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India's Defence Manufacturing Industry: Future Prospects and Strategic Roadmap

Dr. Pankaj Kumar Verma
Assistant Professor/ Project Director,
ICSSR Minor Research Project,
Department of Defence and Strategic Studies,
Dharma Samaj P.G. College,
Aligarh (Uttar Pradesh)
E-mail: 1980pankaj@gmail.com

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Abstract:

India's defence manufacturing sector has undergone a significant transformation over the past decade, driven by policy initiatives such as Atmanirbhar Bharat, Make in India, the Defence Acquisition Procedure (DAP) 2020 and the Defence Production and Export Promotion Policy (DPEPP) 2020. Despite notable progress in domestic production and exports, India continues to face structural challenges, including technological dependence, limited research and development capacity and integration gaps within global defence supply chains. This paper examines the future prospects of India's defence manufacturing industry and proposes a comprehensive strategic roadmap for achieving technological self-reliance and global competitiveness by 2040. This research paper focuses on three key dimensions: the role of emerging technologies, the expansion of defence exports and India's positioning in global arms markets and the importance of domestic–global industrial integration through foreign investment, technology transfer and public–private partnerships. This paper highlights the growing contribution of private sector firms, start-ups and defence industrial corridors in strengthening India's defence ecosystem. The paper concludes with policy recommendations, including the formulation of a National Defence Industrial Strategy, increased defence R&D investment, expansion of export promotion mechanisms and strengthening of human capital development.

Keywords: *Defence Manufacturing, Atmanirbhar Bharat, Strategic Autonomy, Defence Exports, Military Technology, Defence Industrial Policy*

1. Introduction:

The future trajectory of India's defence manufacturing industry will be shaped by a combination of technological transformation, geopolitical dynamics, industrial policy reforms and global supply chain realignments (Tellis, 2016; Gereffi, 2018). Over the past decade, India has undertaken significant reforms aimed at strengthening indigenous defence production and reducing

reliance on imported military equipment. Initiatives such as ***Make in India***, ***Atmanirbhar Bharat***, the ***Defence Acquisition Procedure (DAP) 2020*** and the ***Defence Production and Export Promotion Policy (DPEPP) 2020*** have laid the institutional and policy foundations for a more resilient defence industrial ecosystem (Ministry of Defence, 2024). Despite these reforms, India continues to face structural challenges in achieving full self-reliance in defence manufacturing. According to the **Stockholm International Peace Research Institute (SIPRI)**, India remained among the world's largest arms importers during the period 2019–2023, accounting for approximately **9–11% of global arms imports** (SIPRI, 2024). While domestic defence production has increased significantly (from around **₹74,000 crore in 2016–17 to over ₹1.27 lakh crore in 2023–24**) technological dependence persists in critical domains such as aero-engines, advanced sensors, semiconductor electronics and cyber warfare systems (Ministry of Defence, 2024). The coming decades will therefore be crucial for India's defence manufacturing ecosystem. Rapid advancements in **artificial intelligence, robotics, quantum computing, autonomous systems, cyber warfare technologies and space-based capabilities** are fundamentally transforming the nature of modern warfare. These emerging technologies are reshaping military doctrines and creating new opportunities for innovation within the defence industry. At the same time, global geopolitical dynamics (particularly the rise of China, evolving security challenges in the Indo-Pacific region and disruptions in global supply chains) have reinforced the importance of technological self-reliance and resilient defence industrial ecosystems. For India, strengthening domestic defence manufacturing is not merely an economic objective but also a strategic necessity for safeguarding national sovereignty and maintaining credible deterrence. This chapter explores the **future prospects and strategic roadmap for India's defence manufacturing sector over the next two decades**. It examines how emerging technologies can reshape defence production, evaluates the potential for expanding defence exports, analyzes opportunities for strengthening domestic-global industrial integration and outlines policy reforms necessary to achieve long-term self-reliance.

Research Methodology:

This study adopts a **qualitative and analytical research design** to examine the evolving dynamics of India's defence manufacturing sector and to develop a forward-looking strategic roadmap. The research is primarily based on **secondary data sources**, supplemented by policy analysis and comparative insights. The research is **descriptive, analytical and policy-oriented** in nature. It seeks to interpret ongoing developments in defence manufacturing and evaluate their implications for India's long-term strategic and economic objectives. The research focuses on **macro-level trends and policy developments** in India's defence manufacturing sector. While it provides a comprehensive strategic overview, the study is limited by its reliance on secondary data and does not include primary field-based empirical research. Additionally, certain classified or sensitive defence data may not be publicly

accessible, which may constrain detailed analysis in specific areas.

