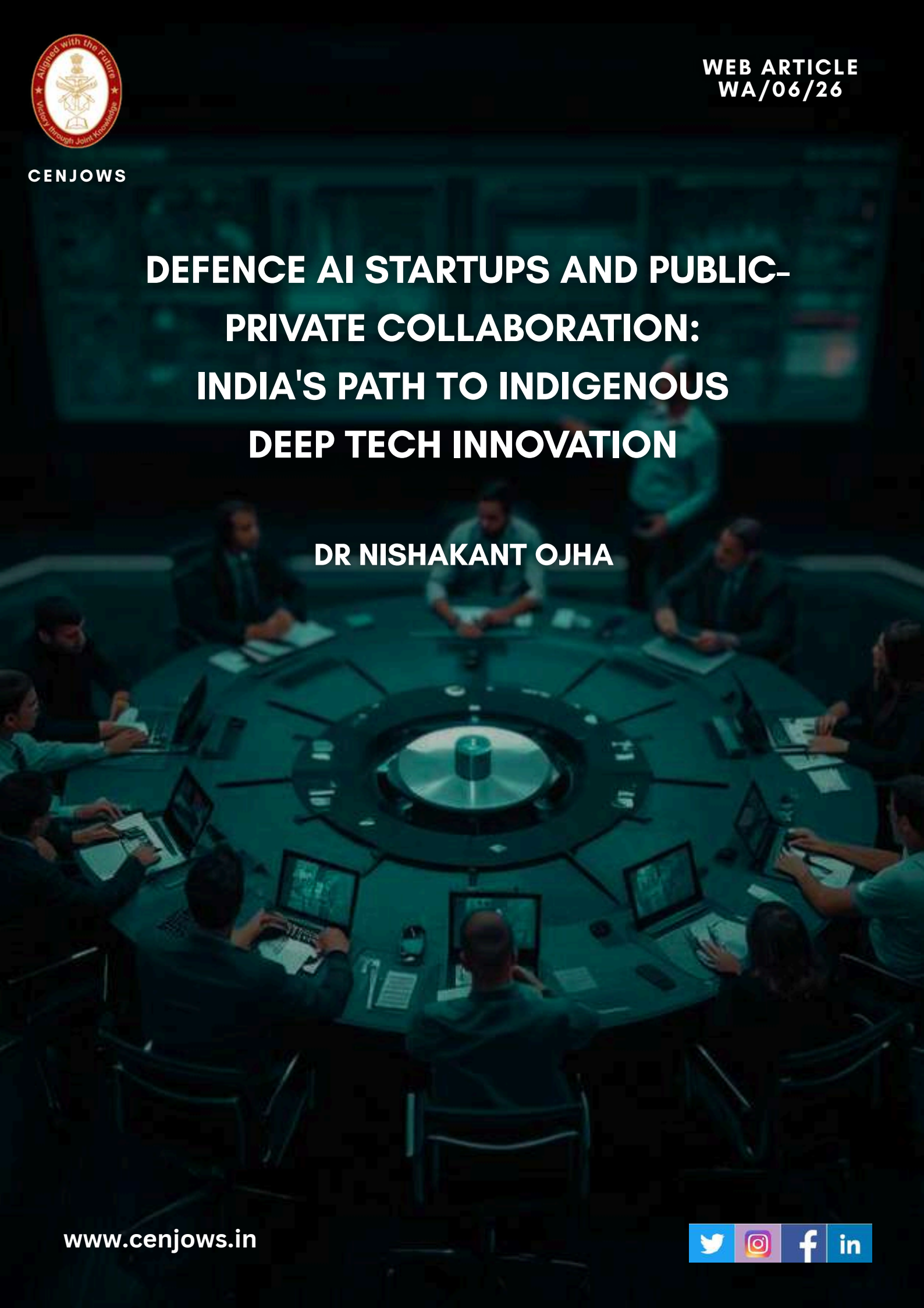
CENJOWS

WEB ARTICLE
WA/06/26

DEFENCE AI STARTUPS AND PUBLIC-PRIVATE COLLABORATION: INDIA'S PATH TO INDIGENOUS DEEP TECH INNOVATION

DR NISHAKANT OJHA



CENTRE FOR JOINT WARFARE STUDIES

CENJOWS

DEFENCE AI STARTUPS AND PUBLIC-PRIVATE COLLABORATION: INDIA'S PATH TO INDIGENOUS DEEP TECH INNOVATION

Dr Nishakant Ojha is a strategic expert on AI, quantum, and emerging technologies, analysing their impact on defence, intelligence, warfare, and geopolitics and a Chair of Excellence at CENJOWS

