUs fall short of the per capita productivity levels seen in Israel and South Korea, underscoring the need for workforce rationalisation, automation, and export-oriented innovation.

Export Performance
DPSU exports rose to ₹8,389 crore in FY 2024-25, marking a 42.85% increase over the previous year [75]. This growth reflects improved global acceptance of Indian defence products, including artillery systems, protective gear, optoelectronics, and specialised munitions. MIL accounted for ₹3,081 crore of this export value, while AWEIL and GIL secured new orders in Southeast Asia and Africa [76]. The export surge is supported by streamlined licensing, targeted marketing, and enhanced product certification standards.

Performance of OFB Successor Entities
The seven corporatised DPSUs, MIL, AVNL, AWEIL, IOL, YIL, TCL, and GIL have demonstrated operational viability and financial resilience. Within their first six months (Oct 2021-Mar 2022), six entities reported provisional profits, with cumulative turnover exceeding ₹8,400 crore. By FY 2024-25, MIL, AWEIL, and AVNL have emerged as revenue leaders, while GIL and TCL have shown early profitability and niche export traction. Collectively, these entities secured domestic contracts worth over ₹3,000 crore and export orders exceeding ₹600 crore in their initial phase, validating the corporatisation model [77]. The newly corporatised DPSUs however, exhibit lower productivity, likely due to transitional inefficiencies and legacy staffing structures.

Technology Absorption and High-Tech Indigenisation
DPSUs continue to manufacture advanced platforms such as the LCA Tejas, ALH Dhruv, and BrahMos missiles, with increasing indigenous content [78]. The T-90 tank now incorporates 74% indigenous components, while the Sukhoi-30 MKI aircraft has reached 58% indigenisation. Indigenous systems like Akash and Pinaka have matured into production-ready platforms, with DPSUs leading their integration and deployment [79]. These achievements reflect successful absorption of transferred technologies and incremental domestic innovation. However, despite manufacturing many advanced military systems like Sukhoi-30 or T-90 tanks locally under licensed production arrangements, DPSUs have been able to create adequate competence to produce similar products through R&D.

Continued Reliance on Foreign OEMs
Despite progress, DPSUs remain reliant on foreign OEMs for critical technologies, especially in aero-engines, advanced sensors, and electronic warfare systems [80]. The DAP-2020's "Make-III" category institutionalises this reliance by permitting manufacturing under Technology Transfer (ToT) arrangements, with a mandated minimum of 60% indigenous content [81]. This framework enables capability building but also underscores persistent technological gaps that require strategic foreign partnerships and co-development models.

Private Sector: A Growing Force
The Indian private sector is rapidly emerging as a critical and dynamic force in the defence manufacturing landscape, moving beyond its traditional role as a mere feeder to public sector undertakings. The private sector contributed 21% to total defence production in FY 2023-24. In FY 2024-25, private firms accounted for ₹15,233 crore of defence exports, surpassing the DPSUs' contribution [82]. This strong performance demonstrates that private firms are not merely filling gaps but are leading innovation and becoming critical partners in modern warfare. Companies such as Tata Advanced Systems (TAS), Alpha Design Technologies (ADTL), Paras Defence & Space Technologies, ideaForge, and Larsen & Toubro (L&T) are now pivotal partners in delivering cutting-edge systems [83]. A brief write up on major defence producers including MSMEs, is given below.

Leading Private Defence Companies in India
Ashok Leyland Defence (Hinduja Group) manufactures logistics vehicles, light tactical platforms, and power systems. In FY 2024-25, its parent company reported consolidated revenue of ₹38,753 crore, with defence contributing an estimated ₹1,200 crore [84]. Exports rose by 29% to 15,255 units. The division employs over 1,000 personnel and has offset contracts with the Indian Army. FDI has been routed via Switch Mobility, and the company maintains partnerships with foreign OEMs for electric propulsion.
Bharat Forge Defence (Kalyani Group) produces artillery systems, armoured platforms, and aerospace components. FY 2024-25 consolidated revenue stood at ₹14,800 crore, with defence contributing ~₹1,200 crore [85]. It has offset-linked export orders and JVs with Rafael (Israel) and Paramount Group (South Africa). Over 2,000 personnel are employed in its defence vertical, with FDI received via JV structures.
L&T Defence manufactures naval platforms, missile launchers, and land systems. Defence revenue in FY 2024-25 was ₹5,200 crore [86]. Exports stood at ₹1,050 crore, with offset contracts linked to BrahMos and Pinaka. It employs over 4,000 personnel and has partnerships with MBDA (France), though no direct FDI is reported.
TASL focuses on aerospace structures, UAVs, radars, and missile subsystems. FY 2024-25 revenue crossed ₹4,500 crore, with exports exceeding ₹1,200 crore [87]. It has offset contracts and JVs with Boeing, Airbus, and Sikorsky. TASL employs over 3,500 personnel and has received FDI via equity partnerships.
Solar Industries manufactures military-grade explosives, rockets, UAVs, and energetic materials. FY 2024-25 revenue reached ₹8,700 crore, with net profit of ₹1,290 crore [88]. Defence orders exceeded ₹6,000 crore, and exports accounted for 40% of total revenue. The company employs approx. 3000 personnel and has offset contracts for PINAKA MLRS. It signed MoUs with the Maharashtra government for UAV and drone manufacturing, with FDI routed through strategic expansion plans.
Mahindra Defence Systems produces armoured vehicles, naval systems, and surveillance platforms. FY 2024-25

revenue was ₹1,100 crore, with net profit of ₹95 crore [89]. It has offset contracts with the Indian Army and exports to Africa and Latin America. It employs around 1,200 personnel and has a JV with BAE Systems, with FDI routed through the JV.

Astra Microwave manufactures RF and microwave subsystems for radars and EW systems. FY 2024-25 revenue was ₹1,050 crore, with net profit of ₹112 crore [90]. Defence exports contributed ₹90 crore. It has offset contracts with DRDO and ISRO and employs around 1,100 personnel. No equity JV or FDI reported.

Alpha Design focuses on avionics, simulators, and satellite subsystems. FY 2024-25 revenue was ₹480 crore, with net profit of ₹42 crore [91]. It has offset contracts with DRDO and exports to Israel and Southeast Asia. It employs approx. 1,000 personnel and has a JV with Elbit Systems involving equity infusion.

Data Patterns designs electronic systems for radars, avionics, and missile guidance. FY 2024-25 revenue was ₹470 crore, with net profit of ₹92 crore [92]. Exports stood at ₹38 crore. It has offset contracts with DRDO and ISRO and employs around 600 personnel. No JV or FDI reported.

Paras Defence manufactures electro-optics, space payloads, and defence electronics. FY 2024-25 revenue was ₹112.35 crore, with net profit of ₹19.72 crore [93]. Exports stood at ₹18 crore. It has offset contracts with HAL and BEL and employs over 400 personnel. No direct FDI reported.

Ideaforge manufactures tactical drones for surveillance and reconnaissance. FY 2024-25 revenue was ₹210 crore, with net profit of ₹38 crore [94]. Exports contributed ₹28 crore. It has offset contracts with the Indian Army and DRDO. It employs over 350 personnel and has received FDI from Qualcomm Ventures and Infosys Innovation Fund.

Challenges Faced by Leading Private Defence Companies

Private defence companies, though better capitalised than MSMEs, face their own set of structural challenges.

Procurement delays and contract uncertainty remain widespread, with long gestation periods between tender issuance and award. This includes delays in post-contract payments, which strain industry cash flows. The Defence Ministry is working to simplify the acquisition process, aiming to reduce the 5-7-year timeline to six months [95]. For instance, Tata Advanced Systems Ltd (TASL), despite being a strategic partner in the C-295 aircraft programme, experienced delays due to inter-ministerial coordination and certification bottlenecks [96]. Bharat Forge Defence faced similar delays in the ATAGS artillery programme, with trials and procurement decisions stretching over multiple years [97].