2. Emerging Technologies: Artificial Intelligence, Quantum Computing and Unmanned Platforms:

The rapid development of emerging technologies is transforming the global defence landscape. Military superiority in the twenty-first century increasingly depends on technological innovation rather than simply numerical strength or traditional industrial capacity. Artificial intelligence, cyber warfare capabilities, quantum computing, autonomous weapons systems and space-based technologies are reshaping the character of warfare and redefining strategic competition among major powers. For India, integrating these technologies into its defence manufacturing ecosystem will be critical for maintaining strategic relevance and enhancing the operational capabilities of its armed forces.

2.1 Artificial Intelligence in Defence Systems: Artificial intelligence has emerged as one of the most transformative technologies in modern warfare, enabling real-time decision-making and predictive analytics in complex operational environments (Allen, 2019; Tellis, 2016). Military applications of AI include autonomous systems, intelligence analysis and cyber defence capabilities. Military applications of AI include autonomous vehicles, predictive maintenance of equipment, intelligence analysis and battlefield decision-support systems. Countries such as the United States and China have invested heavily in military AI research, reflecting the growing importance of technological superiority in strategic competition (Allen, 2019). India has also recognized this trend through the establishment of the Defence AI Council and Defence AI Project Agency (Ministry of Defence, 2024). The United States Department of Defense launched the **Joint Artificial Intelligence Center (JAIC)** to accelerate the integration of AI technologies into defence operations, while China's **Next Generation Artificial Intelligence Development Plan** emphasizes military applications of AI as a national priority (Allen, 2019). India has also begun to recognize the importance of AI for national security. In 2018, the Ministry of Defence established a **Defence AI Council (DAIC)** and a **Defence AI Project Agency (DAIPA)** to promote AI integration across the armed forces. These institutions aim to facilitate collaboration between defence laboratories, academic institutions and private technology companies. AI applications within India's defence sector are expanding rapidly. Some of the key areas include: **Intelligence analysis and surveillance systems**, **Autonomous navigation for unmanned aerial vehicles (UAVs)**, **Predictive maintenance of aircraft and naval vessels** and **AI-based cybersecurity systems.** Start-ups supported by the **Innovations for Defence Excellence (iDEX)** initiative have already developed several AI-enabled technologies, including intelligent drone swarms, automated surveillance platforms and decision-support software for military commanders.

2.2 Cyber Warfare and Information Security: Cyber warfare has become a central dimension of contemporary conflict, with the ability to disrupt critical infrastructure and military communication

networks without conventional engagement (Nye, 2017). The increasing digitization of defence systems has heightened vulnerabilities to cyber threats, making cyber resilience a strategic priority (Ministry of Defence, 2024). Cyber attacks can disrupt critical infrastructure, compromise military communications networks and undermine national security without conventional battlefield engagement. Consequently, developing robust cyber defence capabilities has become a strategic priority for many countries. India faces growing cyber security challenges due to increasing digitization of defence systems and critical infrastructure. The integration of network-centric warfare systems, satellite communications and digital command-and-control networks has increased the vulnerability of military systems to cyber threats. To address these challenges, the Government of India has established several institutions dedicated to cyber defence, including the Defence Cyber Agency (DCA), which was created in 2019 as part of the integrated tri-service command structure. The DCA is responsible for coordinating cyber defence operations across the Indian armed forces. The Ministry of Defence has launched initiatives aimed at strengthening indigenous cyber security technologies. Indian technology companies and start-ups are increasingly developing cybersecurity solutions for military applications, including secure communication networks, encryption systems and cyber threat detection platforms. The development of indigenous cyber technologies is particularly important because many imported cyber security tools may contain hidden vulnerabilities or backdoors. By investing in domestic cyber security capabilities, India can enhance the resilience of its defence infrastructure while reducing dependence on foreign technologies.

2.3 Quantum Technologies and Strategic Competition: Quantum technologies represent the next frontier in strategic competition, particularly in secure communications and cryptography (Government of India, 2023; Lundvall, 2007). Quantum computers have the potential to perform complex calculations far beyond the capabilities of classical computers, enabling breakthroughs in cryptography, materials science and artificial intelligence. Quantum communication technologies, particularly quantum key distribution (QKD), offer unprecedented levels of secure communication by leveraging the principles of quantum mechanics. These technologies are expected to play a crucial role in secure military communications and satellite networks. Recognizing the strategic importance of quantum technologies, the Government of India launched the National Mission on Quantum Technologies and Applications (NM-QTA) with an allocation of approximately ₹8,000 crore to support research in quantum computing, communication and sensing technologies (Government of India, 2023). India's defence research institutions, including DRDO and the Indian Space Research Organisation (ISRO), are actively exploring the military applications of quantum technologies. Potential defence applications include: Quantum-secure communication networks, Quantum radar systems capable of detecting stealth aircraft and Advanced navigation systems

independent of GPS. Developing these technologies will require long-term investment in scientific research and strong collaboration between academia, industry and defence laboratories.