Forging the Future of Defence Through Strategic Partnerships

India's defence landscape is undergoing a transformative shift, moving from import dependence to indigenous innovation. At the heart of this transformation lies an unprecedented collaboration between public institutions like DRDO (Defence Research and Development Organisation), enabler platforms such as iDEX (Innovations for Defence Excellence), and a burgeoning ecosystem of private defence AI startups. This synergy is not merely reshaping India's military capabilities but positioning the nation as a formidable player in the global defence technology export market.[1]

The Imperative for Dual-Use AI Innovation

Dual-use AI technologies, systems that serve both civilian and military applications, represent a strategic sweet spot for defence innovation. These technologies maximise research investment returns while accelerating development cycles through broader market validation.[2] In the defence context, AI applications for surveillance, threat

detection, autonomous systems, and decision support can often leverage advances made in commercial sectors like autonomous vehicles, computer vision, and natural language processing.

The dual-use approach offers multiple strategic advantages. First, it allows startups to sustain themselves through commercial revenues while developing defence-grade solutions, reducing dependence on sporadic government contracts. Second, it enables faster iteration and improvement through larger user bases and diverse use cases. Third, it creates a robust industrial base that can rapidly scale production during emergencies or conflicts.[3]

For India, pursuing dual-use AI innovation aligns perfectly with the Atmanirbhar Bharat (Self-Reliant India) vision. It builds technological sovereignty while creating economic value, reduces foreign dependence on critical technologies, and develops expertise that spans both commercial and strategic domains.[4]

DRDO: The Anchor Institution Evolving for Collaboration

The Defence Research and Development Organisation has traditionally been India's primary defence R&D institution, responsible for developing cutting-edge military technologies. However, the complexity and pace of AI innovation have necessitated a shift in DRDO's operational model from a purely in-house development approach to one that actively embraces external innovation partnerships.[5]

DRDO's evolution includes opening its testing facilities and ranges to startups, providing technical mentorship and validation support, co-developing solutions where DRDO contributes domain expertise while startups bring agility and AI capabilities, and creating clear pathways for startup-developed technologies to be inducted into armed forces.[6] This transformation acknowledges a crucial reality: innovation in AI and emerging technologies often happens faster in nimble startup environments than in large bureaucratic institutions.

Recent DRDO initiatives have focused on creating technology demonstrators for AI-powered intelligence, surveillance, and reconnaissance (ISR) systems, autonomous ground and aerial platforms for combat support, predictive maintenance systems for military hardware, and AI-enabled cybersecurity solutions for defence networks.[7] By partnering with startups on these initiatives, DRDO leverages cutting-edge AI

research while maintaining strategic oversight and ensuring solutions meet stringent military requirements.

iDEX: Catalysing the Defence Startup Ecosystem

Launched in 2018, the Innovations for Defence Excellence (iDEX) initiative represents perhaps the most significant structural reform in India's defence innovation landscape. Operating under the Defence Innovation Organisation (DIO), iDEX serves as a bridge between the defence establishment and the startup ecosystem, dramatically lowering barriers to entry for innovative companies.[8]

iDEX's model is elegantly simple yet powerful. It issues specific problem statements or challenges based on actual defence needs, provides grant funding to selected startups (typically ranging from ₹1.5 crore to ₹10 crore depending on the challenge category), offers mentorship and access to defence facilities for testing and validation, and creates a structured pathway for successful solutions to be acquired by the armed forces.[9] Critically, iDEX allows startups to retain intellectual property rights, a crucial factor that encourages participation from high-potential companies that might otherwise avoid government contracts.

For AI startups specifically, iDEX has issued challenges across multiple domains, including autonomous surveillance drones with AI-based target recognition, AI-powered threat detection systems for border security, machine learning algorithms for satellite imagery analysis, natural language processing tools for intelligence gathering, and computer vision systems for automated perimeter security.[10] The program has funded over 300 startups since its inception, with several solutions already in field trials or limited deployment with the armed forces.[11]

Private Defence AI Startups: The Innovation Vanguard

India's private defence AI startup ecosystem has grown remarkably in recent years, driven by policy reforms, funding availability, and the massive addressable market both domestically and internationally.[12] These startups bring fresh perspectives, cutting-edge technical expertise, rapid development cycles, and cost-effective solutions to traditionally expensive defence problems.