Access to strategic programs remains limited, as DPSUs continue to dominate high-value contracts. In FY 2024-25, out of 193 defence contracts worth ₹2,09,050 crore, only a fraction was awarded to private firms, with 177 contracts (₹1,68,922 crore) going to domestic industry, largely to DPSUs [98].

Technology transfer and FDI inflows remain modest despite policy allowances of up to 74% under the automatic route. Alpha Design Technologies, in JV with Elbit Systems, faced delays in technology approvals, while Adani Defence Systems & Technologies Ltd struggled to secure core technology access due to IPR concerns and volume assurance gaps [99].

Infrastructure and testing constraints also persist; ideaForge Technology Ltd had to rely on DRDO and Army field trials for UAV validation, while Paras Defence & Space Technologies Ltd faced limited access to ISRO facilities for space payload testing [100].

Talent acquisition is another bottleneck Reliance Naval and Engineering Ltd experienced attrition of skilled shipbuilding engineers post-restructuring, while HBL Engineering Ltd had to invest heavily in in-house training to overcome shortages in defence-grade electronics talent [101].

Finally, capital intensity and investor risk aversion continue to deter private entry into high-tech domains; Adani Aero Defence Systems & Technologies Ltd reported losses in FY 2024-25 due to high R&D expenditure and delayed revenue realisation, while Punj Lloyd exited defence manufacturing altogether due to unsustainable exposure and lack of repeat orders [102].

While offsets aim to facilitate technology transfer, foreign technology purchase terms can be restrictive, leading to limited active absorption and continued dependence on foreign collaborators. Issues around IPR and buy-out restrictions also concern private equity investors.

Fluctuations in exchange rates can make Indian industry uncompetitive, especially given the need to import raw materials and components for aerospace and other high-tech defence manufacturing.

MSMEs in Defence Industry of India

India's ambition to achieve strategic autonomy in defence manufacturing is inseparable from the development of a robust and inclusive industrial ecosystem. Central to this vision is the integration of MSMEs, which serve as critical Tier-2 and Tier-3 suppliers to both Indian defence primes and global Original Equipment Manufacturers (OEMs). MSMEs are recognised for their agility, cost-effective precision engineering, and ability to deliver customised components across aerospace, land systems, and naval platforms.

As of February 2025, over 16,000 MSMEs were formally engaged in defence production, contributing to indigenous capability development and supply chain resilience [103]. The MoD, through its Innovations for Defence Excellence (iDEX) initiative, has cleared procurement of 43 items worth ₹2,400 crore from MSMEs and startups, reflecting a growing institutional commitment to decentralised innovation [104]. Furthermore, 25% of the defence procurement budget earmarked for private industry is intended to benefit MSMEs directly, ensuring their sustained participation in capital acquisition programmes [105].

Challenges Faced by MSMEs in Defence Industry

Despite these policy advances, MSMEs face persistent challenges that inhibit their scalability and competitiveness. Financial constraints remain a primary concern, with high working capital requirements and limited access to low-cost credit [106].

High working capital requirements and limited access to easy, low-cost finance are significant challenges. While various schemes exist, their operationalisation can be difficult [107].

Many MSMEs have difficulties not only in terms of finances but primarily incorporating advanced production technologies like CNC machines or IoT-based systems.

Since all the projects undertaken in the sector are for specific targets with close compliance to international standards.

While PILs are designed to protect domestic industry, they place a significant burden on the private sector, especially MSMEs, to rapidly develop capabilities for the listed items. This requires substantial R&D investment and capacity building, often with uncertain long-term order books, making it a high-risk proposition for private firms. Balancing local sourcing compliance with maintaining global quality standards is also a challenge.

While schemes such as CGTMSE and SIDBI's defence-linked credit lines exist, procedural complexity and risk-averse lending norms restrict their operationalisation.

Order visibility is another major hurdle; MSMEs often lack clarity on future procurement cycles and face uncertainty regarding repeat business, discouraging long-term investment and innovation [108].

Procurement process complexities including delays in customer schedules, raw material bottlenecks, and extended lead times for product approvals are compounded by the "L1" pricing policy, which forces firms into unsustainable cost structures [109].

MSMEs also face stiff competition from larger players, including DPSUs which benefit from legacy contracts and preferential access to infrastructure and R&D funds [110].

Bureaucratic hurdles such as inconsistent tendering norms, opaque evaluation criteria, and limited access to government e-marketplaces (GeM) further restrict MSME participation in high-value contracts [111].

While many MSMEs are adopting AI, IoT, and digital twins for design and supply chain optimisation, scaling these innovations requires targeted funding and policy standardisation [112].

MSMEs also have to deal with inadequate supply of skilled labour shortages, particularly in Tier-2 and Tier-3 cities, which continue to affect quality assurance and delivery timelines as well as higher expenditure on training labour repeatedly [113].

Together, these challenges underscore the need for a more enabling policy environment, one that balances procurement transparency, credit facilitation, and skill development with targeted support for innovation, exports, and MSME integration. A healthy defence manufacturing ecosystem is not merely a policy aspiration; it is a strategic imperative given the complex security situation.

Performance Evaluation of Private Defence Companies (Including MSMEs)

The private sector's contribution to India's defence manufacturing ecosystem has grown significantly, particularly in high-technology domains. This transformation is most visible in the following areas:

Leading private firms such as L&T Defence, TATA Advanced Systems, Bharat Forge, and Adani Defence have secured contracts for the production of critical components for fighter aircraft, missile systems, and unmanned aerial vehicles (UAVs) [114]. These firms are increasingly involved in the design and integration of next-generation platforms, including submarines and helicopters, under the Strategic Partnership and Make-II frameworks.

The private sector has played a pivotal role in indigenising complex systems, including hypersonic weapon technologies, cybersecurity solutions, and marine-grade steel for naval platforms. Collaborations such as the MoU between Jindal Steel & Power and the Indian Coast Guard exemplify the sector's contribution to enhancing indigenous content in shipbuilding.

Private enterprises accounted for ₹15,233 crore of India's total defence exports in FY 2024-25, surpassing DPSUs (DPSUs) in export value [115]. India now exports defence equipment to over 100 countries, with private firms leading the charge in supplying bulletproof jackets, interceptor boats, and lightweight torpedoes.

Through initiatives like iDEX (Innovations for Defence Excellence), private firms especially MSMEs and start-ups have emerged as key drivers of innovation. These entities are developing niche technologies in artificial intelligence, robotics, and space-based surveillance, contributing to the strategic autonomy of India's armed forces [116].

The establishment of Defence Industrial Corridors in Uttar Pradesh and Tamil Nadu has catalysed private investment in high-tech manufacturing clusters. These corridors offer integrated infrastructure, policy support, and access to testing facilities, enabling private firms to scale production and collaborate with global OEMs.

A comparison of productivity levels (given at Table-1 and Table-2 below) reveals a nuanced picture, which shows that most private sector companies lag DPSUs (except newly minted OFB Avatars). While DPSUs benefit from legacy infrastructure, assured order flows, and institutional support, most private firms struggle to match productivity benchmarks. This disparity is not necessarily due to inefficiency but is often rooted in structural constraints such as irregular procurement cycles, limited export assurances, and lack of predictable demand. A few of the reasons are enumerated below, addressing them through transparent procurement pipelines, streamlined export mechanisms, and infrastructure parity could significantly enhance private sector performance in defence manufacturing: -

Private sector firms frequently cite the absence of long-term procurement visibility and delayed contract finalizations as key impediments to capacity utilization and productivity. In contrast, DPSUs operate under budgetary allocations and long-term purchase arrangements, allowing them to plan production cycles with greater certainty [117].

Moreover, export licensing remains a bottleneck for private firms. Although India issued 1,762 defence export authorizations in FY 2024-25, private sector firms still face delays in clearances for sensitive or dual-use technologies, which directly affects their ability to scale operations.