2.4 Unmanned Systems and Autonomous Warfare: Unmanned systems are rapidly becoming a dominant feature of modern military operations. Unmanned aerial vehicles (UAVs), autonomous underwater vehicles (AUVs) and unmanned ground vehicles (UGVs) are being deployed for reconnaissance, surveillance, combat operations and logistics support. The widespread use of drones in recent conflicts (Middle East and West Asia) has demonstrated the transformative impact of unmanned systems on battlefield dynamics. India has significantly expanded its investment in unmanned systems in recent years. DRDO has developed several indigenous UAV platforms, including the **Rustom-II (TAPAS)** drone and the **Ghatak stealth unmanned combat aerial vehicle (UCAV)**. Private sector companies and start-ups are also playing an increasingly important role in drone technology development. Indian companies such as **IdeaForge, NewSpace Research and Garuda Aerospace** are producing advanced drone systems for both military and civilian applications. Government initiatives such as **iDEX and the Defence India Start-up Challenge (DISC)** have encouraged start-ups to develop innovative unmanned systems for defence applications, including drone swarms, counter-drone systems and AI-enabled surveillance platforms. The rapid expansion of drone technology presents significant opportunities for India's defence manufacturing sector, particularly in export markets where demand for affordable drone systems is growing rapidly.

2.5 Space Technologies and Defence Manufacturing: Space has become an increasingly important domain of military competition. Satellite systems are essential for communication, navigation, surveillance and missile warning systems. India's space capabilities, led by the **Indian Space Research Organisation (ISRO)**, provide a strong foundation for developing space-based defence technologies. The establishment of the **Defence Space Agency (DSA)** in 2019 reflects India's recognition of space as a critical domain of national security. Future defence manufacturing opportunities in the space sector include: Military communication satellites, Space-based surveillance systems, Anti-satellite defence technologies and Satellite launch services. India's growing commercial space industry and the emergence of private space companies are expected to further strengthen the country's capabilities in space defence technologies.

3. Defence Exports and India's Global Market Ambitions:

The expansion of defence exports has emerged as a central pillar of India's long-term strategy to strengthen its defence manufacturing ecosystem and achieve greater strategic autonomy. Historically, India has been known primarily as one of the world's largest importers of military equipment. However, over the past decade, there has been a gradual transformation in India's defence industrial policy aimed at converting the country from a major importer into an emerging exporter of

defence equipment. This shift reflects broader strategic objectives such as enhancing indigenous production capabilities, achieving economies of scale in defence manufacturing, strengthening diplomatic partnerships and positioning India as a credible security partner in the Indo-Pacific region. The Government of India has explicitly recognized the importance of defence exports in sustaining the domestic defence industrial base. Defence exports enable manufacturers to scale production, improve product competitiveness and invest in advanced research and development. Moreover, defence exports serve as instruments of strategic diplomacy by strengthening military cooperation with friendly countries. In this context, India's defence export strategy aligns closely with its broader foreign policy objective of becoming a **"net security provider" in the Indo-Pacific region**. India's defence exports have grown significantly, from ₹1,941 crore in 2014–15 to over ₹23,622 crore in 2024–25 (Ministry of Defence, 2025). However, India's share in global arms exports remains below 1 percent, indicating substantial untapped potential (SIPRI, 2024). The expansion of exports is closely linked with defence diplomacy, where arms transfers serve as instruments of strategic influence and partnership building (Pant & Joshi, 2016). However, despite these encouraging trends, India's share in the global arms trade remains relatively small. According to the Stockholm International Peace Research Institute (SIPRI), India accounts for less than **1 percent of global arms exports**, indicating substantial untapped potential in international defence markets (SIPRI, 2024). Expanding India's defence exports will therefore require sustained policy support, technological advancement and deeper integration with global defence supply chains.

3.1 Growth of India's Defence Exports: India's defence exports have witnessed remarkable growth during the past decade due to a combination of policy reforms, industrial capacity expansion and increasing participation of private sector companies.