Key focus areas for defence AI startups include surveillance and reconnaissance technologies powered by computer vision and machine learning for real-time threat detection, drone swarm coordination using distributed AI algorithms, satellite imagery analysis employing deep learning for intelligence gathering, and autonomous ground vehicles for logistics and patrol in hostile environments.[13] Combat support systems leverage AI-driven decision support tools for battlefield commanders, predictive maintenance systems that anticipate equipment failures before they occur, ammunition and logistics optimisation through machine learning, and cyber defence solutions utilising AI for threat detection and response.[14]

Several Indian startups have made notable progress in these domains. Companies are developing indigenous AI chips optimised for edge deployment in harsh battlefield conditions, creating autonomous underwater vehicles for coastal surveillance, building AI-powered electro-optical and infrared surveillance systems, and designing counter-drone systems with AI-based threat classification.[15] The diversity of applications demonstrates the breadth of opportunities in defence AI and the creativity of India's startup ecosystem in addressing them.

Export-Ready Platforms: From Indigenous Innovation to Global Markets

One of the most exciting dimensions of India's defence AI startup ecosystem is its export potential. As countries worldwide seek to modernise their militaries while managing costs, affordable, effective AI-powered defence solutions from India are increasingly attractive. This is particularly true for nations seeking alternatives to traditional Western or Chinese defence suppliers.[16]

Several factors position Indian defence AI startups favourably for exports. Cost competitiveness represents a significant advantage, as Indian solutions typically cost 40-60% less than Western equivalents while maintaining quality.[17] Non-alignment considerations matter too, as India's independent foreign policy makes it an attractive supplier to nations seeking strategic diversification. Technical capability is increasingly recognised globally, with India's AI and software engineering talent being globally recognised. Proven solutions matter as well, with technologies validated through deployment with the Indian armed forces carrying significant credibility.[18]

Export-ready platforms emerging from the Indian ecosystem include border surveillance systems combining AI, sensors, and drones for comprehensive perimeter security, maritime domain awareness solutions using satellite data, AIS, and machine learning for coastal and economic zone monitoring, counter-terrorism tools including facial recognition, predictive policing algorithms, and communications intelligence, and training and simulation platforms leveraging AI for realistic, adaptive military training scenarios.[19]

The Indian government has actively supported these export ambitions through streamlined export licensing processes for non-lethal defence technologies, inclusion of defence AI companies in trade delegations and defence exhibitions, financial support through Export Credit Guarantee Corporation for defence exports, and bilateral defence cooperation agreements that facilitate technology transfers and sales.[20]

Technology Deep Dive: Key AI Capabilities in Development

To understand the sophistication of work happening in India's defence AI ecosystem, it's worth examining some key technological capabilities being developed.

In computer vision and image recognition, startups are developing multispectral image analysis systems that operate across visible, infrared, and synthetic-aperture radar spectra. These systems can identify vehicles, personnel, and installations even under camouflage or adverse weather conditions. Advanced object-tracking algorithms maintain continuity of observation across multiple sensors and platforms, which is critical for tracking targets in complex environments. Real-time video analytics process feeds from hundreds of cameras simultaneously, automatically flagging anomalies or threats.[21]

Natural language processing and intelligence-gathering capabilities include automated translation and transcription services for military communications across multiple regional languages and dialects. Sentiment analysis tools assess social media and open-source intelligence to predict potential unrest or security threats. Information extraction systems automatically parse vast quantities of text to identify actionable intelligence, connections between entities, and emerging patterns.[22]

Autonomous systems and robotics development focus on path-planning and obstacle-avoidance algorithms that enable autonomous vehicles to navigate complex, GPS-denied environments. Swarm intelligence protocols allow multiple drones or ground robots to coordinate without centralised control, providing resilience against communications jamming. Adaptive behaviour systems enable robots to adjust their actions based on environmental conditions and mission parameters.[23]

Predictive analytics and decision support tools employ anomaly detection algorithms that identify unusual patterns in logistics, personnel behaviour, or equipment performance that might indicate problems. Forecasting models predict equipment maintenance needs, spare parts requirements, and optimal deployment patterns. Simulation and war-gaming engines powered by AI create realistic scenarios for training and strategic planning.[24]