The Strategic Partnership Model introduced by the MoD aims to position private firms as system integrators. However, uptake remains uneven due to ecosystem gaps, including limited access to testing infrastructure and certification facilities [118]. While DPSUs benefit from embedded supply chains and captive MSMEs must invest heavily in R&D and compliance without guaranteed returns.

Despite growing indigenous capabilities, both testing ranges, private firms, especially DPSUs and private firms continue to rely on foreign OEMs for advanced technology transfer, particularly for complex systems and critical components like aero-engines, advanced sensors, and certain high-end electronics. While policies like offsets aim to facilitate technology transfer and investment, the actual absorption and mastery

Table 2: Performance Metrics of Private Defence Firms

Ser	Company Name	Defence Revenue (₹ Cr)	Manpower (Approx)	Productivity per Employee (₹ Lakh)	Segment Focus
1	Solar Industries India Ltd	6,070	4,000	152	Ammunition & Explosives
2	Bharat Forge Defence (Kalyani) @	1,772	1,200	148	Artillery, armoured systems, aerospace components
3	Astra Microwave Products Ltd	1,368	1,000	137	RF/Microwave Systems for Defence & Space
4	Adani Defence (AEL Subsidiary) @	1,200	1,000	120	UAVs, small arms, radars, cyber & AI systems
5	ideaForge Technology Ltd	314	296	106	UAVs & Surveillance Systems
6	Tata Advanced Systems Ltd (TASL) @	3,000	3,500	86	Aerospace, UAVs, radars, homeland security
7	Alpha Design Technologies @	549	641	86	Defence electronics, avionics, satellite systems
8	Mahindra Defence Systems @	642	800	80	Armoured vehicles, border security, comms
9	L&T Defence @	5,000	7,000	71	Naval platforms, missiles, artillery, electronics
10	Data Patterns (India) Ltd	566	1,345	42	Radars, EW, Avionics, Defence Electronics
11	Paras Defence & Space Tech Ltd	291	1,100	26	Electro-optics, Defence R&D

of these technologies for independent design and innovation remain a challenge. Many imported systems remain "black-box" technologies, limiting India's ability to modify, upgrade, or fully understand their underlying mechanisms without foreign support. These dynamic underscores the ongoing need for strategic partnerships that ensure genuine intellectual property sharing rather than mere licensed production.

Defence Manufacturing Infrastructure and Funding Mechanisms

Defence Industrial Corridors

India's Defence Industrial Corridors (DICs), located in Uttar Pradesh and Tamil Nadu, represent a strategic intervention aimed at transforming the country's defence manufacturing landscape. Conceived under the Atmanirbhar Bharat initiative, these corridors are designed to consolidate industrial capacity, attract investment, and embed domestic firms into global supply chains. The Uttar Pradesh Defence Industrial Corridor (UPDIC) comprises six nodes, i.e. Lucknow, Kanpur, Jhansi, Aligarh, Agra, and Chitrakoot, administered by UPEIDA, while the Tamil Nadu Defence Industrial Corridor (TNDIC) includes Chennai, Coimbatore, Hosur, Salem, and Tiruchirappalli, coordinated by TIDCO and the Guidance Bureau. Both corridors are strategically aligned with multimodal logistics networks, including expressways, dry ports, and Dedicated Freight Corridors (DFCs), with UPDIC linked to the Eastern DFC and TNDIC benefiting from proximity to the Western DFC and major seaports [119].

The policy ecosystem underpinning the corridors is anchored in the DAP-2020, which prioritises domestic sourcing and offers higher offset multipliers of up to 2.0 for corridor-based production. The MoD has notified five Positive Indigenisation Lists, collectively embargoing over 5,000 items from import. As of mid-2025, more than 3,000 items have been successfully indigenised, many through corridor-based firms [120]. In parallel, the liberalisation of FDI norms by allowing up to 74% under the automatic route and 100% under government approval has facilitated the entry of foreign OEMs via joint ventures and wholly owned subsidiaries. State-level single-window clearance systems such as Nivesh Mitra (UPDIC) and the TN Guidance Portal (TNDIC) further streamline land allotment, licensing, and environmental approvals.

As of FY 2024-25, the two corridors have collectively attracted ₹8,658 crore in realised investment, with over 250 MoUs signed with a projected investment potential exceeding ₹53,000 crore. Key industrial participants include BrahMos Aerospace in Lucknow (missile subassemblies), Adani Defence Systems in Kanpur (ammunition manufacturing), Tonbo Imaging in Chennai (thermal sights and surveillance systems), and Alpha Design Technologies in Coimbatore (avionics and electronic warfare modules). These firms benefit from corridor-specific testing infrastructure under the Defence Testing Infrastructure Scheme (DTIS), which provides up to 75% grant-in-aid for greenfield facilities [121]. Preferential procurement under DAP 2020's Buy Indian-IDDM category further incentivises corridor-based production. India's defence exports reached ₹23,622 crore in FY 2024-25, with corridor-based firms contributing significantly in missile systems, drones, and electronic warfare technologies. Export facilitation is supported by the Online Defence Export Clearance Portal (ODECP), which processed over 1,700 authorisations in the same fiscal year. Corridor firms also fulfil offset obligations through export-oriented production, aligning with foreign OEM requirements under DAP 2020 [122]. Bonded warehousing and customs support in TNDIC nodes enable efficient export processing, while certification compliance with Wassenaar Arrangement and MTCR norms ensures global market access. The corridors have generated over 50,000 direct and indirect jobs, with node-level employment ranging from 2,000 to 3,000 per site. MSMEs are integrated through anchor contracts linked to indigenisation mandates, supplying previously imported components such as hydraulic actuators, servo valves, and drone payloads [123]. Corridor-based firms are also eligible for Production Linked Incentives (PLI) for defence electronics and drone components [124], as well as grants under the iDEX and ADITI schemes. The ADITI scheme, launched in 2024, offers up to ₹25 crore for deep-tech defence innovation. Skill development subsidies under state industrial policies further support workforce readiness.

India's Defence Industrial Corridors represent a strategic convergence of infrastructure, policy, and industrial capability. By aligning indigenisation mandates with export facilitation and MSME integration, the corridors are not only reducing import dependency but also embedding Indian firms into global defence value chains. Their continued success will depend on sustained investment, regulatory agility, and deeper linkages with academic and R&D institutions.

Investment Capital

The availability of capital is a crucial determinant for the growth of the Indian defence manufacturing sector. It is covered as Domestic and Foreign Capital in subsequent paras.

Domestic Capital

While the government has increased budgetary allocations for defence, a significant portion is consumed by personnel costs (salaries and pensions), leaving a limited share for modernisation and capital acquisitions. In FY 2025-26, out of a proposed ₹6.81 trillion defence budget, ₹1.80 trillion is earmarked for modernisation and procurement. This allocation structure raises concerns about the adequacy of funds for capital outlay needed to counter strategic challenges effectively [125]. The government has increased funding for prototype development under Make-I projects, and schemes like TDF and iDEX provide grants to startups and MSMEs. However, the high cost of capital in India, particularly for MSMEs, remains a barrier to investment by private sector.

Innovations for Defence Excellence (iDEX)

Launched in April 2018, serves as a crucial platform to foster innovation and technology development in the defence and aerospace sectors. It achieves this by engaging industries (including MSMEs), startups, individual innovators, R&D institutes, and academia, providing them with grants and support. Under iDEX, grants ranging from ₹1.5 crore to ₹10 crore are disbursed to support prototype development and field-ready technologies, often linked to specific problem statements issued by the Services. For the fiscal year 2025-26, ₹449.62 crore has been allocated to iDEX, including its sub-scheme ADITI (Acing Development of Innovative Technologies with iDEX). As of February 2025, 43 items worth over ₹2,400 crore from iDEX-supported startups and MSMEs have been cleared for procurement by the Armed Forces [126].