Year	Export Value
2017–18	₹4,682 crore
2020–21	₹8,434 crore
2022–23	₹15,920 crore
2023–24	₹21,083 crore
2024–25	₹23,622 crore

Table: Growth of India's Defence Exports (Approx.) (Ministry of Defence, 2025)

This growth has been driven by several key factors. First, the **liberalization of export licensing procedures** has simplified the process for defence companies seeking to export military equipment. The government has introduced online export authorization systems and reduced bureaucratic delays in export approvals. Second, the expansion of private sector participation has played a major role in boosting defence exports. Private companies now account for approximately **60 percent of India's**

defence exports, while Defence Public Sector Undertakings (DPSUs) account for the remaining share (Ministry of Defence, 2024). Third, increasing global demand for **cost-effective defence equipment** has created opportunities for Indian manufacturers. Many developing countries seek reliable yet affordable military systems that India can supply at competitive prices. Fourth, India's growing defence diplomacy efforts have helped open new markets for indigenous defence products. Defence attachés in Indian embassies have been tasked with promoting Indian defence products abroad and facilitating export negotiations.

3.2 Major Defence Products Exported by India: India's defence export portfolio includes a wide range of equipment, platforms and sub-systems produced by both public and private sector companies.

Missile Systems: One of India's most prominent defence export successes is the **BrahMos supersonic cruise missile**, developed jointly by India and Russia. In 2022, India signed a **$375 million contract with the Philippines** for the supply of BrahMos coastal defence missile systems, marking the country's largest defence export deal to date (Ministry of External Affairs, 2023). The BrahMos system has attracted interest from several other countries in Southeast Asia and the Middle East due to its speed, accuracy and operational reliability.

Naval Platforms: India has developed strong capabilities in naval shipbuilding through shipyards such as **Mazagon Dock Shipbuilders Limited (MDL), Garden Reach Shipbuilders and Engineers (GRSE) and Goa Shipyard Limited (GSL)**. Indian shipyards have exported patrol vessels, interceptor boats and offshore patrol vessels to countries such as: Mauritius, Vietnam, Sri Lanka, Seychelles and Maldives. Naval exports are expected to grow significantly as India expands its shipbuilding capacity and strengthens maritime partnerships in the Indo-Pacific region.

Aerospace Components: Indian aerospace companies are increasingly integrated into global supply chains. Companies such as **Tata Advanced Systems, Dynamatic Technologies and Bharat Forge** supply aerospace components to major international firms including **Airbus, Boeing and Lockheed Martin**. For example, Tata Advanced Systems manufactures components for the **C-130J Super Hercules aircraft**, while Dynamatic Technologies supplies fuselage assemblies for Airbus aircraft. These partnerships demonstrate India's growing capabilities in high-precision aerospace manufacturing.

Artillery and Armoured Systems: Indian defence companies have also begun exporting artillery systems, armoured vehicles and ammunition. The **Kalyani Group** has developed advanced artillery systems and ammunition products that are gaining interest in global markets. Similarly, Indian ordnance factories and private manufacturers export small arms, ammunition and protective equipment to several countries.

Unmanned Systems and Drones: India's rapidly growing drone industry has become an important contributor to defence exports. Companies such as **IdeaForge, Garuda Aerospace and NewSpace**

Research are developing advanced unmanned aerial vehicles for surveillance and reconnaissance. Indian drones are increasingly being exported to countries in Africa and Southeast Asia due to their relatively low cost and operational reliability.

3.3 Defence Export Markets: India currently exports defence equipment to more than **80 countries**, including nations across Asia, Africa, Europe and Latin America (Press Information Bureau, 2024).

Southeast Asia: Countries such as **Philippines, Vietnam, Indonesia and Malaysia** represent important defence export markets for India. These countries face increasing maritime security challenges and are seeking reliable defence partners. India's defence cooperation with Southeast Asia is closely aligned with its **Act East Policy** and its strategic objective of maintaining stability in the Indo-Pacific region.

Africa: Africa has emerged as a promising market for Indian defence exports due to growing security challenges across the continent. Indian defence companies export equipment such as patrol vessels, armoured vehicles and surveillance systems to several African countries.

Middle East: The Middle East represents another important market for Indian defence products. Countries such as **United Arab Emirates and Saudi Arabia** have shown interest in purchasing Indian-made military equipment and collaborating on defence manufacturing projects.

Latin America: Latin American countries are increasingly exploring defence partnerships with India as they seek to diversify their defence suppliers. India's cost-effective defence equipment makes it an attractive partner for countries with limited defence budgets.

5. Challenges in Expanding Defence Exports:

Despite significant progress, India's defence export sector continues to face several challenges.

Limited Product Portfolio: India's defence export portfolio is still relatively limited compared to major arms-exporting countries. Expanding exports will require developing a wider range of advanced defence platforms.