Challenges and Path Forward

Despite significant progress, the defence AI startup ecosystem faces several challenges that require ongoing attention. Regulatory and bureaucratic hurdles include lengthy procurement cycles that can outlast startup runway, complex export controls and licensing requirements, and security clearance processes that can delay or prevent talented personnel from contributing.[25]

Technical challenges include the data scarcity problem, limited availability of labelled military datasets for training AI models, adversarial robustness requirements where defence AI systems must resist sophisticated adversarial attacks and jamming, and edge deployment constraints requiring AI systems to function in environments with limited computing power, intermittent connectivity, and extreme conditions.[26]

Funding and sustainability concerns persist, with the capital intensity of defence technology development requiring patient, long-term investment. There's a limited number of defence-focused venture capital firms in India, and challenges exist in sustaining operations between government contracts. The talent gap remains significant, with competition for AI talent with high-paying technology companies, and limited numbers of engineers with both AI expertise and defence domain knowledge.[27]

Addressing these challenges requires coordinated action across multiple dimensions. Policy reforms should continue to streamline defence procurement processes,

particularly for innovative startups, create specialised fast-track procurement categories for AI and emerging technologies, expand programs like iDEX with increased funding and broader mandates, and establish clear, transparent pathways from prototype to production and deployment.[28]

Infrastructure development needs include creating specialised testing and validation facilities for defence AI systems, establishing defence-focused AI research centres at leading technical institutions, building secure cloud infrastructure for defence AI development and deployment, and developing shared datasets and simulation environments that startups can access for development and testing (with appropriate security controls).[29]

Ecosystem building requires fostering stronger connections between startups, academic institutions, and defence labs, creating mentorship programs where retired defence personnel guide startups on operational requirements, establishing defence-focused accelerators and incubators in key technology hubs, and facilitating international partnerships and collaborations while protecting critical technologies.[30]

Conclusion: A Strategic Imperative for the Digital Age

The collaboration between DRDO, iDEX, and private defence AI startups represents more than an industrial policy; it's a strategic imperative for India's security and economic future. As warfare becomes increasingly technological and AI-centric, nations that lead in defence AI innovation will hold decisive advantages.[31]

India possesses unique strengths for this competition: a large, talented pool of AI researchers and engineers, a massive domestic market for defence technologies, growing geopolitical influence that creates export opportunities, and a demonstrated commitment from government leadership to defence self-reliance.[32] The public-private partnership model, with institutions like DRDO providing strategic direction and validation, iDEX offering funding and facilitation, and startups delivering innovation and agility, creates a powerful engine for indigenous deep tech development.

The path forward is clear: continue policy reforms that enable rather than impede innovation, invest substantially in defence AI research, development, and testing infrastructure, cultivate talent at the intersection of AI and defence technologies, and

build international partnerships that expand markets while protecting core capabilities.[33]

As India advances on this path, the vision of being a net security provider in the region and a leading exporter of defence technologies becomes increasingly attainable. The defence AI startups emerging today, nurtured through public-private collaboration, are not just building products; they're forging the technological foundation of India's security and prosperity for decades to come. In this endeavour, innovation is not merely encouraged; it is essential, urgent, and ultimately, a matter of national destiny.

DISCLAIMER

The paper is the author’s individual scholastic articulation and does not necessarily reflect the views of CENJOWS, the Defence forces or the Government of India. The author certifies that the article is original in content, unpublished, and it has not been submitted for publication/ web upload elsewhere and that the facts and figures quoted are duly referenced, as needed and are believed to be correct.

ENDNOTES

[1]Harsh V. Pant, "India's Defence Industrial Base: Seeking Self-Reliance and Strategic Autonomy," *Asian Security* 16, no. 3 (2020): 255-256.

[2]Elsa B. Kania and Wilson VornDick, "Weaponising Innovation: China's Pursuit of Military Dominance Through Dual-Use Technologies," *Joint Force Quarterly* 94 (2019): 84.

[3]Michael Raska, *Military Innovation in Small States: Creating a Reverse Asymmetry* (London: Routledge, 2016), 87-89.

[4]Government of India, *Defence Production and Export Promotion Policy 2020* (Department of Defence Production, Ministry of Defence, 2020), 12-15.