Technology Development Fund (TDF)

Executed by DRDO, provides financial support and expertise to industries, particularly startups and MSMEs, for R&D in defence technologies [127]. The funding limit was recently increased to ₹50 crore per project, offering up to 90% of the total project cost as a grant [128]. As of December 2024, 80 projects worth approx. ₹335 crore had been sanctioned under TDF [129].

Foreign Capital (FDI)

India has made significant reforms to its FDI policy in the defence sector to attract foreign capital and facilitate technology transfer. In May 2001, the defence industry was opened to 100% Indian private sector participation, with FDI initially capped at 26%. This limit was subsequently revised, allowing up to 49% FDI under the automatic route and beyond 49% through the government route, especially where it leads to access to modern technology. More recently, the FDI limit was further enhanced to 74% through the automatic route for companies seeking new industrial licenses, with 100% allowed via the government route for modern technology access.

The government's investor-friendly policy has resulted in over 90% of FDI inflow occurring via the automatic route across most sectors. Overall, India has attracted $1 trillion in cumulative FDI since April 2000, with $81.04 billion in FY 2024-25, a 14% increase from the previous year. However, some analyses indicate that net FDI inflows have significantly declined due to increased repatriation and outward FDI by Indian companies. This suggests that while gross FDI inflows remain robust, the long-term commitment of foreign investors may be a concern, with a growing share of financial flows potentially seeking short-term gains rather than long-term production.

Since April 2000, till mid-2025, cumulative FDI inflows into India's defence and aerospace sector have crossed ₹6,800 crore, reflecting a modest but steady rise in investor engagement. Despite this upward trend, the sector's share remains marginal compared to India's overall FDI inflow of USD 81.04 billion in FY 2024-25, suggesting that structural hurdles such as complex licensing, export restrictions, and limited visibility into long-term procurement pipelines, which continue to temper investor confidence [130]. Nevertheless, the emergence of wholly owned foreign subsidiaries such as SAAB FFVO India and increased joint ventures in missile systems, avionics, and MRO services indicate a gradual shift towards deeper capital and technology integration.

Historically, India's defence industry was heavily centralised and state-dominated. The creation of DICs provides dedicated physical infrastructure and regional incentives, moving beyond abstract policy pronouncements. The establishment of DICs and the implementation of specific funding mechanisms like TDF and iDEX and policies encouraging FDI for getting desired capital with better technology, signify a strategic shift from a purely procurement-driven approach to a more holistic ecosystem development strategy, aiming to nurture a robust domestic defence industrial base from the ground up. These attempt to address the critical R&D and funding gaps faced by smaller private players and startups. This multi-pronged strategy indicates a recognition that sustainable indigenous growth requires not just demand-side policies (procurement preferences) but also robust supply-side nurturing, including physical infrastructure, R&D support, and financial incentives for new entrants. This reflects a long-term, systemic approach to building self-reliance.

Conclusions and Recommendations

The Indian defence manufacturing landscape is at a critical juncture, marked by a determined push towards self-reliance and a gradual, yet significant, shift from a state-dominated, import-heavy model to a more diversified, indigenous ecosystem. Policy reforms, particularly DAP 2020 and the Positive Indigenisation Lists, have laid a strong foundation for this transformation, fostering domestic production and encouraging private sector participation. The corporatisation of the OFB and the growth of private players, including MSMEs, are tangible indicators of progress.

However, significant challenges persist. Deep-seated bureaucratic inefficiencies continue to impede timely procurement and project execution. While funding for R&D has increased, it remains inadequate compared to global leaders, and the fear of failure in R&D stifles innovation. The reliance on foreign OEMs for critical technologies and complex system upgrades highlights persistent capability gaps, necessitating more effective technology absorption mechanisms. The private sector, despite its growing capabilities and value addition, faces hurdles related to long-term order visibility, access to capital, and equitable competition with state-owned entities. To fully realise the vision of "Atma Nirbhar Bharat" in defence and establish India as a global defence manufacturing hub, the following recommendations are crucial:

The ongoing efforts to streamline DAP 2020 must go beyond incremental changes. This requires a fundamental overhaul of the procurement bureaucracy, centralising decision-making, establishing a dedicated cadre of acquisition professionals, and significantly reducing approval points and timelines. Lessons from successful emergency procurement mechanisms should be institutionalised for routine processes where applicable.

The national R&D budget, particularly for defence, needs a significant boost as a percentage of GDP. A dedicated, substantial fund for private sector-led R&D, de-risked by government co-funding and clear procurement guarantees for successful prototypes, is essential. This should include mechanisms that embrace the inherent risk of R&D without punitive audits for unsuccessful projects, mirroring successful international models. India needs to urgently incentivize private R&D expenditure in defence through measures like tax rebates/ PLI kind of incentives and corelate the same with patents secured.

Reform Pillar	Strategic Action
Mission-Driven Structure	Create thematic directorates with short-term mandates and external program managers
High-Risk Funding	Allocate 10-15% of budget to exploratory R&D via a Defence R&D Investment Board
User Integration	Embed Services officers, mandate joint trials, and institutionalise review boards
Global Collaboration	Launch diaspora-led missions and joint labs with IITs, IISc, and foreign universities
Commercialisation	Establish a DRDO commercial arm for IP monetisation and startup incubation
Talent Reform	Introduce lateral entry, performance-linked incentives, and global fellowships

Undertake meaningful reforms in DRDO ecosystem to increase accountability, responsibilities and motivation amongst scientists. Integrate a few related labs of DRDO with concerned DPSUs to ensure alignment with the capabilities and drive the innovation with profit motive by a single management. To emulate the agility of DARPA and the scale of Chinese R&D, the following reforms are proposed:Foster a true "triple helix" model where academic research is seamlessly integrated with DRDO's strategic objectives and industry's production capabilities. This involves not just funding academic projects but ensuring clear pathways for technology transfer, joint development, and commercialisation, with shared intellectual property frameworks.

Provide long-term procurement visibility and clear order pipelines to incentivise private investment in manufacturing and R&D. Implement performance-based contracting models that reward quality and innovation over lowest price (L1) in strategic areas. Ensure equitable access to testing infrastructure and streamline certification processes for private players.

While foreign collaborations are necessary, future agreements should prioritise comprehensive technology transfer, including design know-how and critical manufacturing processes, to enable true indigenous capability development and reduce "black-box" dependencies. Incentivise foreign OEMs to invest in India-based R&D and co-development rather than just licensed assembly. India needs to discourage licensed production, without technology transfer and encourage forging of equity partnerships, with transfer of technology. This could come with guarantees for exports, enabling foreign OEMs to convert Indian Subsidiaries as their offshore manufacturing hubs with immense cost advantages akin to Suzuki or Apple.

Continue and expand financial incentives, technical assistance, and mentorship programs for MSMEs. Address their specific challenges related to working capital, raw material access, and skilled labour. Mandate greater integration of MSMEs into the supply chains of DPSUs and large private players, ensuring timely payments and fair contractual terms.

Rebalance the defence budget to allocate a larger proportion towards capital outlay and modernisation, ensuring that manpower costs do not disproportionately constrain technological advancement. Explore innovative financing mechanisms and private equity investment models tailored to the unique characteristics of the defence sector.

Encourage all DPSUs/ private defence players towards dual use products so as to expand the market. IdeaForge is thriving by selling drones to non-governmental customers. Similarly, Troops Comforts Ltd. should make clothing items for trekking/ adventure activities and aggressively market them aggressively or Gliders Ltd. should sell para gliders etc. HAL should also focus on civil trainers/ small civil aircrafts as expanded market will push for economies of scale/ better productivity and better innovation.

Explore the feasibility of large stake sales of major DPSUs like Hal, BEML, BHEL etc.to Indian strategic investors (large private defence companies). Thereafter, India can also allow foreign stake holding in divested DPSUs in lieu of critical technology. Government may also consider early market listing all seven ex OFB DPSUs and opt for divesting strategic shareholding to enhance the productivity.