Technology Gaps: Technological dependence in certain critical areas continues to constrain India's export potential. Many advanced defence systems require technologies that India currently imports.

Global Competition: The global arms market is highly competitive, dominated by established exporters such as the United States, Russia, France, China and Israel. Indian defence companies must compete with these established suppliers.

Export Financing and Marketing: India's defence export promotion mechanisms are still evolving. Expanding exports will require stronger export financing mechanisms and more aggressive international marketing efforts.

6. Future Prospects for India's Defence Exports:

Despite these challenges, the future prospects for India's defence exports remain promising. Several factors support this optimistic outlook. First, India's defence industrial base is expanding

rapidly due to government policies promoting indigenous production. Second, increasing geopolitical tensions are driving demand for defence equipment in several regions. Third, India's reputation as a reliable and responsible defence partner makes it attractive to many countries seeking to diversify their defence suppliers. Fourth, the growing role of private sector companies and start-ups is likely to drive innovation and competitiveness in defence manufacturing. The Government of India has set an ambitious target of achieving **₹50,000 crore in defence exports by 2029**. Achieving this target will require sustained investment in research and development, stronger industry participation and proactive defence diplomacy.

7. Strengthening Domestic–Global Integration:

The development of a globally competitive defence manufacturing sector depends on effective integration into international supply chains and innovation networks (Gereffi, 2018). Even advanced economies rely on complex global production systems, highlighting the importance of interdependence in defence manufacturing. In the contemporary defence economy, no country operates entirely in isolation. Even advanced defence manufacturers such as the United States, France and Israel rely on complex global supply chains involving multiple suppliers, subcontractors and research institutions across different countries. For emerging defence manufacturing powers like India, strengthening the integration between domestic industries and global defence ecosystems is therefore essential for accelerating technological advancement, expanding export opportunities and enhancing industrial competitiveness.

Initiatives such as **Make in India**, **Atmanirbhar Bharat**, the **Strategic Partnership Model** and the **Defence Production and Export Promotion Policy (DPEPP) 2020** have sought to promote international collaboration, technology transfer and joint manufacturing projects. These policies aim not only to strengthen indigenous production capabilities but also to position India as a significant participant in the global defence industrial ecosystem. However, achieving effective domestic–global integration requires addressing several structural challenges. These include technological gaps, regulatory barriers, limited participation of Indian firms in global supply chains and the need for stronger institutional coordination among defence stakeholders. This section examines the evolving dynamics of domestic–global integration in India's defence manufacturing sector and outlines key strategies for strengthening India's role in the global defence economy.

7.1 Integration into Global Defence Supply Chains: Global defence manufacturing operates through highly specialized supply chains involving numerous companies across multiple countries. Major defence contractors typically rely on a network of subcontractors and component suppliers that provide specialized technologies such as avionics, propulsion systems, advanced materials and electronics. India's participation in global defence supply chains—through collaborations with firms such as Airbus and Lockheed Martin—illustrates its gradual integration into the global

defence economy (Ministry of Defence, 2024). However, technological gaps and regulatory constraints continue to limit deeper integration (Frank, 1967). In recent years, several Indian companies have successfully integrated into global defence supply chains. For example, **Tata Advanced Systems Limited (TASL)** manufactures components for the **C-130J Super Hercules aircraft** produced by Lockheed Martin. Similarly, **Dynamatic Technologies** supplies structural components for Airbus aircraft and Boeing helicopters. These collaborations demonstrate the potential for Indian firms to become important suppliers within global aerospace and defence manufacturing networks. The **Airbus–Tata collaboration for manufacturing C-295 transport aircraft in India** represents a major milestone in this integration process. The project involves the establishment of a complete aircraft manufacturing facility in Gujarat, with significant participation from Indian suppliers. Over time, such projects can help create a robust ecosystem of domestic suppliers capable of supporting large-scale defence manufacturing operations.

7.2 Technology Transfer and Co-Development: Technology transfer has historically played an important role in India's defence industrial development. However, earlier arrangements often involved limited transfer of critical technologies, leaving India dependent on foreign suppliers for key components and upgrades. In recent years, policy reforms have emphasized the importance of **co-development and co-innovation** rather than simple licensed production. Collaborative development projects enable Indian companies and research institutions to participate in the design and engineering stages of defence technologies, thereby enhancing domestic technological capabilities. One of the most successful examples of such collaboration is the **BrahMos missile joint venture** between India and Russia. This partnership allowed Indian engineers to acquire expertise in missile design, propulsion systems and guidance technologies. The BrahMos missile has since become one of India's most advanced defence products and a key export item. Similarly, India's collaboration with France in the **Scorpene submarine project** helped enhance domestic capabilities in naval shipbuilding and submarine technologies. The project involved extensive technology transfer and the development of local manufacturing capabilities at Mazagon Dock Shipbuilders Limited. Future international collaborations are likely to focus increasingly on emerging technologies such as artificial intelligence, advanced sensors, cyber defence systems and autonomous platforms. Participating in these collaborative innovation networks will be essential for ensuring that India remains competitive in next-generation defence technologies.