[5]Defence Research and Development Organisation, *Technology Perspective and Capability Roadmap* (New Delhi: DRDO, 2018), 45-48.

[6]Abhijit Nayak, "DRDO's Technology Transfer Model: Challenges and Opportunities," *Defence Science Journal* 70, no. 4 (2020): 418-419.

[7]Laxman Kumar Singh, "Artificial Intelligence in Indian Defence: Opportunities and Challenges," *Journal of Defence Studies* 13, no. 3 (2019): 78-82.

[8]Government of India, Ministry of Defence, "Innovations for Defence Excellence (iDEX): Framework and Guidelines" (New Delhi, 2018), https://www.idex.gov.in.

[9]Defence India Research Wing, "iDEX Framework and Impact Assessment" (Ministry of Defence, Government of India, 2023), 8-12.

[10]Ibid., 23-27.

[11]Sandeep Unnithan, "The New Defence Ecosystem: How Startups Are Changing India's Military Innovation," *India Today*, September 8, 2021.

[12]Dinesh Kumar, "Public-Private Partnerships in Defence Manufacturing: The Indian Experience," *Journal of Defence Studies* 14, no. 2 (2020): 52-55.

[13]Singh, "Artificial Intelligence in Indian Defence," 83-86.

[14]Kelley M. Sayler, *Artificial Intelligence and National Security: Emerging Opportunities, Challenges, and Implications*, Congressional Research Service Report R45178 (Washington, DC, 2020), 14-18.

[15]Devirupa Mitra, "How India's Defence Startups Are Innovating for Atmanirbhar Bharat," *The Wire*, July 15, 2021, https://thewire.in/security/india-defence-startups-atmanirbhar-bharat.

[16]Ranjit Sharma, "India's Defence Exports: Potential and Challenges," *Strategic Analysis* 43, no. 6 (2019): 485-487.

[17]Society for Indian Defence Manufacturers, *Defence Manufacturing Ecosystem Report 2022* (New Delhi: SIDM, 2022), 34-36.

[18]Sharma, "India's Defence Exports," 488-490.

[19]Society for Indian Defence Manufacturers, *Defence Manufacturing Ecosystem Report 2022*, 56-62.

[20]Government of India, *Defence Production and Export Promotion Policy 2020*, 28-31.

[21]Vincent Boulanin and Maaike Verbruggen, *Mapping the Development of Autonomy in Weapon Systems* (Stockholm: Stockholm International Peace Research Institute, 2017), 45-52.

[22]NITI Aayog, *National Strategy for Artificial Intelligence* (New Delhi: Government of India, 2018), 67-71.

[23]Robert O. Work and Shawn Brimley, *20YY: Preparing for War in the Robotic Age* (Washington, DC: Center for a New American Security, 2014), 23-28.

[24]Mary L. Cummings, "Artificial Intelligence and the Future of Warfare," Research Paper (Chatham House, London, January 2017), 12-15.

[25]C. Uday Bhaskar, "Defence Indigenisation: The Challenge of Self-Reliance," *Strategic Analysis* 44, no. 5 (2020): 405-407.

[26]Michael C. Horowitz, "Artificial Intelligence, International Competition, and the Balance of Power," *Texas National Security Review* 1, no. 3 (May 2018): 45-48.

[27]Gary Schaub Jr. and Kelley Sayler, "Artificial Intelligence and National Security: The Importance of the Startup Ecosystem," *War on the Rocks*, December 12, 2018, https://warontherocks.com/2018/12/artificial-intelligence-and-national-security-the-importance-of-the-startup-ecosystem/.

[28]Kumar, "Public-Private Partnerships in Defence Manufacturing," 60-63.

[29]NITI Aayog, *National Strategy for Artificial Intelligence*, 89-94.

[30]Defence India Research Wing, "iDEX Framework and Impact Assessment," 45-49.

[31]Gregory C. Allen and Taniel Chan, *Artificial Intelligence and National Security* (Cambridge, MA: Belfer Center for Science and International Affairs, Harvard Kennedy School, 2017), 5-8.

[32]Pant, "India's Defence Industrial Base," 267-270.

[33]Ashley J. Tellis, *Hustling in the Himalayas: The Sino-Indian Border Confrontation* (Washington, DC: Carnegie Endowment for International Peace, 2021), 78-82.