Initiate measures to improve the overall productivity of both DPSUs and private defence companies by simplifying procurement process and giving better visibility of orders to all concerned.

- Level the operating field for all companies operating in the country by allowing equal opportunities to private or public companies.
- Remove anomaly of higher multiplier Offsets to DPSU/DRDO as critical tech could be received by any firm- private or public. Government may also consider making rules for prioritising offsets for private companies by assigning higher multipliers for private companies. MSMEs

could be placed even higher for multipliers as is being done currently.

Even the foreign owned but geographically located foreign firms like SAAB Factory in Jhajjar could be treated as Indian firms for bidding purposes, which will greatly incentivize relocation of major foreign OEMs.

India's defence manufacturing sector stands at a pivotal inflection point, transitioning from a legacy of import dependence and state dominance to a more competitive, innovation-driven, and self-reliant ecosystem. The policy architecture, anchored by DAP 2020, the Positive Indigenisation Lists, and the corporatisation of the OFB, has laid the groundwork for this transformation. However, the journey towards true strategic autonomy demands more than incremental reforms. It requires a systemic overhaul of procurement processes, a recalibration of R&D funding priorities, and a reimagining of institutional roles across DRDO, DPSUs, and private industry. The persistent asymmetries in order flow, infrastructure access, and export facilitation must be addressed to unlock the full potential of private sector and MSME participation and improving the productivity levels across the industry.

The recommendations advanced in this chapter underscore the need for bold, coordinated action across multiple fronts: procurement reform, fiscal incentives for innovation, DRDO restructuring, and equitable market access. Embracing a "triple helix" model of academia-industry-government collaboration, incentivising dual-use product development, and enabling strategic equity partnerships with foreign OEMs are not just desirable but are essential. If implemented with urgency and coherence, these measures can position India not only as a regional defence powerhouse but as a globally competitive manufacturing hub for defence goods. The vision of Atma Nirbhar Bharat in defence will be realised not through protectionism, but through productivity, innovation, and institutional agility. By systematically addressing these critical areas, India can accelerate its journey towards becoming a self-reliant defence power, capable of meeting its security needs indigenously and emerging as a significant global exporter of advanced defence technologies.

References

1. A new era of transformation for India's defence sector [Internet]. Mint. Available from: https://www.livemint.com/focus/a-new-era-of-transformation-for-india-s-defence-sector-11744013448643.html
2. Defence Production Marching Towards Self-Reliance [Internet]. Press Information Bureau. Available from: https://www.pib.gov.in/PressReleasePage.aspx?PRID=1497914
3. Defence Production Marching Towards Self-Reliance [Internet]. Press Information Bureau. Available from: https://www.pib.gov.in/PressReleasePage.aspx?PRID=1497914
4. Defence industry of India [Internet]. Wikipedia. Available from: https://en.wikipedia.org/wiki/Defence_industry_of_India
5. SIPRI. Trends in International Arms Transfers-2023 [Internet]. 2024 Mar [cited 2025 Oct 16]. Available from: https://www.sipri.org/sites/default/files/2024-03/fs_2403_at_2023.pdf
6. Economic Times. India Remains World's Largest Arms Importer, Russia Its Top Supplier [Internet]. 2024 Mar 12 [cited 2025 Oct 16]. Available from: https://economictimes.indiatimes.com/news/defence/india-remains-worlds-top-arms-importer-sipri-report/articleshow/108399377.cms
7. Defence Reforms and National Security: 2025 - The Year of Transformation [Internet]. Available from: https://www.lifeofsoldiers.com/2025/02/25/defence-reforms-and-national-security-2025-the-year-of-transformation/
8. Ministry of Defence (MoD). Defence Acquisition Procedure 2020 (DAP 2020) [Internet]. Available from: https://mod.gov.in/sites/default/files/DAP%202020%20%2011%20Nov%2021_0.pdf
9. Defence Acquisition Procedure 2020: Imperatives for Further Reforms [Internet]. Observer Research Foundation. Available from: https://www.orfonline.org/public/uploads/posts/pdf/20230525222943.pdf
10. Global Innovation Index 2024. GII 2024 results [Internet]. Available from: https://www.wipo.int/web-publications/global-innovation-index-2024/en/gii-2024-results.html
11. Saraswat V, *et al*. Improving the Culture of Research and Development (R&D) in State Universities and Institutes [Internet]. NITI Aayog; 2024. Available from: https://www.niti.gov.in/sites/default/files/2024-06/StateUniRnD_FinalReport-Designedv3%20%281%29.pdf
12. Indian Defence Budget 2025: A Strategic Push or a Status Quo? PART 4 [Internet]. SAMDeS India. Available from: https://www.samdesindia.in/blog/indian-defence-budget-2025-a-strategic-push-or-a-status-quo-part-4/
13. Walia A. Urgent need to reimagine India's R&D strategy: NITI Aayog paper draws lessons from China [Internet]. The Indian Express; 2025 Apr 7. Available from: https://indianexpress.com/article/business/business-others/urgent-need-to-reimagine-indias-rd-strategy-niti-aayog-paper-draws-lessons-from-china-8211375/
14. Co-operative Research Between Academia, Industry And Defence: A Paradigm Shift [Internet]. Times Now News. Available from: https://www.timesnownews.com/opinion/co-operative-research-between-academia-industry-and-defence-a-paradigm-shift-article-117861049
15. NITI Aayog. Improving the Culture of R&D in State Universities and Institutes [Internet]. New Delhi: Government of India; 2024. Available from: https://www.niti.gov.in/sites/default/files/2024-06/StateUniRnD_FinalReport-Designedv3%20%281%29.pdf
16. Department of Scientific and Industrial Research (DSIR). Industrial R&D Promotion Programme (IRDPP) [Internet]. Ministry of Science and Technology, Government of India. Available from: https://www.dsir.gov.in/industrial-rd-promotion-programme-irdpp
17. Ministry of Civil Aviation. PLI Scheme for Drones and Drone Components [Internet]. PIB; 2022. Available from: https://pib.gov.in/PressReleasePage.aspx?PRID=1793826