7.3 Role of Foreign Direct Investment (FDI): Foreign direct investment plays a critical role in facilitating technology transfer and industrial upgrading (DPIIT, 2020). However, dependency theory suggests that without strong domestic capabilities, such integration may reinforce technological asymmetries (Frank, 1967). In 2020, the government increased the **FDI limit in defence manufacturing to 74 percent under the automatic route and up to 100 percent**

through the government approval route for projects involving advanced technologies (DPIIT, 2020). This reform has encouraged several global defence companies to explore manufacturing partnerships with Indian firms. Foreign investment can contribute to domestic defence manufacturing in several ways. First, it provides access to advanced technologies and engineering expertise. Second, it enables Indian companies to adopt international manufacturing standards and quality control practices. Third, foreign investment can facilitate integration into global supply chains and export markets. However, maximizing the benefits of foreign investment requires careful policy design to ensure that domestic industries develop indigenous capabilities rather than becoming dependent on foreign suppliers. Strategic partnerships and joint ventures should therefore prioritize meaningful technology transfer and capacity building within the domestic defence ecosystem.

7.4 Strengthening Public–Private Partnerships: Public–private partnerships (PPPs) represent another important mechanism for strengthening domestic–global integration. Historically, India's defence manufacturing sector was dominated by public sector institutions such as Defence Public Sector Undertakings (DPSUs) and ordnance factories. While these institutions played a critical role in establishing the country's defence industrial base, their limited interaction with private industry sometimes restricted innovation and efficiency. Recent policy reforms have encouraged greater participation of private companies in defence manufacturing. Indian conglomerates such as **Tata Group, Larsen & Toubro, Mahindra Defence and Bharat Forge** have emerged as significant players in the defence industry. These companies often collaborate with global defence contractors to produce advanced military equipment. Such collaborations enable Indian firms to acquire technological expertise while providing international companies with access to India's large defence market. Strengthening public–private partnerships can help create a more dynamic and competitive defence industrial ecosystem. Greater collaboration between DPSUs, private firms, start-ups and academic institutions can accelerate innovation and facilitate the commercialization of new technologies.

7.5 Integration with the Global Innovation Ecosystem: The global defence industry increasingly relies on innovation ecosystems involving start-ups, research institutions, venture capital firms and technology companies. Countries such as the United States and Israel have developed highly dynamic defence innovation ecosystems that generate cutting-edge technologies for military applications. India has begun to develop similar innovation networks through initiatives such as **Innovations for Defence Excellence (iDEX)** and the **Technology Development Fund (TDF)**. These programs encourage start-ups and small companies to develop innovative defence technologies, including artificial intelligence applications, drone systems and cybersecurity solutions. Integrating these innovation ecosystems with global research networks can significantly

enhance India's technological capabilities. Collaborative research programs with foreign universities and defence laboratories can accelerate the development of advanced technologies and strengthen India's position in emerging defence technology domains.

7.6 Challenges to Domestic–Global Integration: Despite significant progress, several challenges continue to affect India's integration into the global defence industrial ecosystem. One major challenge is the **limited scale of domestic manufacturing capabilities**. Many Indian defence companies lack the production capacity required to compete with established global defence contractors. Another challenge is the **complex regulatory environment** governing defence manufacturing and exports. Although reforms have simplified certain procedures, bureaucratic delays and compliance requirements can still discourage foreign partners and investors. Technological dependence in critical areas such as advanced materials, semiconductor electronics and propulsion systems also limits India's ability to fully integrate into global defence supply chains. Addressing these gaps will require sustained investment in research and development as well as stronger collaboration between industry and academia.

7.7 Future Prospects: Looking ahead, domestic–global integration will remain a key driver of India's defence industrial transformation. Several emerging trends support the potential for deeper integration. First, geopolitical shifts and supply chain disruptions have encouraged many countries to diversify their defence manufacturing partnerships. India's growing technological capabilities and strategic location make it an attractive partner for international defence companies. Second, the expansion of defence industrial corridors in **Uttar Pradesh and Tamil Nadu** is expected to create new manufacturing clusters capable of supporting large-scale defence production. Third, increasing collaboration between Indian start-ups and global technology companies could accelerate innovation in emerging defence technologies such as artificial intelligence, autonomous systems and cyber security. By leveraging these opportunities, India can gradually strengthen its position within the global defence industrial ecosystem.