18. Outlook Business. Defence Start-Ups Expect Increased R&D Funds, PLI Expansion in Upcoming Budget [Internet]. 2025. Available from: https://www.outlookbusiness.com/budget/defence-start-ups-expect-increased-rd-funds-pli-expansion-in-upcoming-budget
19. Office of the Controller General of Patents, Designs and Trade Marks. Annual Report 2023-24 [Internet]. Ministry of Commerce and Industry, Government of India; 2024. Available from: https://ipindia.gov.in
20. About DRDO [Internet]. Defence Research and Development Organisation. Available from: https://www.drdo.gov.in/drdo/about-drdo
21. Defence Research and Development Organisation - DRDO, Ministry of Defence, Government of India [Internet]. Available from: https://www.drdo.gov.in/drdo/
22. To expand defence manufacturing base, DRDO transfers tech on 9 systems [Internet]. Times of India. Available from: https://timesofindia.indiatimes.com/india/to-expand-defence-manufacturing-base-drdo-transfers-tech-on-9-systems/articleshow/121713005.cms
23. To expand defence manufacturing base, DRDO transfers tech on 9 systems [Internet]. Times of India. Available from: https://timesofindia.indiatimes.com/india/to-expand-defence-manufacturing-base-drdo-transfers-tech-on-9-systems/articleshow/121713005.cms
24. Second list of Systems and Subsystems for Industry to Design, Develop and Manufacture [Internet]. Defence Research and Development Organisation. Available from: https://www.drdo.gov.in/drdo/sites/default/files/inline-files/SLoSaSfItDDaMP.pdf
25. DRDO Strategic Success, Conventional Laggard [Internet]. Security Risks Asia. Available from: https://www.security-risks.com/post/drdo-strategic-success-conventional-laggard
26. India Today. India's 15-Year Defence Plan Eyes AI, Hypersonics, and Next-Gen Warfare [Internet]. 2025 Sept 5. Available from: https://www.indiatoday.in/india/story/india-15-year-defence-plan-ai-hypersonic-next-generation-warfare-2782430-2025-09-05
27. DRDO, Industry Engagement Framework, Directorate of Futuristic Technology Management [Internet]. Available from: https://drdo.gov.in/drdo/headquarter-directorates/industry-engagement/directorate-futuristic-technology-management-dftm
28. Comptroller and Auditor General (CAG) of India. Performance Audit of DRDO Mission Mode Projects. Parliament of India; 2022 Dec.
29. DRDO. Guidelines for Transfer of Technology [Internet]. Ministry of Defence, Government of India. Available from: https://www.indiascienceandtechnology.gov.in/sites/default/files/file-uploads/guidelineregulations/1527507521_DRDO-guidelines-for-ToT.pdf
30. South Asia Times. India's Defence Procurement Woes: A System Stuck in Bureaucratic Quicksand [Internet]. 2025 Feb. Available from: https://southasiatimes.org/indias-defence-procurement-woes-a-system-stuck-in-bureaucratic-quicksand
31. IndBiz. Defence Modernisation Faces Hurdles Despite Progress in Self-Reliance [Internet]. 2025 Jan. Available from: https://indbiz.gov.in/defence-modernisation-faces-hurdles-despite-progress-in-self-reliance
32. Standing Committee on Defence. Review of the Working of DRDO [Internet]. PRS Legislative Research; 2023 Dec. Available from: https://prsindia.org/files/policy/policy_committee_reports/Report_Summary-DRDO.pdf
33. Bhushan G, Gopal M. DRDO and Expectations of Stakeholders. Defence Science Journal. 2019 Nov;69(6): [cited 2025 Oct 16]. Available from: https://publications.drdo.gov.in/ojs/index.php/dsj/article/download/12685/7176/47713
34. Vivekananda International Foundation. Challenges in Reforms of DRDO [Internet]. 2023 Oct 5. Available from: https://www.vifindia.org/article/2023/october/05/challenges-in-reforms-of-drdo
35. Comptroller and Auditor General of India. Report No. 36 of 2016 - Spares Management in Army Base Workshops [Internet]. 2016. Available from: https://cag.gov.in/uploads/download_audit_report/2016/Chapter_4_Spares_Management_Report_36_of_2016_Union_Government_Defence_PA.pdf
36. Indian Defence Budget 2025: A Strategic Push or a Status Quo? PART 4 [Internet]. SAMDeS India. Available from: https://www.samdesindia.in/blog/indian-defence-budget-2025-a-strategic-push-or-a-status-quo-part-4/
37. India must increase R&D spend to meet future defence challenges, says DRDO chief [Internet]. The Week. 2025 Apr 17. Available from: https://www.theweek.in/news/defence/2025/04/17/india-must-increase-r-d-spend-to-meet-future-defence-challenges-says-drdo-chief.html
38. Comptroller and Auditor General Report. Management and Outcome of Mission Mode Projects in DRDO. Parliament of India; 2022 Dec.
39. Bhargava Y. How DRDO Projects Overshot Budgets by up to 426% CAG Flags Serious Flaws in Cost Estimation [Internet]. ThePrint. 2022 Dec 30. Available from: https://theprint.in/india/how-drdo-projects-overshot-budgets-by-up-to-426-cag-flags-serious-flaws-in-cost-estimation/1288206/
40. Kaushik K. DRDO Projects Plagued by Delays and Performance Issues [Internet]. IMR Media. 2023 Jan 15. Available from: https://imrmedia.in/drdo-projects-plagued-by-delays-and-performance-issues/
41. News Digest on CAG Audit Reports. Indian Public Administration Institute; 2022 Dec 23 [cited 2025 Oct 16]. Available from: https://ipaiindia.org/wp-content/uploads/2023/02/News-Digest-on-23.12.2022.pdf
42. Defence Research and Development Organisation (DRDO). Scientists and Career Progression Framework. Ministry of Defence. DRDO Scientist Portal [Internet].
43. Defence Research and Development Organisation (DRDO). Technology Clusters Overview. Ministry of Defence, Government of India [Internet].
44. Indian Defence News. DRDO Unveils New Technology Transfer Policy [Internet]. 2025 Aug [cited 2025 Oct 16]. Available from: https://www.indiandefensenews.in/2025/08/drdo-unveils-new-technology-transfer.html

45. Press Information Bureau (PIB). PRIS in DRDO. Ministry of Defence; 2019 Jan [cited 2025 Oct 16]. Available from: https://www.pib.gov.in/newsite/PrintRelease.aspx?relid=187050
46. Defence Research and Development Organisation (DRDO). Startups and MSME Support Portal - Technology Development Fund Scheme [Internet].
47. Legitt Blog. Tracking Project Milestones in Real Time with AI Tools [Internet]. 2025 Feb [cited 2025 Oct 16]. Available from: https://legittai.com/blog/tracking-project-milestones-in-real-time
48. Press Information Bureau (PIB). DRDO's 67th Foundation Day. 2025 Jan [cited 2025 Oct 16]. Available from: https://pib.gov.in/PressReleasePage.aspx?PRID=2089584
49. Behera L. India's defence economy planning, budgeting, industry and procurement. pp. 90.
50. Bharat Electronics Limited (BEL). Financial results [Internet]. BEL Official Website. Available from: Newspaper-Publication-Financial-Results-for-the-quarter-and-year-ended-31st-March-2025.pdf (SECURED)
51. Bharat Dynamics Limited (BDL). Annual Report 2024-25 [Internet]. Available from: BDL official website.
52. PSU Watch. BEML reports record annual profit in FY25, charts expansion plans in key sectors. 2025 May 23 [cited 2025 Oct 16]. Available from: https://psuwatch.com/defencewatch/beml-reports-record-annual-profit-in-fy25-charts-expansion-plans-in-key-sectors
53. Midhani. Official Website. MDN_Outcome_BM_28052025.pdf [Internet].
54. Mazagon Dock Shipbuilders Limited (MDL). Investor Presentation_Q4 FY24-25 V8.pdf [Internet].
55. Goa Shipyard Limited (GSL). Annual Report 2024-25 English Language.pdf [Internet].
56. PSU Watch. HSL achieves positive net worth after 4 decades; poised for Mini Ratna status. 2025 Apr 2 [cited 2025 Oct 16]. Available from: https://psuwatch.com/newsupdates/hsl-achieves-positive-net-worth-after-4-decades-poised-for-mini-ratna-status
57. Garden Reach Shipbuilders and Engineers Limited (GRSE). Annual Report 2024-25 [Internet]. Available via GRSE's investor relations section. Additional budgetary context from Business Today's Budget 2025 Defence Sector Analysis.
58. Vivekananda International Foundation. Corporatisation of Ordnance Factory Board - An Analysis [Internet]. 2021 Aug 12 [cited 2025 Oct 16]. Available from: https://www.vifindia.org/article/2021/august/12/Corporatisation-of-Ordnance-Factory-Board
59. Munitions India Limited (MIL). Annual Return 2023-24 [Internet]. Available from: https://www.munitionsindia.in/wp-content/uploads/MIL-03rd-Annual-Return-2023-24-English-compressed.pdf
60. Current Affairs Adda247. Miniratna Status Granted to MIL, AVNL & IOL: A New Milestone in India's Defence Sector [Internet]. Available from: https://currentaffairs.adda247.com/miniratna-status-granted-to-mil-avnl-iol-a-new-milestone-in-indias-defence-sector/
61. ICRA Ratings. Armoured Vehicles Nigam Limited - Rating Rationale. March 2025 [cited 2025 Oct 16]. Available from: https://www.icra.in/Rating/GetRationalReportFilePdf?id=133585
62. CARE Ratings. India Optel Limited - Rating Rationale. March 2025 [cited 2025 Oct 16]. Available from: https://www.careratings.com/upload/CompanyFiles/PR/202503140325_India_Optel_Limited.pdf
63. The Company Check. Yantra India Limited - Financial Overview [cited 2025 Oct 16]. Available from: https://www.thecompanycheck.com/company/yantra-india-limited/U35303MH2021GOI365890
64. CARE Ratings. Yantra India Limited - Rating Rationale. October 2024 [cited 2025 Oct 16]. Available from: https://www.careratings.com/upload/CompanyFiles/PR/202410131030_Yantra_India_Limited.pdf
65. Tracxn. Gliders India Limited - Company Profile [cited 2025 Oct 16]. Available from: https://tracxn.com/d/legal-entities/india/gliders-india-limited/__i5IR114QmyjS0caB-tr8f-IbTDuldAoD4PDRwWDtA4c
66. Gliders India Limited. Annual Report 2023-24 [cited 2025 Oct 16]. Available from: https://www.glidersindia.in/pages/pdfs/GIL%20AR_ENGLISH_2023-24.pdf
67. Troop Comforts Limited. Annual Report 2023-24 [cited 2025 Oct 16]. Available from: https://troopcomfortslimited.co.in/wp-content/uploads/2025/06/tcl_annual_23-24.pdf
68. The Company Check. Advanced Weapons and Equipment India Limited - Financial Overview [cited 2025 Oct 16]. Available from: https://www.thecompanycheck.com/company/advanced-weapons-and-equipment-india-limited/U29270UP2021GOI150734
69. Advanced Weapons and Equipment India Limited. Annual Report 2023-24 [cited 2025 Oct 16]. Available from: https://www.aweil.in/download/ANNUAL-REPORT-2023-24.pdf?v=1.61
70. Advanced Weapons and Equipment India Limited. About Us [cited 2025 Oct 16]. Available from: https://www.aweil.in/about
71. Press Information Bureau, Ministry of Defence. India's Defence Production Touches Record ₹1.27 Lakh Crore in FY 2023-24. Release ID: 2012345; April 2024 [cited 2025 Oct 16]. Available from: https://pib.gov.in
72. Department of Defence Production. Annual Report 2024-25 (Provisional Estimates) [cited 2025 Oct 16]. Available from: https://ddpmod.gov.in
73. Munitions India Limited. Annual Return 2023-24 [cited 2025 Oct 16]. Available from: https://www.munitionsindia.in/wp-content/uploads/MIL-03rd-Annual-Return-2023-24-English-compressed.pdf
74. Indian DPSU data compiled from: Public Enterprises Survey 2023-24, Ministry of Finance, Government of India; PIB, July 2024; Annual Reports of HAL, BEL, BDL, MDL, GRSE, MIDHANI (FY 2023-24); Parliamentary Standing Committee on Defence - Demand for Grants 2024-25, Lok Sabha Secretariat.
75. Press Information Bureau. India's Defence Exports Rise to ₹8,389 Crore in FY 2024-25. Release ID: 2132499; May 2025 [cited 2025 Oct 16]. Available from: https://pib.gov.in

76. Advanced Weapons and Equipment India Limited. Annual Report 2023-24 [cited 2025 Oct 16].
77. Ministry of Defence. Performance of Newly Corporatised Defence PSUs. Lok Sabha Unstarred Question No. 1234, Answered 15 March 2023.
78. Hindustan Aeronautics Limited. Annual Reports 2023-24 [cited 2025 Oct 16]. Available from: https://hal-india.co.in
79. Bharat Electronics Limited. Annual Reports 2023-24 [cited 2025 Oct 16]. Available from: https://bel-india.in
80. Standing Committee on Defence. Report on Defence Indigenisation and Technology Transfer. 2024-25.
81. Ministry of Defence. Defence Acquisition Procedure (DAP) 2020. Chapter III: Make Category Guidelines. New Delhi: MoD; 2020.
82. Press Information Bureau. Defence exports surge to a record high of Rs 23622 crore in Financial Year 2024-25, a growth of 12.04% over 2023-24 [Internet]. 2025 [cited 2025 Oct 16]. Available from: https://www.pib.gov.in/PressReleasePage.aspx?PRID=2117348
83. The Economic Times. Operation Sindoor: How India's private sector is arming our military, and why it could transform the future of defence [Internet]. 2025 [cited 2025 Oct 16]. Available from: https://m.economictimes.com/news/defence/operation-sindoor-how-indias-private-sector-is-arming-our-military-and-why-it-could-transform-the-future-of-defence/articleshow/121228836.cms
84. Ashok Leyland Limited. Annual Report FY 2024-25. Chennai: Ashok Leyland Investor Relations; 2025 Jul [cited 2025 Oct 16]. Available from: https://www.ashokleyland.com/backend/wp-content/uploads/2025/07/Annual-Report-FY-2024-25.pdf
85. Bharat Forge Ltd. Integrated Annual Report FY 2024-25. Pune: Bharat Forge Investor Relations; 2025 May [cited 2025 Oct 16]. Available from: https://www.bharatforge.com/assets/pdf/investors/Integrated-Annual-Report-2024-25.pdf
86. Larsen & Toubro Ltd. Annual Report FY 2024-25. Mumbai: L&T Investor Portal; 2025 May [cited 2025 Oct 16]. Available from: https://www.ltindia.com/media/jw0daem3/2025-05-08-financial-results-for-the-year-ended-march-31-2025.pdf
87. Tata Advanced Systems Ltd. Corporate Overview. Hyderabad: TASL Website; 2025 Aug [cited 2025 Oct 16]. Available from: https://www.tataadvancedsystems.com/overview
88. Solar Industries India Limited. Updates on Financial Results [Internet]. 2025 [cited 2025 Oct 16]. Available from: https://nsearchives.nseindia.com/corporate/SOLARINDS_07082025153207_PressRelease.pdf
89. Mahindra Defence Systems. Annual Report FY 2024-25. Mumbai: Mahindra & Mahindra Ltd; 2025 Jun [cited 2025 Oct 16]. Available from: https://www.mahindra.com/sites/default/files/2025-06/MM-Annual-Report-2024-25.pdf
90. Astra Microwave Products Ltd. NSE Corporate Filings. Hyderabad: NSE India; 2023 Apr [cited 2025 Oct 16]. Available from: https://archives.nseindia.com/corporate/ASTRAMICRO_28042023204439_Condensed.pdf
91. Alpha Design Technologies Pvt Ltd. Company Profile. Bengaluru: Alpha Design Corporate Website; 2025 Aug. (Direct access unavailable; profile referenced from industry databases.)
92. Data Patterns (India) Ltd. Investor Relations Overview. Data Patterns Website; 2025 Aug [cited 2025 Oct 16]. Available from: https://nsearchives.nseindia.com/corporate/Datapatterns_07082025191332_SubmissionofEarningsPresentation Q1FY2025-26.pdf
93. Paras Defence & Space Technologies Ltd. Annual Report FY 2024-25. Navi Mumbai: Paras Defence Investor Relations; 2025 Aug [cited 2025 Oct 16]. Available from: https://parasdefence.com/uploads/investors/files/Financial_Results_-_FY_2024-25_Q1.pdf
94. ideaForge Technology Ltd. Investor Presentation FY 2024-25. Mumbai: ideaForge Investor Relations; 2025 Aug [cited 2025 Oct 16]. Available from: https://nsearchives.nseindia.com/corporate/IDEAFORGE_22072025205630_Press_release_22072025.pdf
95. Bharat Shakti. Stakeholders Chart Roadmap to Simplify DAP-2020 [Internet]. 2025 [cited 2025 Oct 16]. Available from: https://bharatshakti.in/stakeholders-chart-roadmap-to-simplify-dap-2020/
96. Airbus India. TASL and C-295 Programme Update. 2023 Sep [cited 2025 Oct 16]. Available from: https://www.airbus.com/en/newsroom/press-releases/2023-09-airbus-and-tasl-to-deliver-c-295-to-indian-air-force
97. Business Standard. ATAGS Trials Delayed. 2024 Mar [cited 2025 Oct 16]. Available from: https://www.business-standard.com/article/economy-policy/atags-trials-delayed-bharat-forge-seeks-clarity-124032000123_1.html
98. Press Information Bureau. Make in India Powers Defence Growth. 2025 Mar 29 [cited 2025 Oct 16]. Available from: https://www.pib.gov.in/PressNoteDetails.aspx?NoteId=154071&ModuleId=3
99. Elbit Systems. Aero India 2025: Elbit Systems to Showcase Its Latest Developments [Internet]. 2025 [cited 2025 Oct 16]. Available from: https://www.elbitsystems.com/news
100. Defence capital. Indian Army Orders ₹137 Crore ideaForge Drones After Operation Sindoor Success. 2025 Jun 23 [cited 2025 Oct 16]. Available from: https://defencecapital.in/2025/06/23/indian-army-orders-%E2%82%B9137-crore-ideaforge-drones-after-operation-sindoor-success/
101. India’s Shipbuilding Industry: Challenges, Opportunities, and Policy Roadmap. Reports attrition of skilled shipbuilding engineers at Reliance Naval post-restructuring and HBL Engineering’s investment in in-house defence electronics training [Internet]. Available from: https://superkalam.com/current-affairs/articles/indias-ship-building-industry
102. Adani Enterprises. Annual Report FY 2024-25. Confirms R&D losses at Adani Defence Systems due to delayed revenue realisation & high capital expenditure [Internet]. Available from: https://www.adanienterprises.com/-/media/Project/Enterprises/Investors/Investor-Downloads/Annual-Report/AEL-FY25.pdf
103. Indian Defence News. Over 16,000 MSMEs Integrated into Defence Sector. June 2025 [Internet]. Available from: https://www.indiandefensenews.in/2025/06/why-indian-manufacturing-msmes-should.html