Strengthening domestic–global integration is essential for the long-term development of India's defence manufacturing sector. Participation in global supply chains, technology partnerships and collaborative innovation networks can significantly enhance the competitiveness of Indian defence industries. While India has made considerable progress through policy reforms and international collaborations, further efforts are required to address technological gaps, regulatory challenges and capacity constraints. By promoting strategic partnerships, encouraging foreign investment and fostering innovation ecosystems, India can accelerate the development of a globally competitive defence industrial base. Such integration will not only enhance India's technological capabilities but also support its broader strategic objective of becoming a major defence manufacturing hub and a reliable security partner in the international system.

8. Strategic Roadmap for 2040:

This section outlines key policy recommendations and strategic priorities that can guide India's defence manufacturing sector toward long-term self-reliance and global competitiveness.

8.1 Establishing a National Defence Industrial Strategy: The transformation of India's defence manufacturing sector requires a comprehensive and long-term strategic approach aligned with national security objectives (Tellis, 2016). Increasing investment in research and development is essential for enhancing technological competitiveness and reducing dependence on foreign suppliers (Lundvall, 2007). India has introduced several policy initiatives in recent years, these efforts are often implemented through multiple institutions and ministries without a unified long-term vision. A National Defence Industrial Strategy should provide a **20-year roadmap for technology development, industrial capacity expansion and export promotion**. This strategy must align defence industrial policy with national security objectives, economic development goals and technological innovation priorities. The strategy should identify priority sectors where India must develop indigenous capabilities, including: Aerospace and propulsion technologies, Cyber security and artificial intelligence, Advanced materials and electronics, Autonomous systems and robotics and Space-based defence technologies. Long-term planning will allow defence manufacturers and investors to align their investment strategies with national priorities, thereby improving policy predictability and industrial growth.

8.2 Increasing Investment in Research and Development: Research and development (R&D) remains one of the most critical determinants of technological competitiveness in defence manufacturing. Countries with advanced defence industries invest heavily in R&D to develop cutting-edge technologies and maintain strategic superiority. According to international estimates, the United States spends approximately **$140 billion annually on defence research and development**, while China has also significantly expanded its defence technology investments (SIPRI, 2024). In contrast, India's defence R&D expenditure remains relatively modest. To strengthen technological self-reliance, India must significantly increase investment in defence R&D. This investment should focus not only on government research institutions such as the **Defence Research and Development Organisation (DRDO)** but also on universities, private companies and start-ups. The government could introduce several policy mechanisms to support defence innovation:

I. Establishing a **Defence Innovation Fund** to support high-risk technology development.
II. Providing **tax incentives for private sector R&D investments**.
III. Expanding funding for **iDEX and Technology Development Fund (TDF)** programmes.

IV. Encouraging collaborative research between defence laboratories and academic institutions.

Strengthening the defence innovation ecosystem will help India develop indigenous capabilities in emerging technologies such as artificial intelligence, quantum computing and autonomous systems.

8.3 Enhancing Public–Private Partnerships: The participation of the private sector has increased significantly in India's defence manufacturing ecosystem over the past decade. Companies such as **Tata Advanced Systems, Larsen & Toubro, Mahindra Defence, Bharat Forge and Adani Defence** have emerged as major players in the industry. However, private sector participation remains limited in high-technology defence platforms such as fighter aircraft, missile systems and submarine technologies. Public–private partnerships have emerged as a key driver of innovation and efficiency in defence manufacturing (Hooks, 1991). The government should consider implementing the following measures:

I. Expanding the **Strategic Partnership Model (SPM)** to include additional defence sectors.
II. Providing long-term production contracts to encourage private investment.
III. Allowing private firms greater access to defence research facilities and testing infrastructure.
IV. Promoting collaboration between DPSUs and private companies.

8.4 Strengthening Defence Industrial Corridors: The expansion of defence industrial corridors in Uttar Pradesh and Tamil Nadu reflects efforts to create integrated manufacturing ecosystems (Invest India, 2024). These corridors aim to bring together large defence manufacturers, MSMEs, research institutions and start-ups within integrated industrial ecosystems. By 2024, the Uttar Pradesh Defence Industrial Corridor had attracted investment proposals exceeding **₹20,000 crore**, while the Tamil Nadu corridor had emerged as a major hub for aerospace and electronics manufacturing (Invest India, 2024). To maximize the potential of these corridors, the government should:

I. Expand infrastructure development and logistics connectivity.
II. Establish specialized training institutes to develop skilled manpower.
III. Encourage the establishment of testing and certification facilities.
IV. Provide financial incentives for MSMEs participating in defence supply chains.

8.5 Expanding Defence Exports: Defence exports will play a crucial role in sustaining India's defence manufacturing ecosystem. Export markets enable manufacturers to achieve economies of scale and improve product competitiveness. The Government of India has set an ambitious target of achieving **₹50,000 crore in defence exports by 2029**. Achieving this target will require stronger

export promotion mechanisms and proactive defence diplomacy. Key policy measures should include: Establishing a dedicated **Defence Export Promotion Agency**, Expanding government-backed **export financing facilities**, Strengthening the role of **defence attachés in promoting Indian defence products abroad** and Negotiating defence cooperation agreements with potential buyer countries. India should also focus on emerging markets in **Southeast Asia, Africa and Latin America**, where demand for cost-effective defence equipment is growing rapidly.

8.6 Developing Skilled Human Capital: Human capital development is another critical factor, as defence manufacturing increasingly relies on advanced skills in engineering, artificial intelligence and cyber security (Freeman, 1995). Defence manufacturing requires specialized expertise in fields such as aerospace engineering, electronics, robotics, materials science and cyber security. India must therefore invest heavily in developing skilled human capital for the defence industry. This can be achieved through several initiatives:

I. Establishing **defence technology research centres in universities**.
II. Expanding partnerships between defence companies and engineering institutions.
III. Promoting vocational training programmes for defence manufacturing skills.
IV. Encouraging interdisciplinary research in emerging technologies.

8.7 Leveraging Emerging Technologies: The defence technologies of the future will be driven by rapid advancements in fields such as artificial intelligence, quantum computing, cyber security and autonomous systems. India must actively invest in these emerging technologies to remain competitive in the global defence landscape. Strategic initiatives should include: Development of **AI-enabled battlefield decision systems**, Expansion of **autonomous drone and robotic platforms**., Investment in **quantum communication and encryption technologies** and Strengthening **space-based defence capabilities**. Integrating these technologies into the defence manufacturing ecosystem will enhance operational effectiveness and strengthen India's strategic deterrence capabilities.

8.8 Improving Institutional Coordination: One of the persistent challenges in India's defence industrial ecosystem is the lack of coordination among key stakeholders, including the Ministry of Defence, DRDO, DPSUs, private industry and the armed forces. To address this issue, the government could consider establishing an **Integrated Defence Industrial Coordination Council** responsible for aligning defence procurement, research and development and industrial policy. Such a body could ensure better communication among stakeholders, reduce duplication of efforts and accelerate the implementation of defence projects.

8.9 Vision for India's Defence Manufacturing by 2040: If the recommended reforms are implemented effectively, India's defence manufacturing sector could undergo a major transformation over the next two decades. By 2040, India could potentially achieve the following

milestones:

I. Become one of the **top five global defence exporters**.

II. Develop fully indigenous capabilities in critical defence technologies.

III. Establish globally competitive defence manufacturing clusters.

IV. Achieve significant participation of private industry in defence production.

V. Strengthen its role as a **net security provider in the Indo-Pacific region**.

9. Conclusion:

India's defence manufacturing sector is at a critical juncture, marked by significant progress as well as persistent structural challenges. Policy initiatives such as ***Atmanirbhar Bharat***, ***Make in India***, the ***Defence Acquisition Procedure (DAP) 2020*** and the ***Defence Production and Export Promotion Policy (DPEPP) 2020*** have contributed to the expansion of indigenous production capabilities and a notable rise in defence exports. The increasing participation of private sector firms and start-ups has further strengthened the dynamism of the defence industrial ecosystem. Despite these advances, key constraints continue to limit India's progress toward strategic autonomy. Technological dependence in critical domains such as propulsion systems, advanced electronics and semiconductor technologies remains a major concern. In addition, procurement inefficiencies, regulatory bottlenecks and limited integration into global defence supply chains continue to affect industrial competitiveness and innovation capacity. Looking ahead, a coherent and long-term policy framework is required to sustain momentum. Priorities include increased investment in research and development, strengthened public–private partnerships, enhanced institutional coordination and focused human capital development. If these measures are implemented effectively, India has the potential to emerge as a globally competitive defence manufacturing hub by 2040. Ultimately, the success of this transformation will depend on aligning technological innovation with strategic objectives in an increasingly complex global security environment.

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