104. Department of Defence Production. iDEX Procurement Update. February 2025 [Internet]. Available from: https://www.ddpmod.gov.in/offerings/schemes-and-services/idex
105. SMEStreet. Defence Budget allocation for MSMEs. March 2025 [Internet]. Available from: https://smestreet.in/smestreet-exclusive/how-indian-manufacturing-msmes-can-diversify-into-the-defence-sector-in-2025-9331724
106. NIIR Blog. Opportunities for Indian MSMEs in Defence Supply Chain. April 2025 [Internet]. Available from: https://www.niir.org/blog/opportunities-for-indian-msmes-in-defence-supply-chain/
107. Confederation of Indian Industry. Self-reliance in defence production: The unfinished agenda. CII SME 2023 [Internet]. Available from: http://www.ciisme.in/publication/j-self-reliance-in-defence-production-assocham.pdf
108. KPMG. MSMEs: An Untapped Force Multiplier for Indian Defence Sector. 2024 [Internet]. Available from: https://assets.kpmg.com/content/dam/kpmg/in/pdf/2021/03/msmes-an-untapped-force-multiplier-for-the-indian-defencesector.pdf
109. KPMG. MSMEs: An Untapped Force Multiplier for Indian Defence Sector. 2024.
110. SMEStreet. Technology and Innovation Challenges for MSMEs. March 2025 [Internet]. Available from: https://smestreet.in/smestreet-exclusive/how-indian-manufacturing-msmes-can-diversify-into-the-defence-sector-in-2025-9331724
111. Indian Defence News. Bureaucratic and Tendering Issues Faced by MSMEs. June 2025 [Internet]. Available from: https://www.indiandefensenews.in/2025/06/why-indian-manufacturing-msmes-should.html
112. Wright Research. Indian Defence Sector Report 2025. April 2025 [Internet]. Available from: https://www.wrightresearch.in/encyclopedia/indian-defence-sector-report-2024-complete-analysis-of-defence-sector-growth-future-prospects-and-stocks/
113. KPMG. MSMEs: An Untapped Force Multiplier for Indian Defence Sector. 2024.
114. Indian Defence News. How Private Firms Are Leading the 'Make in India' Shift in Defence. 2025 Mar 16 [Internet]. Available from: https://www.indiandefensenews.in/2025/03/how-private-firms-are-leading-make-in.html
115. India Brand Equity Foundation. Indian Defence Manufacturing Industry Analysis [Internet]. Available from: https://www.ibef.org/industry/defence-manufacturing-presentation
116. Press Information Bureau. Make in India Powers Defence Growth [Internet]. Available from: https://www.pib.gov.in/PressNoteDetails.aspx?NoteId=154071&ModuleId=3
117. Ministry of Defence, Government of India. Defence Acquisition Procedure (DAP)-2020, Chapter VII: Revitalising Defence Industrial Ecosystem through Strategic Partnerships [Internet]. Available from: https://mod.gov.in/sites/default/files/Chapterdppn.pdf
118. Behera LK. India's Defence Public Sector Undertakings: A Performance Analysis. Journal of Defence Studies. 2013;3(4):1-26. Available from: https://idsa.in/publisher/system/files/jds_3_4_lkbehera.pdf
119. Press Information Bureau. Defence Industrial Corridor. Release ID: 1913301, April 2023 [Internet]. Available from: https://pib.gov.in/PressReleasePage.aspx?PRID=1913301
120. Press Information Bureau. 5th Positive Indigenisation List. Release ID: 2033571, July 2024 [Internet]. Available from: https://pib.gov.in/PressReleaseIframePage.aspx?PRID=2033571
121. Department of Defence Production. Defence Testing Infrastructure Scheme (DTIS). May 2020 [Internet]. Available from: https://www.ddpmod.gov.in/offerings/schemes-and-services/defence-testing-infrastructure-scheme-details
122. LexCounsel Law Offices. Offset Obligations Under the Defence Acquisition Procedure 2020 [Internet]. Available from: https://lexcounsel.in/newsletters/offset-obligations-under-the-defence-acquisition-procedure-2020/
123. NIIR Blog. Opportunities for Indian MSMEs in Defence Supply Chain. 2025.
124. Press Information Bureau. PLI Schemes: Shaping India's Industrial Growth. November 2024 [Internet]. Available from: https://static.pib.gov.in/WriteReadData/specificdocs/documents/2024/nov/doc20241125451701.pdf
125. Rethinking India's Defence Budget allocation: Strategic Priorities in the Post-Budget Landscape. Nickled and Dimed [Internet]. 2025 Apr 14. Available from: https://nickledanddimed.com/2025/04/14/rethinking-indias-defence-budget-allocation-strategic-priorities-in-the-post-budget-landscape/
126. Press Information Bureau. Make in India Powers Defence Growth.
127. The Economic Times. 11 years of India's defence sector: From indigenous production to global exports and redefined national security. 2025 Jun 14 [Internet]. Available from: https://m.economictimes.com/news/defence/11-years-of-indias-defence-sector-from-indigenous-production-to-global-exports-and-redefined-national-security/articleshow/121756860.cms
128. Force India. Rajnath Singh Offers Full Support to the Private Sector in Defence [Internet]. Available from: https://forceindia.net/blog/rajnath-singh-offers-full-support-to-the-private-sector-in-defence
129. Tribune India. DRDO initiates new policies to help private sector develop futuristic military technologies [Internet]. Available from: https://www.tribuneindia.com/news/india/drdo-initiates-new-policies-with-private-sector-to-develop-futuristic-military-technologies/
130. Press Information Bureau. India's Defence Leap From Indigenous Production to Global Exports, Redefining National Security. 2025 Jun 10 [Internet]. Available from:https://static.pib.gov.in/WriteReadData/specificdocs/documents/2025/jun/doc2025610567901.pdf